AgroLife Scientific Journal - Volume 5, Number 1, 2016
ISSN 2285-5718; ISSN CD-ROM 2285-5726; ISSN ONLINE 2286-0126; ISSN-L 2285-5718

THE EFFECT OF CARRAGEENAN ON SHELF-LIFE, QUALITY IMPROVEMENT AND ORGANOLEPTIC QUALITIES OF SPENT CHICKEN SAUSAGES

Hendronoto Arnoldus Walewangko LENGKEY, Dani GARNIDA, Jan Alex SIWI, Primiani EDIANINGSIH, Eka WULANDARI, Andry PRATAMA

Padjadjaran University, Bandung, Indonesia Animal Husbandry,
Jl. Raya Bandung-Sumedang km 21, Jatinangor 45363, Indonesia

Corresponding author email: lengkeyhendronoto@gmail.com; lengkeyhendronoto@unpad.ac.id

Abstract

A study about the effect of carrageenan addition, on shelf-life and quality improvement and organoleptic qualities, chemical of spent chicken sausages, was carried out with objectives to assess the right percentage of carrageenan using in manufacturing spent chickens sausages. Different factors during processing have an impact on shelf-life, quality characteristics and organoleptic of final product. Using of spent chickens in further processing, are popular in some countries. Chicken sausages considered as very popular and highly consumed in many countries. Fresh spent chickens sausages were manufactured using some concentration of carrageenan (0.0%, 2.5%, 5.0%, and 7.5%). This work used an experimental, with completely randomized design 4 x 5 (CRD), with 4(four) different percentage of carrageenan, and 5 (five) replications. The effect of pH, moisture and tenderness on the physical, chemical and sensory quality, also about total bacteria and the initial decay of sausages was studied. Samples were analyzed immediately (day zero after manufactured) in room temperature. Results indicated that the moisture and tenderness has significance results, but the sausage pH were not significant between the treatments; and the total bacteria and initial decay also were significant. The conclusion is, that the carrageenan addition has improved the quality, organoleptic and shelf-life of spent chicken sausages. It could be concluded from this work that the tough culled layer hen meat, by value-addition with carrageenan, and processing as sausage, can be converted into an acceptable product.

Key words*: carrageenan, physical, chemical, sensory quality, spent chicken sausage.*

INTRODUCTION

Meat is the most valuable livestock product, as the choice source of animal protein and also as a component of processed meat products. On the other side, the increased number of population growth needs enough food stock to fulfill the food necessity; this is where meat processing plays a permanent role. Meat processing are manufacturing meat products from muscle, animal fat and non-meat additives to enhance flavor, appearance and increase product volume. Processing can create some different type of product composition. Thus, there are economic, dietary and sensory aspects that make meat processing one of the most valuable mechanisms for adequately supplying animal protein to human populations.

Demand rate of chicken meat is four per cent more than its production rate (Jimenez-Colmenero et al., 2013). Chicken meat can be supplied from the poultry farm, either from the broiler or from the layer hens. Layer hens have double benefits, beside production egg. They can also produce meat after their production period over. Unproductive layer hens also can be used to produce meat, and then to be sold as culled layer meat, since they have tough meat (Ilayabharathi et al., 2012). Poultry products are popular, and the meat itself is perceived as wholesome, healthy and nutritious, being relatively low in fat (Muguerza et al., 2001).

Spent hens are the main by-product of egg industry. The meat from these birds is considered as low quality because of its age and relative toughness and therefore sold at a lower market price (Lengkey et al., 2014). Further, the availability of broiler meat all through the year to meet the local demand does not necessitate meat tenderization thereby diminishing the demand for meat from spent hens. Hence meat from these birds needs sufficient processing to improve its acceptability (Heinz and Hautzinger, 2007).

The advantage of meat processing, is the integration of certain animal tissues into the food chain as valuable protein-rich ingredients. Meat and meat products are very important in human nutrition, because they are an excellent source of protein with a well-balanced composition of amino acids (Cocolin et al., 2004; Flores et al., 2004).

Seaweeds are rich and varied source of bioactive natural products and have a broad range of bioactivities such as against microorganisms (Prabhahar et al., 2012).

Carrageenans are a family of anionic polymers extracted from certain marine red algae. These polysaccharides are used as additives to improve food texture, gelation, stability and viscosity and are generally (GRAS) by the FDA in the United States. Carrageenan is a versatile product, used in food such as lunchmeats, is used to improve the safely and efficiently stabilizer food, extend shelf life without loss of quality; and also as a thickening agent such as flour, that used to thicken or bind other ingredients (Necas and Bartosikova, 2013). Carrageenan has also been used as a gelatinizing additive to enhance the texture and water holding capacity of meat and poultry products (Hunt and Park, 2013). Carrageenan acts as an additives in the food industry due to its functional properties, can be used to control moisture, texture and to stabilize foods.

Fresh sausages are meat products, and sausages is an oil-in water emulsions undergo a number of instability processes; so characterization and control of these processes are key aspects of the formulation of the products. In this regard, the addition of carrageenan will give positive effect on consumer acceptance. High fat sausages still had high acceptability due to their appearance and also to other characteristics such as flavor (Heinz and Hautzinger, 2007).

The aim of this study was to determine the best percentage of carrageenan addition on shelf life, quality improvement based on pH, moisture, tenderness and consumer acceptability of fresh spent hen sausages.

It is concluded that the addition of 7.5% carrageenan, could be useful to improve the final quality of fresh spent hen sausages, shelf life and acceptability of consumers.

MATERIALS AND METHODS

The research was performed on 30 fresh, boneless Hy-line spent chickens meat from Missoury Breeding Farm, Bandung, Indonesia and other ingredients were procured from local supermarket in Sumedang, Bandung, Indonesia.

Preparation of sausages

Five batches of fresh sausages (10 kg meat batter for each batch) with different carrageenan contents (0%, 2.5%, 5.0%, and 7.5%) were manufactured.

The meat mixture was stuffed into collagen casings (1.50 cm diameter); the final weight of each sausage was 500 g. Approximately 20 sausages were made in each batch.

From each batch (0%, 2.5%, 5.0%, and 7.5% carrageenan), two sausages from each batch were used to control the pH by introducing a pH meter Jenway 3310. 200 g of the minced meat/meat batter were collected to study the effect of carrageenan on total bacteria and initial decay.

The sample were minced and used for moisture content, tenderness and pH analyses. All the results were expressed as the mean of 4 (four) replicates at each sampling time.

In Table 1, there are the spent sausages ingredients and composition.

Table 1. Composition of spent chicken sausage (g/kg product)

Ingredients	P-1	P-2	P-3	P-4
Spent chicken	1.0 kg	1.0kg	1.0kg	1.0kg
Flour	10.0% (100.0 g)	10.0% (100.0 g)	10.0% (100.0 g)	10.0% (100.0 g)
Carrageenan	0.0% (0.0 g)	2.5% (25.0 g)	5.0% (50.0 g)	7.5% (75.0 g)
Salt	2.0% (20.0 g)	2.0% (20.0 g)	2.0% (20.0 g)	2.0% (20.0 g)
Sugar	2.0% (20.0 g)	2.0% (20.0 g)	2.0% (20.0g)	2.0% (20.0g)
Onion	0.2% (2.0 g)	0.2% (2.0 g)	0.2% (2.0 g)	0.2% (2.0 g)
Pepper	2.0% (20.0 g)	2.0% (20.0 g)	2.0% (20.0 g)	2.0% (20.0 g)

Physical and Chemical analysis

The moisture percentage of spent chicken sausages was determined according to AOAC standard procedures (AOAC, 1997), using hot air oven. The determination of pH was performed by homogenizing 10g of each sample with distilled water in a 1:10 sample:water ratio. The homogenate was subjected to a pH test using pH-meter electrodes (pH-meter Jenway 3310) for 5 minutes while the pH readings were performed. The determination of pH was performed at days 0 post production (fresh sausages). The moisture content was determined also at days 0 post production (fresh sausages), using two sausages per batch. Total bacteria were test and initial decay used to evaluate.

Moisture content was determined according to the official method for analysis of meat products (AOAC, 1997). Moisture were examined by weighing 10g of sample in aluminium dish and kept in an oven drying at 105^0C for overnight (AOAC, 1997).

Shelf life

The bacterial counts of the samples were determined by standard methods (APHA, 1984). Preparation of samples were done near the flame, observing all possible aseptic conditions. Readymade media were used for the enumeration of microbes. The plates for mesophilic counts were incubated at 37^0C for 48 h and plates showing 30-300 colonies were counted. The average number of colonies for each species was expressed as log 10 cfu/g sample.

Sensory analysis

The spent chicken sausages were evaluated for their color, flavor, juiciness, texture, juiciness and overall acceptability. Sensory analysis was conducted by 30 untrained panelists recruited among students, faculty and staff members from the university campus, were asked to express their opinion of the sausages regarding the color, flavor, texture, juiciness and overall acceptance. All data were recorded on a questionnaire designed to indicate the degree of likeness for the sausages of each treatment using a non-structured scoring scale of nine points (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, and 9 = like extremely), according to Larmond (1977). The panelists were served with randomized slices of sausages, two per treatment, together with room temperature water to clean the palate between samples. Four sausages from each batch were taken for sensory analyses. Samples were coded with three random numbers. The presented data are mean values of 30 panelists.

Statistical analysis

All analysis were performed in duplicate, and the data were evaluated by one way analysis of variance (ANOVA) using the SPSS 21.0 version statistical package (IBM Statistics version 21) software package. The averages were compared by Duncan's multiple range test at a confidence level of 5% ($p \leq 0.05$) For sensory analysis, the ability of each descriptor to discriminate between samples was investigated using Kruskall-Walis test. Data obtained from physical-chemical analysis were analyzed using mean comparisons, analysis of variance (ANOVA) and Duncan multiple range test to see significant differences ($p<0.05$) in the formulation of fresh culled hens sausages.

RESULTS AND DISCUSSIONS

Physical and Chemical Composition of Fresh Culled Layer Hens Sausage

Mean of pH, moisture and tenderness value, of fresh culled hens sausages are given in Table 2. The results obtained from this experiments show that carrageenan added in the culled hens sausages show significance different ($p<0.05$), for moisture and tenderness in mean percent, except the pH that has no significant different.

The pH of the spent chickens sausages are 5.51, 5.54, 5.57, and 5.58 respectively. The pH did not show any significant difference ($p>0.05$) among the four treatments. The pH content of culled layer hen sausages ranges from 5.50 to 5.60. The pH of the sausages was increase as more carrageenan added in the sausages batter. The normal pH of meat products range from 4.8 – 6.8, while that of fresh sausages has been suggested to be at a pH of not less than 5.5 (Muguerza et al., 2004; Asmaa et al., 2015). It means that fresh culled hen sausages are in the range of normal fresh sausages.

Table 2. The average physical and chemical composition of fresh spent chicken sausages

	Treatments			
	P-1	P-2	P-3	P-4
pH	5.51[a]	5.54[a]	5.57[a]	5.58[a]
Tenderness (mm/g/10 sec)	8.16[a]	9.25[b]	9.72[c]	9.96[d]
Moisture (%)	53.96[a]	55.05[b]	57.10[b]	58.37[c]

Notes: P-1 = sausages batter + 0.0% carrageenan
P-2 = sausages batter + 2.5% carrageenan
P-3 = sausages batter + 5.0% carrageenan
P-4 = sausages batter + 7.5% carrageenan

The pH value are not different significant, even the pH value was found to increase as the carrageenan in the sausage more added. P-4 treatments (7.5% carrageenan added) has the highest pH value (5.58), while the lowest value (5.51) is P-1 (0.0% carrageenan added). The pH value for the spent chicken sausages is affected by the addition of carrageenan. It means that carrageenan increase the pH value of the product. A work on chicken broiler, spent hens and duck meat, also there was no significant different (Naveena et al., 2012), on pH of the sausages.

The tenderness, were significant among the treatments, and as the carrageenan percentage in the sausages were increase, between 8.16 to 9.96; it means that the spent chicken sausages is affected by the addition of carrageenan.

Moisture content in spent chicken sausages containing carrageenan was higher (P-2, P-3 and P-4) compared to the control samples (P-1). The moisture content is 53.96% (P-1), 55.05% (P-2), 57.10% (P-3), and 58.37% (P-4), respectively: increased as the carrageenan added in sausage increased. In this work, the moisture content increased was accompanied by the rising carrageenan in the sausages ($p<0.05$). There were a significant increase ($p<0.05$) in the moisture content of treatment spent chicken sausages (P-2, P-3 and P-4) as compared to that control sausages (P-1). The moisture content ranging from 53.96 to 58.37%, were increase as the carrageenan content in the sausages were increase, because the carrageenan has to bind more water and also has the ability to form complexes with water. The moisture content of spent chicken hens sausages are significant different ($p<0.05$). This could be because of the ability of carrageenan particles to retain more water than control. The addition of carrageenan improved the quality of the spent chickens sausages based on the results of physical-chemical analysis. So using 7.5% carrageenan in fresh culled hens sausages are fulfill the sausage condition.

Table 3. The shelf life of fresh spent chicken sausages

	Treatments			
	P-1	P-2	P-3	P-4
Total bacteria (cfu/g)	38.05[a]	31.55[b]	29.10[b]	21.43[c]
Initial decay (minutes)	427[a]	472[b]	518[c]	566[d]

Notes: P-1 = sausages batter + 0.0% carrageenan
P-2 = sausages batter + 2.5% carrageenan
P-3 = sausages batter + 5.0% carrageenan
P-4 = sausages batter + 7.5% carrageenan

The shelf life of spent chicken sausages

From Table 3, the results of total bacteria were diminishing as the concentration of carrageenan in the sausages was rise. It means that carrageenan has anti bacteria effect. Because of the diminishing bacteria, than the sausages shelf life were better. It is readily apparent that, the spent chicken sausages from the batters with different content of carrageenan, differ quite markedly. The differences among the four treatments for microbiological parameters indicated that the shelf life of spent chicken sausages is also influenced by the addition of carrageenan of the batter. It is also apparent that carrageenan depressed the total bacteria contents in the sausages, decreased from 38.05 log 10 cfu/g in 0.0% carrageenan to 21.43 log

10 cfu/g in 7.5% carrageenan. According to FMC, carrageenan enables processes that extend shelf life without loss of quality, and it reduces food waste, and also carrageenan has a long history as a safe food stabilizer that thickens and extends shelf-life efficiency, helping to provide healthy and nutritious food. Carrageenan has also been used as a gelatinizing additive to enhance the texture and water-holding capacity of water-based gel systems, dairy products, meat and poultry products, and seafood systems (Hunt and Park, 2013). Thus, this finding suggests that spent chicken sausages could be processed with adding carrageenan until 7.5% in the batter.

The Sensory Quality of Spent Chickens Sausage

The sensory quality average scores of spent chickens sausages are given in Table 4. The sensory attributes were aroma, taste, texture and overall acceptance.

Table 4. The sensory quality average scores of spent chickens sausages

	Treatments			
	P-1	P-2	P-3	P-4
Aroma	7.50[a]	7.65[a]	7.70[a]	7.80[a]
Colour	5.08[a]	5.25[a]	5.35[a]	5.55[a]
Taste	5.10[a]	5.25[a]	5.33[a]	5.37[a]
Texture	5.44[a]	5.63[a]	5.74[a]	5.89[a]
Overall	7.53[a]	7.66[a]	7.70[a]	7.80[a]

Results of the sensory analysis indicated differences between sausages, depending on the carrageenan added; but the scores of all sensory quality are increase as more carrageenan percentage added in the batter. Even there are increase on carrageenan, but there is no significant different, between the treatment. The overall results of sensory quality were between 7.53 to 7.80. It means that between like moderately to like extremely. The results of this work indicate that carrageenan has good effect in fresh culled hens sausages.

The aroma in fresh sausages was not well developed. It was differed than the fermented sausages that has been developed occur during fermentation and drying (Fernandez-Gomez et al., 2005). That is why in this work, the aroma has no significant difference in fresh culled hens sausages.

In solid food emulsions, the texture is determined by the composition of the food, the homogenization conditions and post-processing operations. Sausages are oil in water emulsions in which the continuous phase is a complex colloidal system of gelatine, protein, minerals and vitamins, and the dispersed phase is fat globules (Cocolin et al., 2004).

Sensory analysis shows that carrageenan has significance effect on spent chicken sausages. It can be concluded that carrageenan seem to be suitable for the production of spent chickens sausages. Sensory quality was acceptable in all sausage variants, but somewhat better aroma, taste and texture were detected in sausages produced since added of 7.5% carrageenan.

CONCLUSIONS

It could be concluded from this work that the tough culled layer hen meat, by value-addition with carrageenan, and processing as sausage, can be converted into an acceptable product. This study clearly revealed that addition of carrageenan could make much difference in the chemical composition of final products. Considering the results obtained, it may be concluded that the application until 7.5% carrageenan could improve the quality of spent chicken sausages. The sensory analyses results revealed that the product added since 7.5% carrageenan (P-4) was found to be better in quality attributes. Therefore, could be used to produce a high quality spent chickens sausages.

REFERENCES

AOAC, 1997. Official methods of analysis. 14th ed. Association of Official Analytical Chemists. Washington DC.

APHA, 1984. American Public Health Association Official method of Analysis. In. Speck, M. L. (ed). Compendium of methods for the microbiological examination of foods, 2nd ed. Washington D.C.

Asmaa A.A., Zaman W., Tajul A.Y., 2015. Effect of superheated steam cooking on fat and fatty acid

composition of chicken sausages. International Food Research Journal, 22(2): p. 598-605.
Cocolin L., Rantsion K., Iacumin L., Urso R., Cantona C., Comi G., 2004. Study of the Ecology of Fresh Sausage and Characterization of Population of Lactic Acid Bacteria by Molecular methods. Applied and Environmental Microbiology, 70: p. 1883-1894.
Fernandez-Gines J.M., Fernandez-Lopez J., Sayas-Barbera E., Perez-Alvarez J.A., 2005. Meat Products as functional foods: A review. J. of Food Science, 70(2): R37-R53.
Flores M., M-Asuncion D., Marco A., Toldra F., 2004. Effect of *Debaryomyces* spp. on aroma formation and sensory quality of dry-fermented sausages. Meat Science, 68: p. 439-446.
Heinz G., Hautzinger P., 2007. Meat Processing Technology. RAP Publication 2007/20. FAO of the UN Regional Office for Asia and Pacific. Bangkok. p 12, 402.
Hunt A., Park J.W., 2013. Alaska pollock fish protein gels as affected by refined carrageenan and various salts. J. Food Qual., 36, p. 51-58. http://dx.doi.org/ 10.1111/ jfq.12010.
Ilayabharathi D., Sheriff F.R., Manohar G.R., 2012. Shelf-life of Spent Chicken Sausage and Its Organoleptic Qualities. Tamilnadu J. Veterinary & Animal Sciences, 8(2): p. 60-67.
Larmond Elizabeth, 1977. Laboratory Methods for Sensory Evaluation of Food. Research Branch Canada Dep. of Agriculture. Publication 1637, p. 57.
Lengkey H.A.W., Garnida D., Suryaningsih L., 2014. The Effect of Length of Soaking in Papain on Meat Water Content, pH and Tenderness of Culled Layer Hens. J. of Animal Science, Sofia, Vol. LI (1/2): p. 159-161.
Muguerza E., Gimeno O., Ansorena D., Astiasaran I., 2001. Effect of Replacing pork backfat with pre-emulsified Olive oil on Lipid Fraction and Sensory Quality of Chorizo de Pamplona - A Traditional Spanish Fermented Sausage. Meat Science, 59: p. 251-258.
Muguerza E., Gimeno O., Ansorena D., Astiasaran I., 2004. New Formulations for Healthier Dry Fermented Sausages: A review. Trends in Food Science & Technology, 15(9): p. 452-457.
Naveena B.M., Muthukumar M., Muthulakshmi L., Anjaneyulu A.S.R., Kondaiah N., 2012. Effect of Different Cooking Methods on Lipid Oxidation and Microbial Quality of Vacuum-packaged Emulsion Products from Chicken. J. of Food Processing and Preservation, 38(1): p. 39-47.
Necas J., Bartosikova L., 2013. Carrageenan : a review. VeterinarniMedicina, 58, 2013 (4): p. 187-205.
Prabhahar C., Saleshrani K., Tharmaraj K., Saranraj P., 2012. Investigation on Antimicrobial Activity of *Gracilaria crassa* Extracts Against Pathogenic Microorganisms. International Journal of Recent Scientific Research, Vol. 3(3): p. 166-171.