

PURINES AND MEAT QUALITY OF CHICKEN MEAT FROM VARIOUS BREEDS

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Abstract –This research was aimed at investigating the effect of breeds on chicken meat quality and purine content. Breast and thigh samples of commercial broilers (BR) aged 5 weeks with BW of 1.55 kg crossbreed Korat chickens (KC) aged 10 weeks and 1.33 kg of BW and Thai native chicken, Pradoo-Hangdum (PH) aged 16 weeks and averaged BW of 1.33 kg were collected. They were slaughtered in the same manner. Breast and thigh samples were collected. Proximate composition (moisture, crude protein and crude fat) of breast and thigh samples were analyzed. Purine composition was quantified using High Performance Liquid Chromatography (HPLC). The pH values, Meat colour The Warner–Bratzler shear force and Water holding capacity were analyzed.

The KC breast showed the highest protein content ($P<0.05$), while protein of thigh meat was comparable among 3 breeds ($P>0.05$). Breast and thigh of KC and PH contained lower fat content than those of the commercial broiler. Meat from BR showed the lowest shear force ($P<0.05$). Water holding capacity was comparable among breeds. KC meat showed the highest lightness ($P<0.05$). Redness and yellowness of KC meat was the highest in both breast and ($P<0.05$). pH were comparable among 3 breeds ($P>0.05$). The analyzed purines included guanine, hypoxanthine, adenine, and xanthine with hypoxanthine being the predominant purine found in both muscle. Breast and thigh of PH contained the lowest total purine content ($P<0.05$), while that of KC and BR was comparable ($P>0.05$).

Key Words – Purine composition, broiler, Korat chickens, Pradoo-Hangdum native chicken

I. INTRODUCTION

Purines are heterocyclic aromatic organic compounds. They are essential for production of DNA and RNA and serve as a form of energy for cells, proteins, starch, regulations of enzymes, cell signaling (Guyton, 2006). Human body can synthesize purines and obtain purines from food (Guyton, 2006). Uric acid is a product of the

metabolic breakdown of purine nucleotides (Cappuccio et al., 1993). Accumulation of uric in a joint or surrounding tissue, causing pain, inflammation and swelling, known as gout symptom. Chicken meat is known to contain high amount of purines (Choi et al., 2005).

Besides commercial broiler (BR), Korat chickens (KC), and Pradoo-Hangdum (PH), native and crossbred chicken have been consumed in Thailand and Asian countries. PH a native breed, rearing in the rural environment, slow growth rate makes the quality meat. The meat taste and meat tenderness better than BR. KC a cross between Thai indigenous chicken Leunghangkhaio and BR, is a fast growing breed with chewier texture. As production of these 2 breeds are growing, scientific information regarding meat quality and purine content is still limited. This information is not only vital for meat quality control and processing but also for consumer awareness and perception of KC and PH, The objective of this study was to investigate meat quality and purine content of three chicken breeds, namely BR, KC, and PH.

II. MATERIALS AND METHODS

Sample collection - Breast and thigh meat were collected from commercial broilers (BR) aged 5 weeks with an average BW of 1.55 kg, Korat crossbred chickens (KC) aged 12 weeks and averaged BW of 1.53 kg, Thai native chicken, Pradoo-Hangdum (PH) aged 16 weeks and averaged BW of 1.51 kg. All birds were raised in the intensive system. They were slaughtered in a commercial slaughter house with the same manner. Breast and thigh samples were collected from 3 birds/group in 2 replication. Samples were ground and kept at -20°C .

Proximate composition analysis - Breast and thigh meat of all breeds were analyzed for

moisture, dry matter, crude protein, fat, and ash according to AOAC (1996).

Meat characteristics - The pH values were obtained 45 minute (pH45) and 24 h (pH24) after slaughter using SevenGo™ pH meter SG2 (Mettler Toledo, China). Meat colour (lightness (L^*), redness (a^*), yellowness (b^*)) was measured at three spots 1 h after slaughter using a chroma meter (Konica Minolta CR-410). The Warner–Bratzler shear force described by Laville (2007). Instrumental tenderness was measured on Pectoralis major (chicken fillet) using Instron texture analyzer (model 5565). Water holding capacity according to Committee on Codex Specification (1981)

Determination of purine - Samples were analyzed followed by Kaneko et al., (2009). Samples (0.5 g) were added 5 ml of 70% perchloric acid (HClO_4) and 5 ml of deionized water (DI water), incubated at 95 °C for 1 h, cooled in ice until temperature reached ambient. Subsequently, pH was adjusted to 7.0 with 30% potassium hydroxide (KOH). The solutions were centrifuged at 3,500g for 15 minute at 4 °C. Supernatants were filtered to 0.45-µm RC filters and used for the determination of purine by High Performance Liquid Chromatography (HPLC) (HP 1260, Agilent Technologies, USA) equipped with column Shodex Asahipak GS-320 HQ (3 µm 150x4.6 mm) Thermo Scientific, USA). The mobile phase was 150 mM sodium dihydrogen phosphate (NaH_2PO_4). The temperature of column was set at 25 °C, flow rate was 0.5 ml/min. Ten µl of samples were injected. The quantity of purine was measured at 254 nm. External standards were guanine, hypoxanthine, adenine and xanthine. Statistical analyses were carried out by SAS (SAS, 2001)

III. RESULTS AND DISCUSSION

KC breast showed the highest crude protein ($P<0.05$) (Table 1) but no differences were found in thigh meat among 3 breeds ($P>0.05$). Pongduang et al. (2013) reported that crude protein of BR breast was lower than crossbreed chicken breast ($P<0.05$) but no difference in pure breed native chicken ($P>0.05$). Jaturasitha et al. (2008b) reported that crude protein in breast of male and female Thai native chickens ranged 23-

24% and 21-22% in thigh meat. Damsawang et al. (2010) also reported that crude protein in breast meat of BR had an averaged 22.17%.

Table 1 Mean of proximate composition (%wet basis) in chickens breast (Br) and thigh (Th) of 3 different breeds.

	Sample	Broiler	Korat	Pradoo
Crude protein	Br	21.8±1.38 ^b	23.0±0.82 ^a	21.4±1.15 ^b
	Th	20.9±1.44	20.2±1.03	20.8±0.58
Crude fat	Br	1.6±0.03 ^a	1.4±0.05 ^b	1.1±0.04 ^c
	Th	2.0±0.06 ^a	1.2±0.06 ^b	1.3±0.04 ^b
Moisture	Br	75.1±0.46	74.1±0.96	74.6±1.72
	Th	75.9±0.33	76.3±0.85	75.2±0.87
Ash	Br	0.95±0.02 ^b	1.01±0.03 ^b	1.20±0.06 ^a
	Th	0.97±0.02 ^b	1.31±0.05 ^a	1.35±0.05 ^a

Means with different superscript within a row are different at $P<0.05$

Breast and thigh of BR showed the highest crude fat ($P<0.05$, Table 1). Total fat in breast was lower than thigh in all breeds because glycogen was the main energy source for breast, while fat served as the energy source for thigh (Fernandez et al., 2001). Wattanachant et al. (2008) reported that breast and thigh meat of PH contained lower crude fat content than BR. Somchan et al. (2014) reported that crude fat in breast meat of BR were higher than Chee native chickens (total fat was 0.692 and 0.248 percentage, respectively) ($P<0.05$).

Moisture content of breast and thigh among 3 breeds was comparable ($P>0.05$). Ash content of PH breast and thigh was the highest ($P<0.05$, Table 1). PH contained the highest inorganic matters in the muscle. Okarini et al. 2013. reported that Bali indigenous chicken aged 16 - 20 weeks had moisture content of 72.14%, crude protein of 22.32%, crude fat of 1.73% and ash content of 1.39%.

Water holding capacity (WHC) and meat pH were comparable among 3 breeds ($P>0.05$, Table 2). Guan et al. (2013) reported that Ninghai chicken (NC), one of the indigenous chicken in China, aged 16 weeks, had pH of 5.49 and, WBSF of 6.98 kg. Wattanachant (2008) reported that pH of native chicken meat was lower than BR ($P<0.05$).

Warner-Bratzler shear force (WBSF) of KC breast was the highest ($P<0.05$), while that thigh of BR was the lowest ($P<0.05$). Pongduang et al. (2013)

reported that WBSF of KC and PH meat (breast and thigh) was higher than BR ($P<0.05$). Higher collagen in native chickens could contribute to its high WBSF (Wattanachant, 2008).

KC breast and thigh showed the highest lightness, L^* ($P<0.05$, Table 2). Redness (a^*) of PH breast was the highest ($P<0.05$), corresponding to the highest ash content. It was presumed that PH could contain the highest myoglobin with Fe in the muscle. Chauyuchuwong (1993) reported that as animals grow older, they accumulated more myoglobin and hemoglobin in muscle, leading to higher redness (a^*). This was in agreement with this study which of the age of PH was the oldest.

Table 2 Meat characteristics of breast (Br) and thigh (Th) of 3 different breeds.

	Sample	Broiler	Korat	Pradoo
Water holding capacity (%)	Br	62.8±1.2	59.2±2.7	60.9±2.3
	Th	68.5±5.1	64.8±3.6	67.8±3.0
Warner-Bratzler shear force (WBSF) (kg)	Br	2.3±0.2 ^c	2.8±0.2 ^a	2.7±0.2 ^b
	Th	2.9±0.2 ^b	3.0±0.1 ^{ab}	3.1±0.1 ^a
Meat pH				
pH ₄₅	Br	6.1±0.2	6.0±0.1	5.9±0.28
	Th	6.1±0.2	6.0±0.1	6.1±0.22
pH ₂₄	Br	6.0±0.2	5.9±0.1	5.8±0.17
	Th	6.0±0.1	5.9±0.1	5.9±0.20
Meat color				
Lightness (L^*)	Br	58.6±0.8 ^b	61.4±1.3 ^a	58.6±1.6 ^b
	Th	53.8±0.7 ^b	57.9±1.0 ^a	53.9±1.6 ^b
Redness (a^*)	Br	2.1±0.1 ^b	1.6±0.1 ^c	2.3±0.1 ^a
	Th	9.5±0.6 ^a	8.2±0.1 ^b	9.9±0.6 ^a
Yellowness (b^*)	Br	5.6±0.4 ^a	4.0±0.2 ^c	4.5±0.3 ^b
	Th	4.2±0.3 ^a	3.1±0.2 ^b	4.2±0.3 ^a

Means with different superscript within a row are different at $P<0.05$

Total purine content of breast and thigh of BR and KC were higher than PH ($P<0.05$, Table 3). Total purine content in breast was higher than thigh in all chicken groups. Pongjanla et al. (2014) reported

that there was no difference in total purine content between BR and KC ($p>0.05$).

Table 3 Purine content (mg/100g) of chickens breast (Br) and thigh (Th) of 3 different chicken breeds.

Purine (mg/100g)	Sample	Broiler	Korat	Pradoo
Adenine	Br	33.6±1.6 ^a	33.4±2.0 ^a	27.4±1.3 ^b
	Th	27.8±2.7 ^b	33.1±4.2 ^a	28.3±2.1 ^b
Guanine	Br	35.1±1.8 ^a	42.9±3.4 ^a	21.7±10.2 ^b
	Th	29.4±2.5 ^b	45.8±7.4 ^a	18.3±3.1 ^c
Hypoxanthine	Br	124.9±10.2 ^a	103.8±22.8 ^b	89.5±19.8 ^c
	Th	91.2±12.6 ^a	87.8±22.6 ^a	69.3±2.6 ^b
Xanthine	Br	3.1±0.3 ^{bc}	1.3±1.9 ^c	4.0±1.1 ^{ab}
	Th	5.7±1.8 ^a	3.1±2.1 ^b	6.7±3.3 ^a
Total	Br	196.6±11.9 ^a	181.3±20.5 ^a	142.6±27.5 ^b
	Th	154.1±7.7 ^a	169.8±17.9 ^a	122.7±4.0 ^b

Means with different superscript within a row are different at $P<0.05$

Purine content was typically associated with muscle with high protein content (Choi et al., 2005). Koulouris (2015) reported that BR breast showed total purine content of was 175 mg/100 g and that of thigh meat was 110 mg/100 g. In growing chickens (aged 3-6 weeks), they were received high protein diet (19% crude protein) compared to 15% crude protein of PH aged 16 weeks. High protein intake of BR could contributed to high total purine in BR muscle. Eldaghayes et al. (2010) reported that Gout in growing layers was attributed to high concentration of crude protein and calcium in diet (23.47% crude protein and 3.5% calcium).

Hypoxanthine was the major purine in all samples. BR showed the highest hypoxanthine in meat because pH₂₄ of BR meat was higher than KC and PH. The rate of hypoxanthine production increased with increasing pH in pork (Tikk et al.; 2006) and in beef (Lee and Webster, 1963)

IV. CONCLUSION

Chicken breeds appeared to affect quality and chemical composition of breast and thigh. KC breast had the highest crude protein. KC and PH meat (breast and thigh) had the lowest crude fat. BR breast and thigh showed the lowest WBSF, implying the soft texture. KC breast and thigh exhibited the highest L^* . The a^* value of PH

breast was the highest, implying high myoglobin and hemoglobin in meat. PH breast and thigh contained the lowest purine content.

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