Performance, Carcass, Meat and Fat Characteristics of Thai Native Chicken and Broiler

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Abstract : A study of productive performance and carcass quality of Thai Native chicken (N) and Abor Acres broiler (B) was conducted using the completely random design (CRD), furthermore the meat and fat quality was designed in 2x2 factorial in CRD (2 breeds and 2 muscle; breast and thigh). The native chickens were fed *ad libitum* with commercial layer diet and the broiler a commercial broiler diet. All chickens were slaughtered at market size, the slaughtered weights of N and B were around 1.2 and 1.9 kg respectively. Carcass, meat and fat quality of the two different chicken breeds were investigated. The results showed that body weight at 0 - 6 weeks, average daily gain and feed intake at 0–2, 2–4 and 4–6 weeks of N were less than those of B ($p<0.01$). Furthermore, feed conversion ratio at 0 – 2 and 2 – 4 weeks of N were higher than B ($p<0.01$) but there was no significant difference at 4 – 6 weeks. The mortality rate of B was higher than N ($p<0.05$) at 0 – 2 and at 2 – 4 weeks however, at 4 – 6 weeks there was no significant difference. The feed cost per kg gain of N was higher than B ($p<0.01$). Among carcass characteristics the dressing percentage of N was less than B ($p<0.05$) in contrast, the percentages of retail cuts in terms of thigh and *Pectoralis minor* of N were higher compared to B ($p<0.05$) as well as wing ($p<0.01$) and drumstick ($p<0.05$). There was quite similar percentages of internal and external organ. The results of breeds and muscle types had affected on conductivity value and meat color ($p<0.01$). But no effect for pH value, nutritive value and water holding capacity ($p>0.05$) was found. The results of fat quality found that breeds and muscle types had affected on total saturated fatty acid, monounsaturated fatty acid, total unsaturated fatty acid and technological property in term of unsaturated to saturated fatty acids ratio ($p<0.01$).

Key words: Performance, Carcass, Meat, Fat, Native Thai Chicken and Broiler

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Introduction

Broiler industry in Thailand is well developed and the country can export the products to European Union and Japan markets generating foreign earning much more than any other livestock industries (Jaturasitha, 2000). The main reasons for this industry success in satisfying overseas consumers are proper breed, nutrition and management. In Thailand, however, certain consumers have the acquired taste of native chicken which are now still having a small market but with a quite rapidly growing popularity. The Thai native chicken has the traits to be fighting cock including strong and tough muscles, the characteristics regarded as quality when compared to over-tenderness of broiler meat. It is also an alternative for consumers preferring low fat and antibiotic-free white meat. With the presently growing demand and relatively high price in market of Thai native chicken, this bird's characteristic traits deserve a through study for all fundamental data and information to assure the opportunity for production in commercial and industrial scale.

Traditionally, Thai native chicken which is raised by small farmer with low efficiency in growth. The poor performance is attributable to the lack of proper feed, management, sanitation program and crucially, breed as farmers generally simply raise them in free range with any feed at hand and without breed selection leading to inbreeding situation. It is conceptualized that changes in certain farming practice can lead to improved efficiency of Thai native chicken raising. The objective of the present study is therefore to compare the productive performance, carcass and meat quality of Thai native chicken (N) and broiler (B) when the animals are raised in the same husbandry methods.

Materials and Methods

Each two hundred one-day old bird of Thai Native (N) and Broiler (B) was arranged in CRD experiment, with 4 replications of 50 birds. The birds were raised under the same condition. They were fed *ad libitum* with commercial layer diet for N and commercial broiler diet for B according to Punja (1999):

N : 0-6 weeks commercial layer diet with protein 19%, energy 2,900 Kcal/kg
: 7-12 weeks commercial layer diet with protein 15%, energy 2,900 Kcal/kg
B : 0-3 weeks broiler diet with protein 21%, energy 3,150 Kcal/kg
: 4-6 weeks broiler diet with protein 19%, energy 3,150 Kcal/kg

All chickens were slaughtered at market size when the slaughtered weights of N and B were ca. 1.2 and 1.9 kg, respectively. Meat quality was evaluated 45 minutes post mortem with pH meter (Model 191, Knick, D-Berlin) according to Jaturasitha (2000). After chilling at 4 °C for 24 hours, the right side was dissected to study carcass quality in terms of retail cuts percentage (Jaturasitha, 1991). The *pectoralis major (p. major*, breast) and *Rectus femoris* (thigh) of the left side was investigated for the following meat quality traits as nutritive value (AOAC, 1995), meat color, water holding capacity, and shear force value according to Jaturasitha (2000). For fatty acid profile was analyzed by the method of Folch *et al*. (1957).

All data of productive performance, carcass and meat quality traits were statistically analyzed by Students' t-test (Chantalackhana, 1997). The test on differences means was performed by Duncan's new Multiple Range Test through SAS program for Windows (SAS, 1990).

Results and Discussion

Productive performance

In this study, the average climate temperature was 25 °C (Max 32, min 18 °C). The results of productive performance were provided in Table 1. Productive performance in terms of body weight gain, ADG and FCR of N was inferior to the case of B. This can be explained by the generally presumption that the birth weight of bird is ca. 60% of egg weight (Artamangkul, 2001) and N egg is about 50 g and B 80 g. The breed continued to influence on growth rate particularly N has limitation in feed utilization (Punja, 1999; Thammabut and Choprakarn, 1982) and hence FCR and ADG of B were better in comparison to N (Leotaragul *et al*., 1997; Theeraphanthuwat *et al*., 1988). In contrast, the mortality rate of N was lower than B at 0-2 wks (0 vs 1.5%, $p<0.05$) and at 3-4 wks (1 vs 7.16%, $p<0.01$). Ensminger (1992) reported that the mortality rate of chicks was high at the first 3 weeks and will be 1% per month. This study result revealed that N was a good survivor and could adapt well to the environment. Another advantage of N was therefor the attractive economic return as the investment loss from bird death was very trivial.

Carcass traits

The slaughtered weight of N was lower than that of B (1,200 vs 1,967 kg, $p<0.01$). This market size can explained by the preference of consumers to have N at small size as bigger size would be less popular for old age and toughness (Intarachot *et al*, 1997). The carcass percentage was not significantly different (64.54 vs 65.64% for N and B). The percentages of retail cuts (table 2) in terms of P. *minor*, thigh and drumstick of N were heavier than those of B (5.10 vs 4.52, 16.04 vs 15.02, 16.33 vs 14.41%, respectively, $p<0.05$) and wing percentages of N was even heavier (14.64 vs 12.21%, $p<0.01$). These results was consistent with the reports of Laopaibul *et al*. (1983), Theeraphanthuwat *et al*. (1988) for Thai native chickens and Brake et al. (1993) for broiler. The bone percentage of N was lighter than B (31.08 vs 34.08, $p<0.05$). The advantage of retail cuts of Thai native chickens is due to less fat and lighter bone percentages (Intarachot *et al*, 1996).

The external and internal organ of N and B were quite similar, and in agreement with the findings of Laopaibul *et al*. (1983) and Theeraphanthuwat *et al*. (1988).

Meat characteristics

Meat traits were shown in Table 4. The pH of P. *major* muscle was not statistically different between the two groups, and this result is similar to the findings of Allen *et al.* (1998); Xlong *et al.* (1993) and Lyon *et al.* (1991). However, pH level of N tended to be lower than that of B. This can be due to the more aggressive behavior of N which leads to great intensity of stress which in turn draws more glycogen into use. This consequently affects greatly the post mortem glycolysis process leading to a high lactic acid accumulation and hence low pH value in meat (Jaturasitha, 2000).

L* value of B was brighter than that of N (61.21 vs 55.36, $p<0.01$). N had lower b* value than B (8.70 vs 10.98; $p<0.05$) but its a* value was not statistically different. It could be stated that the color of N was darker and more yellow than B. This can be described that meat color is the content of myoglobin that increases with age (Jaturasitha, 2000 and Forrest *et al.,* 1975) and breed (Fletcher, 1999) and hence makes it darker.

There was no difference in drip and thawing loss percentage between the two groups studied but cooking loss percentage of N was lower than that of B (20.14 vs 23.63; $p<0.05$). This is an advantge of N in satisfying customer preference. WHC occurred as a result of the reduction of pH value down to near iso-electric point impairing the protein and water molecularly holding capacity in meat (Forrest *et al.,* 1975). When meat is cooked, the meat protein will be denatured such that the protein looses water dissolving capacity and gives risk to coagulation of protein molecule (Jaturasitha, 1991). These results were supported by the finding of Allen *et al.* (1998).

The shear force values in terms of energy (N), extension (j) and distance (mm) of N were higher than in the case of B (31.75 vs 13.10, 0.26 vs 0.12 and 69.40 vs 72.35, respectively; $p<0.01$). These results indicated that N meat was tougher than B meat because of older N at market size (Jaturasitha, 2000). B can be raised for 6 weeks but N takes12 weeks to be slaughtered.

Nutritive values in terms of moisture, protein and fat percentages were not statistically significantly different between the two groups while N fat tended to be lower than B (0.12 vs 0.34%, respectively). Xlong *et al.* (1993) reported that breeds affected chemical composition of chicken meat and in this study of B, chemical composition was also related to breed.

Fatty acid profiles

The total percentage of saturated fatty acid of N's breast was more than B's ($p<0.01$), but the thigh muscle of B had saturated fatty acid higher than N ($p<0.01$). In contrast of the result of total unsaturated fatty acid. Furthermore, the ratio of unsaturated and saturated fatty acid in thigh muscle of N was better than B but less favourable in breast muscle. This can be the influence of breeds and muscle types and also the effect of feed (Jaturasitha, 2000)

Conclusion

From this study, N has an advantage in terms of carcass composition and the meat quality traits such as high WHC, firm meat texture and high protein as well as low fat. It can be the alternative health meat. For productive performance N is still inferior to B. Crossbreeding is therefor seen as one of the promising ways to improve productive performance and commercial potential of Thai native chicken and subjects for further experimentation.

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Table 1: Productive performance of Thai native and broiler Chickens

	N	B
No. of animals	200	200
Body weight, at		
0 wk	30.91[b]	44.70[a]
2 wks	90.83[b]	410.88[a]
4 wks	213.27[b]	1,186.39[a]
6 wks	435.48[b]	1,997.00[a]
8 wks	652.05	-
10 wks	866.20	-
12 wks	1156.05	-
Average daily gain, g/day		
0-2 wks	4.24[b]	26.15[a]
2-4 wks	7.32[b]	55.39[a]
4-6 wks	15.87[b]	57.90[a]
6-8 wks	15.46	-
8-10 wks	15.29	-
10-12 wks	16.56	-
ADG	**13.39[b]**	**46.47[a]**
Feed intake, g		
0-2 wks	21.84[b]	39.01[a]
2-4 wks	26.45[b]	90.42[a]
4-6 wks	33.00[b]	123.79[a]
6-8 wks	49.76	-
8-10 wks	58.92	-
10-12 wks	67.78	-
FI (g/day)	**41.64[b]**	**84.40[a]**
Feed conversion ratio (FCR)		
0-2 wks	5.20[a]	1.49[b]
2-4 wks	3.03[a]	1.62[b]
4-6 wks	2.09	2.14
6-8 wks	3.24	-
8-10 wks	3.89	-
10-12 wks	4.66	-
FCR	**3.11[a]**	**1.75[b]**
Mortality rate, %		
0-2 wks	0.00[y]	1.50[x]
2-4 wks	1.00[b]	7.16[a]
4-6 wks	1.00	3.69
6-8 wks	1.00	-
8-10 wks	0.00	-
10-12 wks	0.00	-
Mortality rate, %	**3.00[b]**	**12.35[b]**
Cost per head		
Cost per gain / head	**25.38[a]**	**16.69[b]**
Bird	10.00	10.00
Feed	30.99[b]	33.24[a]
Total	40.99[b]	43.24[a]
Price, Baht/kg	50.00	25.00
Benefit Baht/hd	16.80[a]	6.68[b]

[a, b] Different superscripts indicate means within the rows that are significantly different ($p<0.01$) but x,y are significantly different ($p<0.05$)

N = Native Chickens

B = Broiler

Table 2: The carcass quality of Thai native chickens and broiler

	N	B
No. of animals	64	100
Live weight, g	1,200.35^{a}	1,966.75^{b}
Dressing percentage, %	64.54	65.64
Retail cuts		
Pectoralis major, %	14.62	15.88
Pectoralis minor, %	5.10^{x}	4.52^{y}
Thigh, %	16.04^{x}	15.02^{y}
Wing, %	14.64^{a}	12.21^{b}
Drumstick, %	16.33^{x}	14.41^{y}
Bone, %	31.08^{x}	34.08^{y}

[a, b] Different superscripts indicate means within the rows that are significantly different ($p<0.01$) but x,y are significantly different ($p<0.05$)

N = Native Chickens

B = Broiler

Table 3: The meat quality of breast and thigh muscle of native and broiler chickens

Criteria	N		B		Interaction		
	Breast	**Thigh**	**Breast**	**Thigh**	**Breed**	**Muscle**	**A*B**
pH – value	5.64^{b}	6.05^{y}	5.89^{a}	6.45^{x}	0.0006**	0.0001**	0.33
Conductivity - value	5.52^{x}	1.55	1.25^{y}	1.78	0.0002**	0.0009**	0.0001**
Color							
L	55.36^{y}	49.66^{y}	61.21^{x}	55.65^{x}	0.0001**	0.0001**	0.90
a*	3.08	12.44^{x}	2.18	2.35^{y}	0.0001**	0.0001**	0.0001**
b*	8.70^{b}	5.68	10.98^{a}	7.89^{a}	0.001**	0.0001**	0.94
Nutritive value, %							
Protein	24.18	20.30	23.09	19.82	0.0001**	0.07	0.47
Fat	0.12	1.01^{b}	0.34	1.98^{a}	0.0001**	0.007**	0.06
Moisture	69.40	71.30	72.35	70.46	0.91	0.45	0.11
Water holding capacity,%							
Drip loss	2.77	2.89	4.02	2.93	0.14	0.26	0.17
Thawing loss	3.06	3.22	3.79	3.70	0.89	0.68	0.74
Cooking loss	20.15^{b}	16.62	23.63^{a}	20.71	0.057	0.09	0.86

[a, b,] Different superscripts indicate means within the rows that are significantly different ($p<0.05$). But [x, y] are highly significant different ($p<0.01$)

** highly significant different ($p<0.01$)

N = Native chickens

B = Broiler chickens

L = lightness; 100 = white, 0 = black

a* = redness; green = -80, red = 100

b* = yellowness; blue = -50, yellow = 70

Table 4: Effect of breeds on fat quality of breast and thigh muscle chickens

Criteria	N		B		Interaction		
	Breast	**Thigh**	**Breast**	**Thigh**	**Breed**	**Muscle**	**A*B**
Free fatty acid, %	**100**	**100**	**100**	**100**			
Palmitic (C16:0)	24.93	23.58 ^{y}	20.63	46.30 ^{x}	0.051	0.012	0.003**
Stearic (C18:0)	13.85 ^{x}	6.70	3.92 ^{y}	9.43	0.10	0.68	0.012*
Arachidic (C20:0)	3.98	2.72	2.08	2.20	0.07	0.35	0.27
Total saturated fatty acid, % of total analyzed fatty acid	**40.76** ^{x}	**31.34** ^{y}	**25.66** ^{y}	**55.58** ^{x}	**0.28**	**0.02***	**0.0004****
mono unsaturated fatty acid, %							
Oleic (C18:1)	37.77 ^{y}	47.23 ^{x}	54.74 ^{x}	19.15 ^{y}	0.56	0.05*	0.001**
Poly unsaturated fatty acid, %							
Linoleic (C18:2)	20.59	20.96	19.10	28.91	0.29	0.11	0.13
Linolenic (C18:3)	1.08 ^{x}	0.43 ^{b}	0.45 ^{y}	1.11 ^{a}	0.58	0.72	0.0005**
Total unsaturated fatty acid, % of total analyzed fatty acid	**59.20** ^{y}	**68.64** ^{x}	**74.30** ^{x}	**44.40** ^{y}	**0.28**	**0.02***	**0.0004****
Technological property							
FAR [1]	1.54	2.25 ^{x}	3.08	0.82 ^{y}	0.89	0.053	0.001**
C18:0 / C18:2	0.76 ^{a}	0.31	0.42	0.35	0.001**	0.02*	0.0008**
P/S ratio[2]	0.55	0.69	0.79	0.54	0.70	0.59	0.09
Adjust P/S ratio[3]	0.73	0.82	0.87	0.63	0.82	0.52	0.18
DBI[4]	79.97 ^{y}	88.82 ^{a}	92.79 ^{x}	72.68 ^{b}	0.388	0.27	0.22

$^{a,\ b,}$ Different superscripts indicate means within the rows that are significantly different ($p<0.05$). But $^{x,\ y}$ are highly significant different ($p<0.01$)

* significant different ($p<0.05$)

** highly significant different ($p<0.01$)

N = Native chickens

B = Broiler chickens

[1] = Ratio of unsaturated to saturated fatty acids

[2] = Polyenic acid to saturated acids

[3] = Ratio calculate / without considering stearic

[4] = Double bonds index = double bonds per 100 fatty acids