PHYSICAL-CHEMICAL AND SENSORY PROPERTIES OF FLOSS SPENT LAYING HENS MEAT COOKED WITH DIFFERENT LEVEL OF COCONUT WATER

M. Tamasoleng[1], R.M. Tinangon[1], S.E. Sakul[1], D.B.J. Rumondor[1*], E.S. Tangkere[1], S.M. Sembor[1], H.J. Manangkot[1]

[1]*Animal Production Department, Animal Husbandry, Sam Ratulangi University, Indonesia*

Abstract

This study was aimed to determine the physical-chemical (moisture, ash, protein, fat, carbohydrates) and sensory tests (colour, flavour, taste, and texture) of floss spent laying hens meat (SLHM) cooked with different level of raw coconut water (CW). Randomized completely design was used in this study; four treatments as follows A1 = 300 g chicken meat + spices + 50 ml CW, A2 = 300 g chicken meat + spices + 100 ml CW, A3 = 300 g chicken meat + spices + 150 ml CW and A4 = 300 g chicken meat + spices + 200 ml CW; 4 replications each treatment. The results showed that floss SLHM cooked with different levels of raw CW were given significantly different on moisture content (6.24-6.45%), ash content (2.97-3.20%), protein (27.97-33.34%), fat (27.44-28.83), and carbohydrates (19.34-21.54%) respectively, but not given significantly different on colour, aroma, flavour and texture. It was concluded that even though there were differences on physical-chemical content within the floss SLHM treatments, however the panellists were given relatively the same responses on sensory of floss SLHM overall.

Key words: *floss, meat, spent laying hens, coconut water*

INTRODUCTION

Indonesian generally knows that laying hens as egg producers and at the end of egg production period, the spent laying hens are used as a source of meat. However, so far, spent laying hen meat (SLHM) tastes clay, therefore the variety of processing SLHM into processed products, is still very limited. This is due to meat is obtained from the slaughter of laying hens that are relatively old, so that, meat tenderness is reduced as stated by Murtidjo (2003), that spent laying hens are hens that are already unproductive at the end of the egg production period, namely at the age of 72 to 80 weeks. Therefore, it is necessary to strive for a processing technology to utilize and increase added value as well as public acceptance of SLHM.

Central bureau statistics data (2022), showed that Indonesia's spent laying hen meat (SLHM) production in the past three years were 141,505.44 tons (2019), 152,760.35 tons (2020) and 146,303.06 tons (2021) respectively and the production of SLHM in North Sulawesi province for the past three years were 1,178.92 tons (2019), 1,622.87 tons (2020) and 1,334.62 tons (2021) (BPS, 2022) respectively. So, it can be said that the meat of spent laying hens has a potential to be developed into processed meat products and be developed as a business, both on a small and medium industrial scale. The nutrient content of SLHM is not much different from broiler chicken which has a high fat content (Rasyaf, 2010). Spent laying hen meat is basically the same as other livestock meat, it is a commodity of animal farm products that needs to be developed and improved by doing processed food diversification. One of livestock processed food product is floss.

Floss is a dry processed food product that is well known to most of Indonesian because it is easy to make, affordable price, delicious and generally has a fairly good nutritional composition and can also be consumed as a snack or as a side dish. Floss is made through

*Corresponding author:
dellyrumondor@unsrat.ac.id
The manuscript was received: 28.10.2022
Accepted for publication: 28.01.2023

frying shredded meat and spices all together till dry, so that, the shelf life of floss could be longer (Agustin, 2018). To obtain high-quality floss, good processing is required. Common ingredients added in the process of making floss are water and coconut milk. The addition of coconut milk (coconut milk Kara) 150-300 ml in 300 g of chicken meat could maintain the nutrient content of floss chicken meat (Mandjurungi et al., 2022).

Indonesia is a country that rich in coconut plants (*Cocos nucifera L.*). Ripe coconut fruit is generally used for manufacture of coconut oil and its coconut milk is also used for cooking foods and for making drinks. Raw coconut fruit is consumed for its fresh meat and fresh water. There are 68 Cal/100 g of coconut meat and 17 Cal/100 g of coconut water. Several studies reported that the use of coconut water as a sports drink attracted the attention of manufacturers as a natural functional drink, which contains sugars and minerals (Alexia et al., 2012). Raw coconut water (*Cocos nucifera L.*) contains iron, vit. B6, vit. C, folic acid and so it is known as a refreshing and rehydrating drink or as a functional natural drink with the main content of sugars and minerals (Chathuri et al., 2018). According to Singh et al., (2018), raw coconut water contains water (94.89%), ash (0.45%), protein (0.74%) and fat (0.24%).

Prasetyo and Magna (2014) reported their research results that boiling of chicken meat with coconut water for 30 and 45 minutes was given a good floss results. This is in line with Tamasoleng (2020), reported that boiling of chicken meat with coconut water for 60 minutes affected the physical, chemical and organoleptic properties of chicken meat. Furthermore, Cahyani et al. (2018) examined the hedonic quality of Kefir coconut water and addition of Fructose syrup, could have effects on physical-chemical and hedonic properties. The soaking of chicken carcasses in coconut water vinegar tended to affect the texture of the chicken to become softer stored at room temperature (Mishiyah, et al., 2017). Based on the description above, it can be said that, the processing of chicken meat with coconut water as a technology for diversifying foodstuffs can improve and increase the value of meat and taste. For this reason, a study had been done to determine the physical-chemical properties and sensory tests of floss spent laying hens meat cooked with coconut water at different levels.

MATERIAL AND METHOD

1. Research materials and equipment

The materials used in this study were spent laying hen meat, raw coconut water, spices and cooking oil (table 1). The equipment used in this study were analytical scales, plastics, knife, measuring cups, pots, frying pans, spatulas, stoves.

Table 1. The ingredients composition of floss spent laying hens meat

Materials	Treatments			
	A1	A2	A3	A4
Spent laying hens meat (gr)	300	300	300	300
Raw coconut water (ml)	150	200	250	300
Palm sugar (gr)	8.75	18.75	18.75	18.75
Salt (gr)	6	6	6	6
Shallot (gr)	30	30	30	30
Garlic (gr)	15	15	15	15
Coriander (gr)	3	3	3	3
Pecan (gr)	6	6	6	6
Galangal (gr)	9	9	9	9
Bay leaf (leaf)	6	6	6	6

2. Experimental design

Randomized completely design was used in this experiment. There were four treatments for floss spent laying hens meat (SLHM); four levels of raw coconut water with four replications each treatment. The treatments as follows:

A1 = 300 g SLHM + spices + 50 ml coconut water

A2 = 300 g SLHM + spices + 100 ml coconut water

A3 = 300 g SLHM + spices + 150 ml coconut water

A4 = 300 g SLHM + spices + 200 ml coconut water

Variable taken were physical-chemical test, namely: water content, ash content, proteins, fats, carbohydrates and organoleptic test namely: taste, texture, aroma and colour. The differences between treatments were further tested with BNJ (Real Honest

Differences test). Twenty panellists were got involved in organoleptic test. The sensory scale test can be seen in table 2.

3. Research procedures

Necessary tools and materials for research were prepared. Clean spent laying hens meat (SLHM) were steamed for 60 minutes at a temperature of 100°C. When SLHM was getting cool, the bones (unused parts) were separated from the meat. Then, the meat was torn/shredded. The torn meat was weighed and divided into four. The prepared seasonings were also divided into four. After that those torn meats were mixed with those seasoning and left for a while so that, the seasoning soaks in. Raw coconut water was then measured using a measuring cup into 4 (four) different volumes (treatment). Those torn meats that, had been seasoned, and then cooked with coconut water until dry. The torn/shredded of SLHM that had been boiled with coconut water and spices until dry were then, fried at a medium temperature until their turned to be browned. Floss SLHM were finally cooked, then, drained in order to remove the remaining oil. Floss of SLHM was ready.

Table 2. Sensory scale of floss spent laying hens meat

Variables	Scale	Floss Criteria
Colour	4	Dark brown
	3	Brawn
	2	Fawn
	1	Pale brown
Aroma/ smell	4	Very much smell of chicken meat
	3	Much smell of chicken meat
	2	A slight smell of chicken meat
	1	No smell of chicken meat
Taste/ flavour	4	Very much taste of chicken meat
	3	Much taste of chicken meat
	2	A slight taste of chicken meat
	1	No taste of chicken meat
Texture	4	Very smooth
	3	Smooth
	2	Rough
	1	Very rough

RESULTS AND DISCUSSIONS

1. Floss Moisture Content

As can be seen in table 3, the moisture content within treatments floss were A1 (50 ml) = 6.24%, A2 (100 ml) = 6.25%. A3 (150 ml) = 6.33% and A4 (200 ml) = 6.45% respectively. Based on statistical tests, the moisture content within floss of spent laying hens meat (SLHM) cooked with raw coconut water (CW) of 50 ml, 100 ml and 150 ml were not significantly different (P>0.05). Likewise, the moisture content between floss SLHM cooked with 150 ml raw CW and floss SLHM cooked with 200 ml raw CW were not significantly different (P>0.05). However, the moisture content between floss SLHM cooked with 200 ml raw CW were significantly different (P<0.05) higher than that moisture of floss SLHM cooked with 50 ml and 100 ml raw CW. So, the more of raw CW added to floss products, the more of floss moisture content value increased.

The moisture content values of floss in this study were lower than that of moisture content (5.90 – 8.0%)of floss chicken meat added with coconut milk (Mandjurungi et al., 2022). The differences of floss SLHM moisture contents in this study with other study were due to the differences in steaming and cooking time of meat with spices until it was completely dry at high temperatures. In this study, those spent laying hens meat was steamed for 60 minutes. According to Domiszewski et al., (2011) and Dawson et al., (2012) that cooking meat for a long time could result in an increased amount of liquid meat that came out, so that the meat moisture content decreased. The floss SLHM moisture contents in this study were ranged from 6.24%-6.45%m still met the requirements of the Indonesian National Standardization (SNI) no. 01-3707-1995, where the moisture content's quality requirement for floss meat was maximum 7%.

2. Floss Ash Content

As can be seen in table 3, the ash content within treatments floss were A1 (50 ml) = 2.97%, A2 (100 ml) = 3.09%. A3 (150 ml) = 3.15% and A4 (200 ml) = 3.20% respectively. Based on statistical tests, the ash content between floss spent laying hens meat (SLHM) cooked with raw coconut water (CW) 50 ml and floss SLHM cooked with 100 ml raw CW were not significantly different(P>0.05). Likewise, the ash content between floss SLHM cooked with 100 ml raw CW and floss SLHM cooked with 150 ml raw CW were not significantly different (P>0.05), similarly, the ash content between floss SLHM cooked with 150 ml raw CW and floss SLHM cooked with 200 ml raw CW were not significantly different (P>0.05). However, the ash content between floss SLHM cooked with 200 ml raw CW was significantly different (P<0.05) higher than that moisture contents of floss SLHM cooked with 50 ml and 100 ml raw CW. So, the more of raw CW added to floss products, the more of floss ash content value increased.

Table 3. The averages of physical-chemical of the treatments floss spent laying hen meat

Variables (%)	Treatments			
	A1 (50 ml CW)	A2 (100 ml CW)	A3 (150 ml CW)	A4 (200 ml CW)
Moisture	6.24 ± 0.09[a]	6.25 ± 0.06[a]	6.33 ± 0.04[ab]	6.45 ± 0.06[b]
Ash	2.97 ± 0.08[a]	3.09 ± 0.01[ab]	3.15 ± 0.02[bc]	3.20 ± 0.02[c]
Protein	33.34 ± 0.08[b]	32.32 ± 0.44[b]	28.04 ± 0.11[a]	27.97 ± 0.58[a]
Fat	27.44 ± 0.24[a]	27.48 ± 0.22[a]	28.48 ± 0.05[b]	28.83 ± 0.28[c]
Carbohydrate	19.34 ± 0.04[a]	19.53 ± 0.05[b]	20.84 ± 0.07[c]	21.54 ± 0.12[d]

Note: Different superscripts in the same row means significantly different (P<0.05)

According to Kasmiati et al., (2020) that ash was an inorganic component found in foodstuffs, and the high value of ash content was due to the large amount of minerals that were not burned into substances that cannot evaporate. This opinion was in line with Komariah et al., (2011), that the number of inorganic components was influenced by raw materials and processing processes. In the processing process, it should be noted that the raw materials, seasonings and equipment used must be hygienic to reduce contamination of inorganic components in processed products. The floss SLHM ash contents in this study were ranged from 2.97%-3.20%, still met the requirements of the Indonesian National Standardization (SNI) no. 01-3707-1995, which a maximum content for floss meat was 7%.

3. Floss Protein Content

As can be seen in table 3, the protein content within treatments floss were A1 (50 ml) = 33.34%, A2 (100 ml) = 32.32%. A3 (150 ml) = 28.04% and A4 (200 ml) = 27.97% respectively. Based on statistical tests, the protein content between floss spent laying hens meat (SLHM) cooked with raw coconut water (CW) 50 ml and floss SLHM cooked with 100 ml raw CW were not significantly different(P>0.05). Likewise, the protein content between floss SLHM cooked with 150 ml raw CW and floss SLHM cooked with 200 ml raw CW were not significantly different (P>0.05). However, the protein content of floss SLHM cooked with 200 ml and 150 ml raw CW were significantly different (P<0.05) lower than that protein contents of floss SLHM cooked with 100 ml and 50 ml raw CW. So, the more of raw CW added to floss products, the more of floss protein content value decreased.

The different in floss SLHM protein contents were due to different amount (level) of raw CW used in cooking the SLHM. Coconut water had a protein content of 5.2% (Geetha et al., 2016), while the protein content of chicken meat was 25.4 – 31.5% (Mountney and Parkhurst, 1995). Another thing that caused changing in protein contents values in this study was the length of cooking at high temperatures, the more coconut water added to the dough, the longer the cooking time so, that, the protein would be degradation. According to Aberounmand (2014), the frying process could result in a reduction of amino acids and proteins. The protein content values of the treatments floss in this study were ranged from 27.97%-33.24%, still moderately nutritious.

4. Floss Fat Content

As can be seen in table 3, the fat content within treatments floss were A1 (50 ml) = 27.44%, A2 (100 ml) = 27.48%. A3 (150 ml) = 28.48% and A4 (200 ml) = 28.83% respectively. Based on statistical tests, the fat content between floss spent laying hens meat (SLHM) cooked with raw coconut water (CW) 50 ml and floss SLHM cooked with 100 ml raw CW were not significantly different(P>0.05). However, the fat content of floss SLHM cooked with 200 ml raw CW were significantly different (P<0.05) higher than that fat contents of floss SLHM cooked with and 150 ml, 100 ml and 50 ml raw CW. So, the more of raw CW added to floss products, the more of floss fat content value increased.

The different in floss SLHM fat contents were due to different amount (level) of raw CW used in cooking the SLHM and also oil used in frying process. The increase in fat was thought it caused by absorption of oil in shreds at the time of frying. The fat content values of the treatments floss in this study were ranged from 27.44%-28.83%, still met the Indonesian National Standardization (SNI.01-3707-1995).

5. Floss Carbohydrate Content

As can be seen in table 3, the carbohydrate content within treatments floss were A1 (50 ml) = 19.34%, A2 (100 ml) = 19.63%. A3 (150 ml) = 20.84% and A4 (200 ml) = 21.54% respectively. Based on statistical tests, the carbohydrate content of floss spent laying hens meat (SLHM) cooked with raw coconut water (CW) 200 ml were significantly different (P<0.05) higher than that of carbohydrate of floss SLHM cooked with 150 ml, 100 ml and 50 ml raw CW. The carbohydrate content of floss SLHM cooked with 150 ml raw CW were significantly different (P<0.05) higher than that carbohydrate contents of floss SLHM cooked with and 100 ml and 50 ml raw CW. And so, the carbohydrate content between floss spent laying hens meat (SLHM) cooked with raw coconut water (CW) 100 ml were also significantly different (P<0.05) higher than that of carbohydrate of floss SLHM cooked with 50 ml. So, the more of raw CW added to floss products, the more of floss carbohydrate content value increased.

Benzon et al., (1990), reported that raw coconut water (CW) contains 6.30% carbohydrate, and further research from Alexia et al., (2011), reported that total sugar of raw CW 4.4%, sucrose 5.1%, glucose 1.5% and fructose 1.4%. Sucrose sugar was a non-reduction sugar that can cause caramelized process which caused brown colour. The shreds SLHM added with raw CW as well as brown sugar became brown due to caramelized process during heating. According to Winarno (2004), that fructose and glucose were reduction sugars that could form a browning reaction (Maillard). The carbohydrate content values of the treatments floss in this study were ranged from 19.34%-21.54%, good enough as an energy sources.

6. Sensorial

The averages colour, aroma, flavour/taste and texture of floss laying hen meat (FLHM) within the treatments can be seen in table 4 below.

6.1 Floss colour

The first impression that consumers received on food products is formed through visuals. According to Northcutt (2009), raw poultry meat colour was an important factor in cooking, because consumers associate it with the freshness, the attractiveness of the product, then the consumers made decision whether to buy the product or not. Further Pérez-Alvarez and Fernández-López (2012) reported that, colour was a major aspect in defining the quality of a food product that affected consumer choice.

Table 4. The averages sensory properties of the treatments floss spent laying hen meat

Variables (%)	Treatments			
	A1 (50ml CW)	A2 (100ml CW)	A3 (150ml CW)	A4 (200ml CW)
Colour	3.9 ± 1.10	3.9 ± 0.47	3.8 ± 0.95	3.9 ± 0.98
Aroma	1.1 ± 0.87	1.2 ±0.63	1.2 ± 0.63	1.0 ± 0.47
Flavour / taste	1.5 ± 0.53	1.5 ± 0.53	1.5 ± 0.53	1.4 ± 0.52
Texture	2.1 ± 0.87	2.2 ± 0.52	2.0 ± 0.87	2.0 ± 0.82

As can be seen in table 4, Based on the panellist's assessments result, the average floss colour in this study was A1 (50 ml) = 3.9, A2 (100 ml) = 3.9, A3 (150 ml) = 3.8 and A4 (200 ml) = 3.9. The results of the fingerprint analysis showed that those floss SLHM added with different levels of raw CW did not cause a difference in floss colour. The treatments floss colours were in "dark brown category" (3.8-3.9). The colours of floss SLHM in this study were influenced by non-enzymatic factors, such as temperature changes in processing. Similarly, the caramelized process and the content of other components in foodstuffs could increase the browning reaction (Maillard), where there was reaction between reduction of sugars and reduction of amino acids, which increased the brown colour characteristic of the final product of processed meat (Barbut, 2015).

6.2 Floss aroma

Aroma largely determines the level of reception of panellists from a product. A pleasant or characteristic aroma will increase the taste buds of consumers. Through aroma, panellists or the public can find out the ingredients contained in a product. According to Winarno (2008), that the smell of food determines the deliciousness of foodstuffs and has a lot to do with the sense of smell.

As can be seen in table 4, based on the panellist's assessments result, the average floss aromas in this study were A1 (50 ml) = 1.1, A2 (100 ml) = 1.2, A3 (150 ml) = 1.2 and A4 (200 ml) = 1.0. The results of the fingerprint analysis showed that those floss SLHM added with different levels of raw CW did not cause a difference in floss aroma. The treatments floss colours were in "no meat aroma category" (1.0-1.2). The aromas of floss SLHM in this study was influenced by the spices plus raw CW (dough), thus, when frying, the dough masking the aromas of SLHM.

6.3 Floss flavours

Flavour is a combination of taste and aroma that can affect consumer's behaviour and preferences to meat products (Jayasena et al., 2013). Flavour is a multi-sensory perception produced through the integration of the senses of taste, smell, and trigeminal nerves (Auvray and Spence 2008). The trigeminal nerve is a nerve that plays a role in transmitting sensations from the skin of the anterior part of the head, oral and nasal cavities, teeth and meninges or lining of the brain.

As can be seen in table 4, Based on the panellist's assessments result, the average floss flavours in this study were A1 (50 ml) = 1.5, A2 (100 ml) = 1.5, A3 (150 ml) = 1.5 and A4 (200 ml) = 1.4. The results of the fingerprint analysis showed that those floss SLHM added with different levels of raw CW did not cause differences in floss flavour. The treatments floss flavours were in "no meat flavours and least chicken meat flavours category" (1.4-1.5). The flavours of floss SLHM in this study were again influenced by the spices plus raw CW (dough), dough, when fried became savoury, finally influenced the floss flavours.

6.4 Floss texture

Texture is one of the most important quality factors associated with consumers' highest satisfaction with poultry meat products (Fletcher, 2002).

As can be seen in table 4, Based on the panellist's assessments result, the average floss textures in this study were A1 (50 ml) = 2.1, A2 (100 ml) = 2.2, A3 (150 ml) = 2.0 and A4 (200 ml) = 2.0. The results of the fingerprint analysis showed that those floss SLHM added with different levels of raw CW did not cause differences in floss textures. The treatments floss textures were in "rough category" (1.4-1.5). The textures of floss SLHM in this study were rough or fibrous (not too fine) due to the size of the torn (shredded) meat were quite large due to the meat were not easy to tear (clay), got from chickens that relatively old.

CONCLUSIONS

It was concluded that even though there were differences on physical-chemical content within the treatments of floss SLHM, however, the panellists were given relatively the same responses on sensory of floss SLHM overall.

ACKNOWLEDGEMENTS

The authors would like to thank the Research and Community Service Institutes of the University of Sam Ratulangi through DIPA BLU which has provided research funds.

REFERENCES

1. Alexia, P.M., Dornier, N.D., Pain, J.P. (2012). Fruits Coconut Water user, composition and properties. Cambridge Core, vol. 67(2), p. 87-107.
2. Agustin, R. (2018). Skripsi. Pengaruh Penambahan Pepaya (Carcia pepay L.) Terhadap kualitas Abon Ayam (Gallus gallus domestica). Universitas Gajah Mada. Yogyakarta.
3. Auvray, M., Spence C. (2008). The multisensory perception of flavor. Consciousness and cognition, vol. 17(3), p. 1016-1031.
4. Barbut, S. (2015). The science of poultry and meat processing. Food Science Department, University of Guelph. Guelph, Ontario, Canada.
5. Cahyani, S.O., Bambang, D., Rizqiati H. (2018). Perubahan Sifat Fisiko Kimia Dan Mutu Hedonik Kefir Air Kelapa Hijau (*Cocos Nucifera* L) dengan Penambahan High Fructose Syrup (HFS). Jurnal Teknologi Pangan, vol. 3(1), p. 96-103.
6. Dawson, L.P., Mangalassary, S., Sheldon, B.W. (2012). Thermal Processing of Poultry Product. In: Thermal Food Processing: New Technologies and Quality Issues. D.W. Sun (Ed). CRC Press, USA.
7. Domiszewski, Z., Bienkiewicz, G., Plust, D. (2011). Effects of different heat treatments on lipid quality of striped catfish (*Pangasius hypophthalmus*). Acta Sci. Pol. Technol. Aliment, vol. 10(3), p. 359-373.
8. Fletcher, D.L. (2004). Further Processing of Poultry. In: Poultry Meat Processing and Quality. Edited by: Mead, G.C. Woodhead Publishing Limited Abington Hall, Abington, Cambridge, England.
9. Geetha,V., Bhavana, K.P., Chetana, R., Gapala Krishna, A.G., Suresh Kumar, G. (2016). Studies Composition and in vitro antioxidant activities of concentrates from coconut test and tender coconut water. Journal of Food Processing and Technology, vol. 7(5), p. 1-5.
10. Jayasena, D.D., Ahn, D.U., Nam, K.C., Jo, C. (2013). Flavour Chemistry of Chicken Meat: A Review. Asian-Aust. J. Anim. Sci., vol. 26, p. 732-742.
11. Kasmiati N. Ekantari, Asnani Suadi, Husni, A. (2020). Mutu Dan Tingkat Kesukaan Konsumen Terhadap Abon Ikan Layang (*Decapterus* sp.). Jurnal Pengolahan Hasil Perikanan Indonesia, vol. 23(3), p. 470-478.
12. Komariah S. Rahayu, Arbian, S. (2011). Sifat Kimia Dan Daya Terima Abon Daging Domba Dengan Pelumuran Sari Jeruk Nipis (*Citrus aurantifolia*) Sebelum Pengolahan. Indonesia Livestock Journal, vol. 1(1), p. 8-14.
13. Miskiyah, J., Suryamiyaty, S. (2017). Aplikasi Vinegar Air Kelapa Terhadap Mutu Karkas ayam Di Rumah Potong Ayam (RPA) Dan Pasar Tradisional (Studi Kasus Di RPA Jambi Raya Dan Pasar Shangrila Kebayoran Lama). Jurnal Pascapanen Pertanian, vol. 14(1), p. 53-66.
14. Mountney, G.J., Parkhurst, C.R. (1995). Poultry Products Technology. 3rd edition, The Haworth Press, Inc. New-York. eBook ISBN 9780203742747
15. Northcutt, J.K. (2009). Factors Affecting Poultry Meat Quality. The University of Georgia Cooperative Extension Service. The University's Bull. 1157.
16. Pérez-Alvarez, J.Á., Fernández-López, J. (2012). Chemical and Biochemical Aspects of Color in Muscle Foods. In: Handbook of Meat, Poultry and Seafood Quality, 2nd Ed. Edited by Leo M. L. Nollet. Pub. by John Wiley & Sons, Inc.
17. Prasetyo, E., Nuhriawangsa, A.M.P., Swastike, W. (2012). Pengaruh lama perebusan terhadap kualitas kimia dan organoleptik abon dari bagian dada dan paha ayam petelur afkir. Sains Peternakan: Jurnal Penelitian Ilmu Peternakan, vol. 10(2), p. 108-114.
18. Prasetyo, E. (2014). Pengaruh lama Perebusan Terhadap Kualitas Kimia Dan Organoleptik Abon Dari bagian Dada dan paha Ayam Petelur Afkir. Sains Peternakan, vol. 10(2), p. 108-114.
19. Prades Alexia, Dornier, M., Diop, N., Pain, J.P. (2011). Coconut water uses, composition and properties. A Review. Journal Fruits, vol. 67(2), p. 87-107.
20. Rasyaf, M. (2010). Pengelolaan Produksi Telur. Edisi ke-8. Penerbit Kanisius, Yogyakarta.
21. Tamasoleng, M., Rumondor, D.B.J., Ratulangi, F., Rotinsulu, M., Hadju, R. (2020). Effect Of Boiling Coconut Water On Physical, Chemical and Organoleptic Properties Of Rejected Laying Hen. Scientific Papers, Series D Animal Science, vol.63(2), p. 291-295.
22. Winarno, F.G. (2004). Kimia Pangan dan Gizi. PT. Gramedia Pustaka Umum, Jakarta.
23. Winarno, F.G. (2008). Kimia Pangan dan Gizi edisi terbaru, Bogor M-brio Press.