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Study on quantity and qualities characteristics of chicken essence from Thai native chicken, broiler, and laying hen in Thailand

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Abstract

The purpose of this study was to study the quantity and quality characteristics of chicken essence from 3 chicken breeds, which were Thai native chicken, broiler, and laying hen. Yields, neurotransmitters (such as carnosine, anserine and creatine), pH, color, and amino acids extracted from chicken meat were measured. Chicken essence was divided into three groups in accordance with the extraction periods (1, 1.5 and 2.0 hrs), and the design of these experiments was completely randomized design. Here, the results showed that 2.0-hr extraction time yielded the highest percentages of chicken essence extracted from 3 chicken breed meat, while 1.0-hr extraction time generated the lowest percentages of chicken essence extracted from 3 chicken breed meat. Each neurotransmitter and total neurotransmitter amounts extracted from broiler meat with various extract times were significantly different, while neurotransmitters and total neurotransmitters collected from Thai native meat and laying hen meat with diverse extraction times were insignificantly different. The pH values of chicken essence extracted from Thai native chicken and broiler meat were significantly different ($p<0.05$). When extraction time increased, the pH values of chicken essence extracted from Thai native chicken and broiler meat were reduced. On the other hand, the pH values of chicken essence extracted from laying hen meat were insignificantly different ($p<0.05$). Extraction time significantly affects the lightness, redness, and yellowness of chicken essence. The chicken essence with 2.0-hr extraction time showed the highest redness and yellowness. Compared to chicken essence extracted from Thai native chicken and laying hen meat, most amino acid amounts were higher.

1. Introduction

In the poultry industry, chicken is the main animal for meat and egg production. According to world meat consumption, approximately 43% was chicken meat in 2019 (Berkhout, 2022) while total egg production in the world has grown from 61.7 million tons in 2008 to 76.7 million tons in 2018 (FAO, 2023). For global commercial consumption (Lawal *et al*., 2020) chicken meat, which is a type of white meat, is considered superior to red meat in terms of health and does not have religious limits (Jaturasitha *et al*., 2016). Due to its mellow taste, chicken is therefore the most popular poultry around the world for meat production. Tender chicken meat can be cooked in a variety of ways, including baking, grilling, broiling, barbecuing, frying and boiling. Poultry products provide not only high-quality protein but also important vitamins and nutrients. Consequently, chicken meat is the main source of protein for consumers around the world (Al-Nasser *et al*., 2007).

Currently, healthy food is more interesting than basic nutrition (Al Saqqa, 2021) because it can improve health and reduce the risk of disease. The present consumer behavior trend is interested in health care, eating safe food, and exercise, including buying a lot of available health care products in tablet, capsule, powder and drink forms. As a result, these food supplements, especially

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healthy drinks, are popular with people. Chicken essence is a poultry product extracted from chicken meat, and Asian people, particularly Southeast Asian people, enjoy it very much (Benton and Young, 2015). According to Chinese traditional medicine, chicken essence nourishes bones and muscles, speeds metabolism relieves fatigue, repairs the internal system of the body, recoveries from fatigue after exercise (Li *et al.*, 2012) and from postpartum illness, alleviates stress, improves memory performance (Yasuo *et al.*, 2002), and nourishes the brain (Homjitr, 2015). In agreement with the study of Nopchinda (2015), chicken essence is a nutritious food which warms the body, and restores energy and the body from exhaustion since it contains nutrients, vitamins, essential amino acids, and dipeptides, such as carnosine (beta-alanyl-L-histidine) and anserine(beta-alanyl-3-methyl-L-histidine) (Chan *et al.*, 2016).

Chicken essence is extracted from high-quality chicken meat which is an abundant source of protein and amino acids, such as threonine, valine, methionine, isoleucine, leucine, phenylalanine, lysine, tryptophan, histidine and arginine (Geissler *et al.*, 1996; Zain and Syedsahiljamalulail, 2003). In addition to a large amount of protein and amino acids, it contains nutrients, vitamins, and endogenous compounds, such as carnosine, anserine, and creatine, which are bioactive compounds (Schmid, 2009). These compounds are dissolved in the chicken broth when the heat and boiling process is applied to chicken meat; however, the different processes result in distinct nutrition. To control nutrition and bioactive compounds, the chicken essence process must be optimized. The objectives of this current study were: 1) to measure and identify suitable processes for chicken essence extracted from Thai native chicken, broiler and laying hen meat; 2) to characterize the chemical and physical properties of chicken essence. This research is not only to add value to chickens but also to develop new products. The novel food supplement may be an alternative healthcare product for Thai people.

2. Materials and methods

2.1 Sources of samples

In this study, the chickens were the representatives of chicken breeds in Thailand. Thai native chickens were 16-week white-tailed yellow male and female chickens with an average weight of 1.2 kg (range 1.0 – 1.5 kg). Thai native chickens were purchased from Baimohn Farm, Sing Buri Province, Thailand.

Broilers were male and female 6-week White Plymouth Rock breed with an average weight 1.8 kg (range 1.8 – 2.3 kg). They were purchased from Stars Food Group Company, Nakhon Pathom Province, Thailand.

The laying hen was a female 80-week Rhode Island Red breed with an average weight of 1.4 kg (range 1.3 – 1.7 kg). The laying hens in this study were purchased from Pairat Food Group Company, Nakhom Pathom Province, Thailand.

2.2 The chicken essence preparation

The method for preparing chicken essence was modified from Dong *et al.* (2014) as shown in Figure 1. Whole chicken carcasses were cut into pieces, such as wings and thighs. These pieces were heated at 100°C for 1.0, 1.5 and 2.0 hrs, respectively. Yields were calculated using equation 1.

$$\text{Yield (\%)} = \frac{\text{Wt. chicken essence}}{\text{Wt. raw materials}} \times 100$$

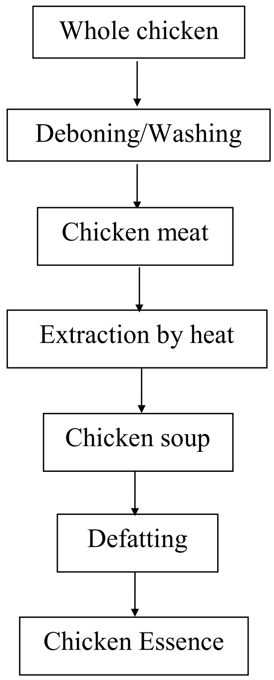

Figure 1. Flow diagram of the preparation of chicken essence.

2.3 The quantitative analysis of neurotransmitters

The method of carnosine, anserine, and creatine quantitation was modified by Jung *et al.* (2013). A gram of chicken essence was mixed with 7.5 mL of 0.01 N HCl dan homogenized at 1,130×*g* for 1 min, and then centrifugated at 17,030×*g* for 15 mins at 4°C. The 2.5 mL of supernatant was mixed with 7.5 mL of acetonitrile, and centrifugated at 17,030×*g* for 15 mins at 4°C. The clear supernatant was passed through a 0.22 µm syringe filter, and 10 µL of samples were injected into the HPLC instrument (Waters 600E). The HPLC instrument consisted of the ultraviolet detector at 214 nm and HILIC silica column (150 mm × 4.6 mm, 3 µm). The mobile phase A was 0.65 mM ammonium acetate in

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water- acetonitrile (25:75 v/v) at pH 5.5, while the mobile phase B was 0.65 mM ammonium acetate in water- acetonitrile (70:30 v/v) at pH 5.5. The rate of mobile phase injection was 1.2 ml/min for 16 min with a linear gradient starting from 0 to 100%. The contents of carnosine, anserine, and creatine were calculated from standard linear regression, and the standards were purchased from Sigma Company.

2.4 pH measurement of chicken essence

Each chicken essence was measured using the calibrated pH meter (C1010 CONSORT, Belgium).

2.5 Color measurement of chicken essence

The color of chicken essence was measured by Colorimeter Miniscan EZ 4500L spectrophotometer (HunterLab, USA). Before measuring, the device was calibrated to a standard whiteboard. For measuring each sample after standardization, the color component L is lightness or luminance. The maximum L* value is 100, indicating a perfect reflector, while the minimum L* value is 0, which represents black. According to the method of Lin *et al.* (2016), a* is defined along the axis of red–green, and b* is defined along the axis of yellow–blue.

2.6 Amino acid measurement of chicken essence

In this study, by using in-house method WI-TMC-06 based on Journal of Chromatography B (Dai *et al*., 2014), eighteen amino acids were measured as follows: aspartic acid, glutamic acid, serine, threonine, proline, glycine, alanine, arginine, tyrosine, valine, methionine, cystine, isoleucine, phenylalanine, tryptophan, leucine lysine and histidine. The amino acid measurement was performed at the Institute of Food Research and Product Development, Kasetsart University, Bangkok, Thailand.

2.7 Statistical data analysis

All data were analyzed for variance (Analysis of Variance: ANOVA) ($p<0.05$) in accordance with the program R, version 4.2.2 (The R Foundation, 2022) and the differences between each sample were analyzed with Duncan's New Multiple Range Test (DMRT). The design of these experiments was a complete randomized design. The means and standard deviation were reported, and all experiments, except amino acid measurement, were replicated at least three times on three independent occasions.

3. Results and discussion

3.1 The yields of chicken essence

The percentages of chicken essence extracted from 3 chicken breed meat incubated at 3 different times are shown in Table 1. The yields of Thai native chicken meat extracted for 1.0, 1.5, and 2.0 hrs were significantly different ($p\leq0.5$). On the other hand, the amounts of chicken essence extracted from broiler and laying hen meat incubated for 1.0-hr extraction were significantly different from chicken essence originating from broiler and laying hen meat incubated for 1.5 and 2.0-hrs. The 1.0-hr extraction produced the lowest amounts of chicken essence, while the 2.0-hr extraction generated the highest contents of chicken essence because heating steam penetrates cells, and nutrients are diffused into chicken essence. In other words, when more incubation time increases, more water passes through the meat. In agreement with Lin *et al*. (2016) who studied chicken essence generated from Taiwanese native chicken meat, when extraction time increased, yield increased.

Table 1. Percentages of chicken essence extracted from chicken meat of 3 breeds at different extraction times.

Treatment	1.0 hr	1.5 hrs	2.0 hrs
Thai native chicken	17.96±1.11^{b}	20.41±0.93^{ab}	21.28±0.76^{a}
Broiler	20.41±0.47^{b}	22.98±0.47^{a}	24.17±0.44^{a}
Laying hens	21.42±0.67^{b}	23.08±0.51^{a}	23.45±0.55^{a}

Values are presented as mean±SD. Values with different superscripts within the same row are statistically significantly different ($p<0.05$).

3.2 The contents of carnosine, anserine, and creatine in chicken essence

The contents of neurotransmitters in chicken essence extracted from chicken meat of 3 breeds which were Thai native chicken, broiler, and laying hen at 1.0, 1.5 and 2.0-hr extraction times are shown in Table 2. Overall, each neurotransmitter and total neurotransmitter extracted from Thai native chicken and laying hen meat at different extraction times were insignificantly different ($p<0.05$); nevertheless, only broiler meat placed at different times yielded different contents of neurotransmitters. At 1.5-hr extraction time, Thai native chicken meat gave the highest carnosine content (62.41±2.83 mg/100 g) while at 2.0-hr extraction time, the highest amounts of anserine and total neurotransmitter contents were 84.13±32.22 and 207.55±24.03 mg/100 g, respectively. However, the highest creatine content was achieved when 1.0-hr extraction time was applied to Thai native chicken meat. At 1.0-hr extraction time, the results report that broiler meat yielded the lowest carnosine, anserine, creatine, and total neurotransmitter contents and was significantly different from those incubated at 1.5 and 2.0-hr extraction time. On the other hand, carnosine, anserine, creatine, and total neurotransmitter contents in all

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Table 2. The contents of neurotransmitters in chicken essence extracted from 3 breeds (mg/100 g).

	Treatment	1.0 hr	1.5 hrs	2.0 hrs
Thai native chicken	Carnosine	52.44±26.33	62.41±2.83	53.70±5.68
	Anserine	42.22±2.17	48.84±2.02	84.13±32.22
	Creatine	71.77±2.81	59.88±2.25	69.71±5.00
	Total neurotransmitters	166.44±30.33	171.14±7.07	207.55±24.03
Broiler	Carnosine	13.08±0.61[c]	22.87±2.32[a]	15.97±0.84[b]
	Anserine	28.41±0.99[b]	47.10±3.87[a]	40.98±1.38[a]
	Creatine	18.88±0.44[c]	29.95±2.07[a]	23.93±1.19[b]
	Total neurotransmitters	60.38±2.03[c]	99.94±8.26[a]	80.89±3.38[b]
Laying hen	Carnosine	33.08±2.96	41.39±1.23	33.25±5.40
	Anserine	90.16±6.56	72.85±1.52	102.99±13.78
	Creatine	40.79±2.50	44.87±1.04	41.32±4.72
	Total neurotransmitters	164.04±12.0	159.11±3.79	177.57±23.90

Values are presented as mean±SD. Values with different superscripts within the same row are statistically significantly different ($p<0.05$).

chicken essence extracted from laying hen meat were insignificant differences. At 1.5-hr extraction time, laying hen meat provided the highest yield of carnosine and creatine which were 41.39±1.23 and 44.87±1.04 mg/100 g, respectively. At 2.0-hr extraction time, the highest amounts of anserine and total neurotransmitter originating from laying hen meat were 102.99±13.78 and, 177.57±23.90 mg/100 g, respectively. In agreement with the study of Wu and Shiau (2002) carnosine contents in 6 brands of commercial chicken essence sold in Taiwan were lower than anserine amounts; the ranges of carnosine and anserine were 8-162 and 36-437 mg/100 g, respectively. According to the report of Pereira-Lima *et al*. (2000) who studied beef broth prepared at different temperatures and different cooking times, the results demonstrate that increased anserine contents produced a greater increase in the intensity of beef broth flavor than increased carnosine content. Many previous studies show that carnosine contents depend upon poultry breed, sex and age (Intarapichet and Maikhunthod, 2005; Tian *et al*., 2007; Al-Nasser, 2007). Like carnosine, many factors result in the differences in creatine contents in chicken essence, such as breed, age, pieces of meat, muscle, and extraction conditions (temperature, time, method, feed, food additive, rate of food additive usage) (Elbir and Oz, 2020).

3.3 pH values of chicken essence

Table 3 represents the pH values of chicken essence extracted from Thai native chicken, broiler, and laying hen meat. The pH values of chicken essence extracted from Thai native chicken and broiler meat with different extraction times were significantly different as shown in Table 3 ($p<0.05$). The highest pH values of chicken essence extracted from Thai native chicken and broiler meat were observed at 1.0-hr extraction time; in other words, the pH values of the chicken essence reduced when extraction time increased. In contrast to chicken essence extracted from Thai native chicken and broiler meat, the pH values of chicken essence extracted from laying hen were insignificantly different ($p<0.05$). The pH values of chicken essence ranged between 5.95 to 6.30. In agreement with the study by Lekjing *et al*. (2021) who studied seabass (*Lates calcarifer*) fish essence soup, the duration of boiling did not affect the pH values of chicken essence extracted from laying hen meat.

Table 3. The pH values of chicken essence in this study.

Treatment	1.0 hr	1.5 hrs	2.0 hrs
Thai native chicken	6.17±0.02[a]	6.07±0.02[b]	5.95±0.02[c]
Broiler	6.28±0.03[a]	6.20±0.02[b]	6.20±0.01[b]
Laying hens	6.25±0.08	6.21±0.02	6.30±0.03

Values are presented as mean±SD. Values with different superscripts within the same row are statistically significantly different ($p<0.05$).

3.4 Color of chicken essence

The colors of chicken essence extracted from Thai native chicken, broiler and laying hen are shown in Table 4. Overall, the color of chicken essence significantly depended on extraction time as shown in Table 4 ($p<0.05$), and the highest a* values representing red color were chicken essence with 2.0-hr extraction time. Also, the highest b* values representing yellow color were chicken essence with 2.0-hr extraction time ($p<0.05$). As a result, when extraction increased, the color of chicken essence was more yellowish. In agreement with the results of Lin *et al*. (2016) who observed chicken essence extracted from Taiwanese native chicken meat, the a* and b* values increased when extraction increased. Compared to chicken essence

Table 4. The color of chicken essence extracted from Thai native chicken, broiler, and laying hen meat.

	Treatment	1.0 hr	1.5 hrs	2.0 hrs
Thai native chicken	L*	73.76±0.22[b]	75.22±0.26[a]	73.87±0.28[b]
	a*	8.45±0.24[a]	6.90±0.44[b]	8.94±0.55[a]
	b*	80.41±0.85[b]	77.36±0.77[c]	85.46±0.29[a]
Broiler	L*	79.83±0.36[a]	79.31±0.44[a]	78.38±0.55[b]
	a*	1.15±0.05[b]	1.52±0.25[b]	3.27±0.30[a]
	b*	64.42±0.33[b]	65.23±0.44[b]	69.93±.0.53[a]
Laying hen	L*	77.79±0.10[a]	76.29±0.48[b]	74.80±0.32[c]
	a*	3.37±0.08[b]	3.77±0.05[b]	8.21±0.32[a]
	b*	66.79±0.43[b]	64.74±0.30[c]	81.00±0.81[a]

Values are presented as mean±SD. Values with different superscripts within the same row are statistically significantly different ($p<0.05$).

extracted from broiler and laying hen meat. The color of chicken essence extracted from Thai native chicken meat was dark yellowish. The lightness of chicken essence extracted from broiler and laying hen meat significantly decreased ($p<0.05$). Consequently, chicken essence extracted from broiler meat was light and light yellow, while chicken essence extracted from laying hen meat was darker and yellower. According to Lekjing *et al*. (2021), when extraction time increased, the yellowness, and redness of sea bass essence increased due to the Maillard reaction. Maillard reaction releases sugar from meat when meat is heated (Li *et al*., 2020). Consequently, temperature and extraction time influence chicken essence.

3.5 Amino acid profiles of chicken essence extracted from three breeds

In this present study, 18 amino acids were analyzed as shown in Table 5. Most amino acids in chicken essence extracted from broiler meat were higher than those in chicken essence extracted from Thai native and laying hen meat The range of aspartic acid in chicken essence extracted from broiler meat was 150–214 mg/100 g, while aspartic acid in chicken essence ranged between 212–307 mg/100 g (Lin *et al*., 2016). In

Table 5. Amino acid profiles of chicken essence extracted from Thai native chicken, broiler, and laying hen meat (mg/100 g).

Treatment	Taste	Thai native			Broiler			Laying hen		
		1.0 hr	1.5 hrs	2.0 hrs	1.0 hr	1.5 hrs	2.0 hrs	1.0 hr	1.5 hrs	2.0 hrs
Aspartic acid	Sour, Umami	97.50	94.49	135.07	150.33	194.10	214.25	83.49	63.46	76.28
Glutamic acid		322.37	238.29	383.45	519.13	546.25	579.83	253.50	182.13	223.40
Total		419.87	332.78	518.52	669.46	740.35	794.08	336.99	245.59	299.68
Serine	Sweet	82.11	55.05	75.41	77.14	125.10	132.61	62.48	43.69	58.72
Threonine		49.50	46.71	63.71	60.14	98.57	105.13	39.77	34.79	35.63
Proline		64.42	82.06	79.05	155.03	125.25	164.51	85.26	97.59	109.44
Glycine		317.36	296.14	433.23	442.19	460.05	553.50	159.00	153.24	195.30
Alanine		152.25	137.15	207.42	238.50	253.21	286.19	95.46	77.29	95.21
Total		665.64	617.11	858.82	973.00	1062.18	1241.94	441.97	406.60	494.30
Arginine	Bitter	107.23	104.67	147.63	165.76	216.45	231.14	76.42	60.51	77.07
Tyrosine		20.57	13.96	18.04	30.76	48.48	46.92	19.95	12.43	15.72
Valine		44.51	40.42	54.90	87.49	88.39	85.81	34.62	38.15	33.13
Methionine		50.83	16.54	50.12	52.46	66.27	58.74	34.77	33.30	31.67
Cystine		84.39	177.46	337.72	347.29	335.54	408.63	113.91	116.67	130.65
Isoleucine		40.18	32.14	42.11	68.81	63.68	67.01	30.27	27.41	27.55
Phenylalanine		41.04	40.18	54.53	64.92	69.60	78.55	27.83	24.26	27.68
Tryptophan		1.66	1.85	1.88	4.61	4.82	5.25	1.86	1.71	1.56
Leucine		67.00	59.51	82.62	131.99	129.98	140.48	57.55	45.63	46.32
Lysine		82.62	78.77	92.23	191.67	197.18	209.33	77.45	64.55	63.26
Histidine		145.12	114.38	149.98	178.47	209.94	180.30	193.38	118.36	168.72
Total		685.15	679.88	1031.76	1324.23	1430.33	1512.16	668.01	542.98	623.33
Total amino acid		1770.66	1629.77	2409.10	2966.69	3232.86	3548.18	1446.97	1195.17	1417.31

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agreement with the results of Lin *et al*. (2016) glutamic acid, serine, threonine, tyrosine, isoleucine, and leucine amounts in chicken essence extracted from broiler meat were approximately 500, 100, 100, 30, 60 and 130 mg/100 g, respectively. Methionine contents in chicken essence extracted from laying hen meat were approximately 30 mg/100 g, in agreement with Lin *et al*. (2016). According to the report of Bellagamba *et al*. (2015) the results demonstrate that when the cooking temperature increased (<115°C) amino acids significantly increased. Similar to the study of Lin *et al*. (2016) total amino acids depended on cooking temperature and extraction time. However, when meat is heated for a long time to the point, which is called limit peptides, fiber muscle is unable to break. Since Thai native chicken meat not only has a unique flavor but also is firm a consumer favorite, and a healthy diet (Wattanachant *et al*., 2004) the price of Thai native chicken meat is 3-5 times more expensive (Jaturasitha *et al*., 2008). Commercial broilers are raised for a few weeks on farms, and the price of their meat is inexpensive. Since laying hens are old and retired chickens; accordingly, their meat is not good, and the price of their meat is quite low (Kaewkot *et al*., 2020). In contrast to chicken essence extracted from Thai native chicken meat and laying hen meat, the findings show that broiler meat yields the highest amino acids. Therefore, broiler meat may be a suitable source of chicken essence production. In other words, it negatively affects the absorption of peptides (Kaur *et al*., 2014). The results Pereira-Lima *et al*. (2000) demonstrate that extraction at 75°C for 2.0 hrs gave the highest content of neurotransmitters since they are dissolved and released by heating. In conclusion, heating affects the structure of the meat.

4. Conclusion

Extraction time significantly affected amounts of chicken essence. The 2.0-hrs extraction time provided the highest amounts of chicken essence. Amounts of each neurotransmitter and total neurotransmitters in chicken essence extracted from broiler meat significantly depended on extraction time ($p<0.05$) compared to those in chicken essence extracted from Thai native chicken and laying hen meat. The pH values of chicken essence extracted from Thai native chicken and broiler meat were significantly different ($p<0.05$) while the pH values of chicken essence extracted from laying hen meat were insignificantly different. According to the results of chicken essence extracted from Thai native chicken and broiler meat, the highest pH values were 1.0-hr extraction time. The lightness, redness, and yellowness of chicken essence significantly depended on extraction. Particularly, chicken meat with a 2.0-hr extraction time yielded the highest yellowness. Compared to chicken essence extracted from Thai native chicken and laying hen meat, most amino acids in chicken essence originated from broiler meat were higher.

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References

Al Saqqa, G.S. (2021). Some functional foods and benefits of their bioactive components. *Journal of the Saudi Society for Food and Nutrition*, 14(1), 1-11.

Al-Nasser, A., Al-Khalaifa, H., Al-Saffar, A., Khalil, F., Albahouh, M., Ragheb, G., Al-Haddad, A. and Mashaly, M. (2007). Overview of chicken taxonomy and domestication. *World's Poultry Science Journal*, 63(2), 285-300. https://doi.org/10.1017/S004393390700147X

Bellagamba, F., Caprino, F., Mentasti, T., Vasconi, M. and Moretti, V.M. (2015). The impact of processing on amino acid racemization and protein quality in processed animal proteins of poultry origin. *Italian Journal of Animal Science*, 14(2), 238-245. https://doi.org/10.4081/ijas.2015.3770

Benton, D. and Young, H.A. (2015). The effect of chicken essence on cognition and mood: A randomized controlled trial. *Current Topics in Nutraceuticals Research*, 13(2), 61-70.

Berkhout, N. (2022). Are we approaching peak poultry and meat consumption? Retrieved on April 21, 2023 from Poultry World Website: www.poultryworld.net/poultry/are-we-approaching-peak-poultry-and-meat-consumption/

Chan, L., Wang, H.M., Chen, K.Y., Lin, Y.C., Wu, P.J., Hsieh, W.L., Chen, Y.R., Liu, C.P., Tsai, H.Y., Chen, Y.R. and Chang, H.H. (2016). Effectiveness of essence of chicken in improving cognitive function in young people under work-related stress: A randomized double-blind trial. *Medicine*, 95(19), 3640. https://doi.org/10.1097/MD.0000000000003640

Dai, Z., Wu, Z., Jia, S. and Wu, G. (2014). Analysis of amino acid composition in proteins of animal tissues and foods as pre-column *o*-phthaldialdehyde derivatives by HPLC with fluorescence detection. *Journal of Chromatography B*, 964, 116-127. https://doi.org/10.1016/j.jchromb.2014.03.025

Dong, X.B., Li, X., Zhang, C.H., Wang, J.Z., Tang, C.H., Sun, H.M., Jia, W., Li, Y. and Chen, L.L. (2014).

Development of a novel method for hot-pressure extraction of protein from chicken bone and the effect of enzymatic hydrolysis on the extracts. *Food Chemistry*, 157, 339-346. https://doi.org/10.1016/j.foodchem.2014.02.043

Elbir, Z. and Oz, F. (2020). Determination of creatine, creatinine, free amino acid and heterocyclic aromatic amine contents of plain beef and chicken juices. *Journal of Food Science and Technology*, 58(9), 3293-3302. https://doi.org/10.1007/s13197-020-04875-8

Food and Agriculture Organization of the United Nations (FAO). (2023). Global Egg Production Continues to Grow. Retrieved on April 21, 2023 from FAO Website: www.internationalegg.com/resource/global-egg-production-continues-to-grow/

Geissler, C., Boroumand-Naini, M., Harada, M., Iino, T., Hirai, K., Suwa, Y., Tanaka, T. and Iwata, S. (1996). Chicken extract stimulates haemoglobin restoration in iron deficient rats. *International Journal of Food Sciences and Nutrition*, 47(4), 351-360. https://doi.org/10.3109/09637489609041035

Homjitr, S. (2015). Factors affecting brand loyalty of essence of chicken brand towards consumers in Bangkok. Bangkok, Thailand: University of the Thai Chamber of Commerce, MBA. Dissertation.

Intarapichet, K.O. and Maikhunthod, B. (2005). Genotype and gender differences in carnosine extracts and antioxidant activities of chicken breast and thigh meats. *Meat Science*, 71(4), 634-642. https://doi.org/10.1016/j.meatsci.2005.05.011

Jaturasitha, S., Chaiwang, N. and Kreuzer, M. (2016). Thai native chicken meat: An option to meet the demands for specific meat quality by certain groups of consumers; a review. *Animal Production Science*, 57(8), 1582-1587. https://doi.org/10.1071/AN15646

Jaturasitha, S., Kayan, A. and Wicke, M. (2008). Carcass and meat characteristics of male chickens between Thai indigenous compared with improved layer breeds and their crossbred. *Archives Animal Breeding*, 51(3), 283-294. https://doi.org/10.5194/aab-51-283-2008

Jung, S., Bae, Y.S., Kim, H.J., Jayasena, D.D., Lee, J.H., Park, H.B., Heo, K.N. and Jo, C. (2013). Carnosine, anserine, creatine, and inosine 5′-monophosphate contents in breast and thigh meats from 5 lines of Korean native chicken. *Poultry Science*, 92(12), 3275-3282. https://doi.org/10.3382/ps.2013-03441

Kaewkot, A., Pamornsuite, N., Kongkapan, N., Koomkrong, N. and Kayan, A. (2020). Comparison of carcass percentage cholesterol and collagen content in laying hen meat at 75 and 80 weeks of age. *Agricultural Science Journal*, 51(1), 56-66.

Kaur, L., Maudens, E., Haisman, D.R., Boland, M.J. and Singh, H. (2014). Microstructure and protein digestibility of beef: The effect of cooking conditions as used in stews and curries. *LWT-Food Science and Technology*, 55(2), 612-620. https://doi.org/10.1016/j.lwt.2013.09.023

Lawal, R.A., Martin, S.H., Vanmechelen, K., Vereijken, A., Silva, P., Al-Atiyat, R.M., Aljumaah, R.S., Mwacharo, J.M., Wu, D.D., Zhang, Y.P., Hocking, P.M., Smith J., Wragg, D. and Hanotte, O. (2020). The wild species genome ancestry of domestic chickens. *BMC Biology*, 18, 13. https://doi.org/10.1186/s12915-020-0738-1

Lekjing, S., Venkatachalam, K. and Wangbenmad, C. (2021). Biochemical evaluation of novel seabass (*Lates calcarifer*) fish essence soup prepared by prolonged boiling process. *Arabian Journal of Chemistry*, 14(10), 103365. https://doi.org/10.1016/j.arabjc.2021.103365

Li, Y., Fan, D., Zhao, Y. and Wang, M. (2020). Effects of quercetin and cinnamaldehyde on the nutrient release from beef into soup during stewing process. *LWT - Food Science and Technology*, 131, 109712. https://doi.org/10.1016/j.lwt.2020.109712

Li, Y.F., He, R.R., Tsoi, B. and Kurihara, H. (2012). Bioactivities of chicken essence. *Journal of Food Science*, 77(4), 105-110. https://doi.org/10.1111/j.1750-3841.2012.02625.x

Lin, Y.C., Chen, C.F. and Tan, F.J. (2016). Influences of different heating conditions on the quality of native chicken essence, presented at 62nd International Congress of Meat Science and Technology, 14-19th August 2016. Bangkok, Thailand.

Nopchinda, S. (2016). Review Studies of Essence of Chicken for Health. *Journal of The Royal Thai Army Nurses,* 16(3), 132-137.

Pereira-Lima, C.I., Ordoñez, J.A., García de Fernando, G.D. and Cambero, M.I. (2000). Influence of heat treatment on carnosine, anserine and free amino acid composition of beef broth and its role in flavor development. *European Food Research and Technology*, 210(3), 165-172. https://doi.org/10.1007/PL00005506

Schmid, A. (2009). Bioactive substances in meat and meat products. *Fleischwirtschaft*, 89(7), 83-90

Tian, Y., Xie, M., Wang, W., Wu, H., Fu, Z. and Lin, L. (2007). Determination of carnosine in Black-Bone Silky Fowl (*Gallus gallus domesticus* Brisson) and common chicken by HPLC. *European Food*

RESEARCH PAPER

Research and Technology, *226, 311-314*. https://doi.org/10.1007/s00217-006-0528-1

The R Foundation (2022). The R Project for Statistical Computing. A language and environment for statistical computing. Retrieved on August 19, 2022 from The R Foundation Website: https://www.r-project.org/

Wattanachant, S., Benjakul, S. and Ledward, D.A. (2004). Composition, color, and texture of Thai indigenous and broiler chicken muscles. *Poultry Science*, 83(1), 123-128. https://doi.org/10.1093/ps/83.1.123

Wu, H.C. and Shiau, C.Y. (2002). Proximate composition, free amino acids and peptides contents in commercial chicken and other meat essences. *Journal of Food and Drug Analysis*, 10(3), https://doi.org/10.38212/2224-6614.2753

Yasuo, M., Satomi, K., Hiroyuki, O., Yoshinobu, K. and Takaharu, T. (2002). Preventive effect of a chicken extract on the development of hypertension in stroke -prone spontaneously hypertensive rats. *Bioscience, Biotechnology and Biochemistry*, 66(5), 1108-1110.

Zain, A.M. and Syedsahiljamalulail, S. (2003). Effect of taking chicken essence on stress and cognition of human volunteers. *Malaysian Journal of Nutrition*, 9 (1), 19-29.

