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Research Article

Effect of the aging period on meat quality and consumption properties of spent laying hens

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Abstract

An experiment was conducted to determine the effect of aging period on meat quality and consumption properties of spent laying hens during 10-15 oC. The duration of the meat aging period was divided into eight treatments. 0, 6, 12, 18, 24, 30, 36 and 42 hours. Sixty-four spent laying hens were assigned into each treatment in a complete randomized design (CRD) with eight replications. The consumer's acceptance was tested using a five-level satisfaction scale. The results showed that textural quality of the meat in groups 6-8 had higher consumer acceptance than from groups 1-5 with significant difference ($p< 0.05$). The textural quality values in each treatment ranged from the lowest to the highest were: 3.09 (T1), 3.16 (T2), 3.21 (T3), 3.47 (T4), 3.44 (T5), 3.87 (T6), 3.92 (T7), and 4.01 (T8), respectively. For meat quality parameters, there were significant difference ($p<0.05$) on the pH (at 24 hours), cooking loss percentage, compression force, shear force, and hardness. However, some parameters showed non-significant difference such as the drip loss, color of meat (L*, a*, b*) chroma, gumminess, springiness, chewiness, and aw values. It was therefore concluded that the aging period could result in better texture of the meat spent laying hens.

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Introduction

Spent laying hens are chickens that are past their prime egg laying years. They are older and less productive. Currently, these chickens are slaughtered and portioned and are being sold as fresh chicken in the markets. On the other hand, the meat of spent laying hens has a sticky texture there is high fat in the carcass, resulting in low quality of its meat with coarse muscle fibers and little water holding capacity percentage. Because there is a high amount of collagen in the area that increases with age and makes oxidation reactions easy during storage, its meat gets tough and not suitable for the usual household consumption. Consequently, these kinds of meat are not being preferred by consumers but are nonetheless being sold at low prices in particular to processing plant operators as an ingredient for emulsion sausage and meat ball product. Such byproducts are found in the market. The spent laying hens are older and less productive. Therefore, there is a discharge from giving the eggs. Nowadays, the spent laying hens are slaughtered and sold as fresh

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chicken meat. But the spent laying hens have a sticky texture high in carcass fat making meat of poor quality with coarser muscle fibers and percentage of lower water holding due to the high content of collagen in the meat with age increases and it is easy to oxidize during storage resulting in difficulty chewing or stuck teeth (Raksasiri. *et al.*, 2020). Therefore, it is not desirable to consumers, so are sold at a low price and it will focus on selling to operators of processing plants It is a meatball, sausage, emulsion products and jerky product that can be taken anywhere which suitable for tourists, it is also a high protein snack (Choi *et al*., 2008; FSIS, 2012). But found that such product groups are common in the market, which the production method is cumbersome and production technology that is expensive not suitable for investors or small farmers. Over the years, natural compounds such as pineapple juice have been studied for the digestibility of protein in meat. Digests food in both acidic and alkaline conditions It has high bass properties. Softens the meat. The enzymes are specific to the substrate. Specific to the digestion of connective tissue and enzymes with high protein digestion activity, the most tender texture is bromelain. (glycoprotein) can accelerate the digestion of molecules. It is classified as a group of enzymes that have a sulfidryl group. In addition, bromelain can accelerate the digestion of amines of amino acids and peptides (Raksasiri.*et al*., 2020). And used have salt solution, table salt (Sodium Chloride), which serves to flavor the product, reducing microorganisms, phosphate salt increases the water holding capacity. Of meat Does not lose too much weight when heated. And can increase the acid-base of the meat resulting in a softer and better flavored meat, inhibits the growth of microorganisms and helps products have a constant flavor. (Raksasiri, 2010). However, said byproducts would require tricky production methods and expensive production technology which are not suitable for small-scale investors or farmers. Therefore, this experiment aimed to study the effect of aging periods on the quality of meat of spent laying hens so as to guide the farmers who are raising laying hens during its processing and to further development their food product.

Material and Methods

Animal and Treatments

Sixty-four spent laying hens were assigned into a complete randomized design (CRD) with, aging period at 10-15 ºC. They were divided into 8 groups with 8 replicates and were allocated to 7 duration treatments: the control diet (T1) while, increasinge the time at; 6, 12, 18, 24, 30, 36, and 42 hours for T2, T3, T4, T5, T6, T7 and T8, respectively.

Sample Collection and Analysis

Lohhmann brown breed spent laying hens at 80-week old were slaughtered as well hair and intestines were removed before the experiment (scientific experimental animal license number: U1-05112-848 2559, Thailand).

Parameters such as sensory panel method with Affective method (consumer method) were used to test the response of consumers in terms of adoption. There were about 50-100 people whom are not necessarily trained tasters were used as consumers (Raksasiri, 2010). Using the hip muscles of spent laying hens in the study the sample breast meat for examination with Ph (45 mn. to 24 hrs.), the percentage of drip loss and cooking loss during storage (Devine, 1999). Parameters used were in accordance to; Van Oeckel et al. (1999), for shear force and compression force; Saricoban et al. (2010) for, color of meat such as Lightness (L*), redness (a*), and yellowness (b*), chroma and hue angle; Novasiana: TH 200, for water activity (aw), and Kristensen and Purslow, 2001; for water-holding capacity (WHC). The sensory panel method (Affective method) gave a preference score on physical properties, including appearance, color, smell, taste, texture and the overall acceptance of consumers with five preference scores ranged from 5 (very like = 4.21-5.00), 4 (like = 3.41-4.20), 3 (passive = 2.61-3.40), 2 (disliked = 1.81-2.60), and 1 (most disliked = 1.00-1.80), used among 212 tasters (regardless of gender and age).

Statistical Analysis

Data was analyzed statistically Following completely randomized design (CRD. Significant differences between treatments were determined using Duncan's news multiple range test (DMRT) SAS (1996).

Results

A study of consumer's acceptance on meat of spent laying hens at different aging period, using the sensory panel method consisted of the appearance, color, flavor, texture and overall acceptance. There were five levels of acceptance rating divided into: 4:21 to 5:00 (very like), 3.41 to 4.20 (like), 2.61 to 3.40 (neutral), 1.81 to 2.60 (like), and 1.00 to 1.80 (most dislike). Average scores were used to adjust to the level of consumer's acceptance rating. Scores were interpreted to determine the acceptability of consumers. The results showed that the appearance, color, smell, taste and overall acceptability were not significant difference. For texture, consumer's acceptance in groups 6, 7, and 8 are statistically significant ($P < 0.05$) than in group 1, 2, 3, 4 and 5, with values of 3.09, 3.16, 3.21, 3.47, 3.44, 3.87, 3.92 and 4.01 in groups 1, 2, 3, 4, 5, 6, 7, and 8 respectively, which showed that the period of aging affected the texture. However, the results also showed that consumers favorable agreed (like) with groups 4-8 (3.41-4.20 = like) as seen on Table 1.

Table 1.

Score of Consumers' Acceptance on Meat of Spent Laying Hens Using the Sensory Panel Method at Different Incubation Periods

Items	Treatments (aging period at 10-15 °C)								SEM	P-value
	0 hr.	6 hr.	12 hr.	18 hr.	24 hr.	30 hr.	36 hr.	42 hr.		
Appearance	3.63 ± 1.72	3.54±1.07	3.59±0.78	3.61±2.14	3.71±1.37	3.76±1.22	3.77±1.17	3.76±1.36	1.24	ns
Color	3.61 ± 1.17	3.52±1.11	3.56±1.79	3.51±1.44	3.53±1.08	3.54±1.37	3.61±1.37	3.62±1.17	0.74	ns
Smell	2.92 ± 2.14	3.07±1.18	3.02±1.08	2.97±1.82	2.94±1.08	3.02±1.32	3.22±1.32	3.36±2.02	0.44	ns
Texture	3.09± 1.24^{a}	3.16±1.01^{a}	3.21±0.72^{a}	3.47±1.46^{a}	3.44±1.17^{a}	3.87±1.21^{b}	3.92±1.21^{b}	4.01±1.21^{b}	0.81	*
Taste	3.63 ± 1.18	3.62±1.13	3.64±1.73	3.66±1.17	3.90±2.08	3.81±1.76	3.92±1.16	3.96±0.63	1.36	ns
Overall acceptance	3.79 ± 1.77	3.81±1.86	3.82±1.75	3.85±2.02	3.96±2.06	4.06±1.46	4.11±1.72	4.09±1.16	1.24	ns

Note: ^{a,b} Means in row with different superscripts letter are significantly different ($P<0.05$), hr = hour, ns = non-significant ($p>0.05$), * = significant and SEM = Standard error of mean

As for study on the quality of the meat, it was found that the percentage of drip loss and the water holding capacity had no significant difference. In group 8, the drip loss was found to be considerable low; while measuring the acidity-alkalinity (pH) at 42 hrs., pressure, shear force, and hardness had decreased and were significantly different ($p < 0.05$) in aging more with 5.85, 5.84, 5.78, 5.76, 5.63, 5.26, 5.13, and 5.21; for cooking loss percentage they were 24.08, 24.43, 24.24, 24.45, 25.27,27.07, 26.86, and 27.44; compression force were 40.14, 37.69, 37.73, 37.44, 35.05, 34.73,30.84, and 2861 (N) shear force were 8.82, 8.27, 7.74, 7.54, 6.56, 4.63, and 4.48 (kg); and hardness were 30.39, 31.12, 31.42, 31.15, 29.41, 30.23, 28.78, and 28.44 (N) in groups 1, 2, 3, 4, 5, 6, 7 and 8, respectively (Table 2).

Table 2.

The Quality on Meat of Spent Laying Hens in Different Aging Periods

Items	Treatments (aging period at 10-15 °C)								SEM	P-value
	0 hr.	6 hr.	12 hr.	18 hr.	24 hr.	30 hr.	36 hr.	42 hr.		
Drip loss (%)										
Day1	0.14±1.17	0.12 ± 1.22	0.13 ± 1.13	0.16 ± 1.82	0.14 ± 1.64	0.28 ± 1.25	0.18 ± 1.15	0.22 ± 1.23	2.28	ns
Day3	1.54±0.97	1.54 ± 1.32	1.56 ± 0.22	1.65 ± 1.62	1.67 ± 1.28	1.75 ± 1.92	1.73 ± 1.12	1.71 ±0.94	1.19	ns
Day5	2.02±1.77	2.05 ± 1.01	2.65 ± 1.81	2.06 ± 1.28	2.04 ± 1.78	2.06 ± 0.82	2.04 ± 1.11	2.06 ± 0.64	3.08	ns
Day 7	2.69±0.75	2.72 ± 0.23	2.76 ± 0.23	2.86 ± 0.58	2.82 ± 2.13	2.86 ± 1.27	2.86 ± 1.27	2.86 ± 1.27	2.16	ns
pH at 45 mn	6.72±1.07	6.74 ± 0.48	6.75 ± 0.48	6.78 ± 0.08	6.77 ± 0.21	6.69 ± 0.34	6.71 ± 1.1 4	6.68 ± 0.46	0.87	ns
pH at 6 hr.	6.73±1.01	5.98 ± 0.08	5.98 ± 0.08	6.82 ± 0.22	6.78 ± 0.18	6.73 ± 0.48	6.73 ± 1.28	7.01 ± 0.82	1.17	ns
pH at 12 hr.	6.74±0.15	5.96 ± 0.03	6.02 ± 0.03	6.81 ± 0.32	6.76± 0.13	6.71 ± 0.21	6.69 ± 1.12	6.71 ± 0.29	2.01	ns
pH at 24 hr.	5.85±0.27a	5.84 ± 0.16a	5.78± 0.16^{a}	5.76 ± 0.12^{a}	5.63 ± 0.07^{a}	5.26 ± 0.18^{b}	5.13 ± 0.11^{b}	5.21 ± 0.27^{b}	1.48	*
Cooking loss (%)	24.08±1.72^{a}	24.43 ±1.10^{a}	24.24±1.10^{a}	24.45 ±1.27^{a}	25.27±2.11^{b}	27.07 ±1.23^{b}	26.86 ±1.17^{b}	27.44±1.13^{b}	0.84	*
Compression force (N)	40.14±1.02^{a}	37.69± 1.81^{a}	37.73±0.76^{a}	37.44± 1.18^{a}	35.05± 2.08^{a}	34.73± 1.12^{ab}	30.84± 0.82^{b}	28.61±0.42^{b}	1.16	*
Shear force (kg)	8.82±1.17^{a}	8.27± 1.33^{a}	7.74±1.81^{a}	7.54±2.09^{a}	6.56± 1.77^{b}	5.42±1.39^{ab}	4.63±1.39^{b}	4.48±1.39^{b}	0.22	*
Hardness (N)	30.39±2.04^{a}	31.12±1.68^{a}	31.42±1.49^{a}	31.15±1.54^{a}	29.41±1.62^{b}	30.23±1.33^{ab}	28.78±1.68^{b}	28.44±1.44^{b}	0.70	*
Cohesiveness (ratio)	0.64±0.93	0.67±1.12	0.67±1.67	0.68±1.83	0.70±1.59	0.66±1.66	0.67±1.76	0.72±1.84	0.02	ns
Gumminess (N)	20.12±1.58	19.59±1.68	18.88±1.43	18.89±1.91	18.56±1.27	17.84±1.22	18.04±1.49	17.91±16	2.01	ns
Springiness (ratio)	0.76±1.47	0.75±1.77	0.74±1.39	0.74±1.89	0.74±1.57	0.73±1.71	0.74±1.44	0.73±1.49	0.12	ns
Chewiness (N)	15.29±1.33	14.69±0.97	13.97±1.11	13.97±1.24	13.73±1.53	13.02±1.49	13.35±1.12	13.12±1.24	0.46	ns

Color at 24 hour after chill storage at 5 °C

Lightness (L*)	52.31±1.27	51.11±1.64	51.24±1.71	50.23±0.89	50.12±1.11	51.27±1.28	50.84±1.77	50.77±1.18	0.71	ns
Redness (a*)	1.58±0.78	1.72±1.13	1.81±1.74	1.37±1.67	1.64±1.47	1.81±1.29	1.39±0.89	1.76±1.33	0.08	ns
Yellowness (b*)	4.61±2.87	3.77±0.97	4.11±1.46	4.27±0.91	3.88±1.87	2.94±1.64	3.86±2.83	2.49±0.85	0.27	ns
Chroma	10.79±1.82	10.80±1.56	10.34±1.73	10.45±2.01	10.39±1.08	10.44±0.99	10.47±1.71	10.38±1.44	0.51	ns
Hue angle	50.61±1.26	50.47±1.33	50.12±1.78	51.03±1.89	53.33±0.89	51.41±1.46	52.14±1.33	51.87±1.48	6.64	ns
a_w	0.93±1.13	0.91±1.14	0.93±1.22	0.96± 0.75	0.92±1.24	0.91± 0.19	0.92± 0.27	0.92± 1.18	2.41	ns
WHC	53.17± 2.13	58.43± 1.34	58.61± 1.83	59.22± 1.22	60.35± 0.86	60.46± 1.38	61.22± 1.17	61.73± 0.81	0.86	ns

Note: [a,b] Different letters in the same line are statistically significant (P <0.05). mn = minute, hr = hour, WHC= water holding capacity and pH = is a measurement after the end of the experiment

Discussion

The results showed that in all groups, consumer's acceptance testing on meat of spent laying hens. The sensory panel method used in the affective method was evaluated based on the physical characteristics, such as appearance, color, smell, taste, texture of meat and overall acceptance of consumers. There were 5 levels of preference: 5 = very like, 4 = like, 3 = neutral, 2 = dislike, and 1 = most dislike. The results, found that the longer the aging period, the more effect on the meat texture. It was found though that the consumer's acceptance in terms of appearance, color, smell, taste, and overall acceptance of meat of spent laying hens using natural dyes in all 8 groups gave no difference. However, the study of Jeremiah *et al.*, (2003) showed that fat and moisture are correlated with juiciness. Therefore, the consumption of chicken meat, it is necessary to use other compounds that can make the chicken meat soft and tender. Consumers can accept the use of meat tenderizer such as pineapple juice or salt solution, since pineapple juice has bromelain enzymes that have protein digestion properties while, salt solution can digest collagen, fat, fascia, and connective tissue, which results in protein deterioration or the ability to absorb water of the protein that could therefore be reduced. (Watchara *et al.*, 2016; Raksasiri *et al.*, 2020).

The result of aging period on the meat quality was an opportunity for its muscles to use energy for metabolism which directly affects the function of the enzyme on meat. It is also responsible for the degradation of protein fibers after the meat through a process to permanently shrink (rigor mortis), while enzyme neutral groups protrinase (calpain I, calpain II) are responsible for the degradation of protein fibers in form of sarcoplasmic protein, myofibillar protein and collagen protein affect to deterioration of the fiber protein and texture of meat was soft (Raksasiri, 2010). The study of Jaturasitha (2010), found that the period of incubation increased carcass quality to consumption of spent laying hens meat. About better tenderness, it is noteworthy that the shear force of turkey meat tested is high and toughness in all experiments. This will affect the adoption of certain products shades. Required texture is soft. The main attribute of palatability influencing consumer acceptance is tenderness. When deciding to purchase meat, palatability is the primary sensory trait of consumer acceptance (Jeremiah *et al.*, 2003). The meat of spent laying hens have the texture characteristic that induces with muscle fibers that are coarse than younger animals; low water holding percentage due to the high amount of collagen in the meat that increases with age resulting in difficult chewing problems, therefore not popularly consumed (Pilasombut *et al.*, 2015). While the drip loss, color of meat (L*, a*, b*) and aw values do not find statistical differences, the aging period had influenced muscles to use energy for metabolism which directly affected the function of the indigenous enzymes of meat and responsible for the degradation of protein fibers after the meat through a process to permanently shrink (rigor mortis), causing liquid proteins such as pigment to flow out of the muscle cells which will result in the color of the flesh becoming pale Raksasiri (2010). However, the color value in the meat depends on the amount of myoglobin, which will vary according to type, age, gender, muscle type and exercise and the timing affects the color change and has a clear effect on the texture of the meat. (Judge *et al.*, 1989; Lewis *et al.*, 1991; Dransfield, 1994; Campo *et al.*, 2000; Sañudo *et al.*, 2004). The supplementation of oil-rich foods in the final phase of laying hen diet may result in, for example, the addition of sesame perilla mint (Perilla frutescens), oil extracts, which can help to reduce cholesterol and improved water holding capacity of meat

(Nopparatmaitree *et al.*, 2018). The experiment using pineapple juice together with the salt solution to ferment the spent laying hens found that the meat is softer and increases well the efficiency of water holding capacity of the meat (Raksasiri et al., 2020).

Conclusion

The study of aging period, affecting the meat of spent laying hens, found to have an effect on the consumer' s acceptance in particular to texture. The aging period of its meat when increased showed a decrease on its pH, pressure was dropped and shear force of meat was reduced as well. The period of aging then represented the direct increase on the tenderness of meat which will consequently continue on to other processed food products that are for consumption. The aging period, however, also affected to an increased percentage of drip loss during cooking, but had no effect on the percentage of drip loss during storage. This showed no effect economically which suggested the development or promotion of spent laying hens. It is a great alternative for farmers who are looking for career development and can be used to develop or promote product processing for farmers who are looking for professional development. Meat management system must be taken into consideration to develop its food product in order to increase its value.

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