Advances in Bioresearch
Adv. Biores., Vol 8 (6) November 2017: 34-42
©2017 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.8.6.3442

Advances in Bioresearch

ORIGINAL ARTICLE

Evaluation of carcass characteristics and meat quality of Hansli, CSML and Hansli×CSML cross under intensive system of management

[1]Rajani Ekka, [1]Nrusingha Charan Behura, [1]Lipismita Samal, [2] Gangadhar Naik, [3]Prasad Kumar Pati and [1]Prasanna Kumar Mishra
[1]Post Graduate Department of Poultry Science, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India
[2]Department of Animal Breeding and Genetics, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India
[3]Department of Livestock Products Technology, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

ABSTRACT
This study was conducted to investigate the influence of genotype on carcass characteristics and meat chemical composition traits of one native (Hansli), one improved (CSML - coloured synthetic male line) and their cross (Hansli×CSML) chickens. The dressing % of Hansli (78.66) and Hansli×CSML (75.94) was comparable to each other whereas that of CSML (86.9) was significantly higher (P=0.029) than that of Hansli and Hansli×CSML. The drumstick, thigh, breast and neck percentages were similar among birds of all genotypes. The drumstick % ranged from 14.20-17.58 % and the thigh % ranged from 15.11-16.64 % of the dressed weight. The breast % varied from 22.93-25.63% whereas neck % varied from 5.68-6.19 % of the dressed weight. Highest wing % was observed in Hansli (15.93) followed by Hansli×CSML (14.34) and CSML (12.41). The back % was higher (P=0.002) in native Hansli (21.06) than that of CSML (18.57) and Hansli×CSML (18.66). Highest crude protein content was observed in thigh meat of Hansli (76.35%) followed by Hansli×CSML (70.78%) and CSML (54.03%) chickens. A reverse trend was observed for crude fat content. Highest crude fat content in thigh meat was observed in CSML (40.29%) followed by Hansli×CSML (21.16%) and Hansli (13.62%). The crude protein content was highest in breast meat of Hansli (86.92%) followed by Hansli×CSML (86.30%) and CSML (82.32%). However, the crude fat content was highest in breast meat of CSML (7.67%) followed by Hansli×CSML (4.47%) and Hansli (2.52%). There was high content of crude protein and low content of crude fat in breast meat than that of thigh meat. The native Hansli and Hansli×CSML chickens have an advantage over CSML broilers in terms of meat quality traits such as high protein and low fat content.
Keywords; *Carcass traits; Meat quality; Hansli×CSML; Hansli*

Received 24.04.2017 Revised 15.07.2017 Accepted 20.09.2017

How to cite this article:
R Ekka, N C Behura, L Samal, G Naik, P Kumar Pati and P K Mishra. Evaluation of carcass characteristics and meat quality of Hansli, CSML and Hansli×CSML cross under intensive system of management. Adv. Biores., Vol 8 [6] November 2017.34-42.

INTRODUCTION

Poultry meat quality is affected by the genotype, diet, age at slaughter and motor activity of birds [1]. The recent development of environmentally rural relations and consumer requests for food safety might encourage use of native fowl in a gastronomical niche market. Compared with the standard broiler, the local breeds of chickens are characterized by slower growth rates and lower carcass fat [2]. Genetic improvement of carcass and meat traits of the native fowl would increase the production efficiency and profitability of these birds. Crossbreeding of the indigenous stock with exotic commercial birds will take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds. Body weight at 8 weeks of age is the most important trait for improving the economic efficiency of native fowl [3]. Considering the necessity to identify potential poultry crossbreds, suitable for backyard farming as well as commercial farming in different regions of India which are easily adaptable to high rainfall, high humidity and high environmental temperature, the present study has been conducted to evaluate one improved broiler sire line (CSML - coloured synthetic male line), one native (Hansli) and their cross (Hansli×CSML) chicken at 8 weeks of age.

METHODOLOGY

Chicks and management

Ninety (90) day-old straight run healthy chicks from the three genotypes (Hansli, CSML and Hansli×CSML cross) were randomly selected, wing banded and kept for 8 weeks in deep litter. Chicks of each genotype were divided into three replicate groups of 30 each. Routine vaccination and medication procedures were followed for all the chicks. An experimental chick diet (crude protein-20% and metabolizable energy-2850 kcal/kg) was prepared and fed to the chicks ad libitum. Clean and fresh water was made available at all times. All procedures were approved by the Local Ethics Committee at the University.

Slaughtering procedure and carcass characteristics

At 8 weeks of age, four male birds and four female birds representing average weight from each of the genotype were selected and weighed prior to slaughter for recording of live body weight (BW). Birds were slaughtered, 12 h after feed withdrawal by severing the jugular vein and carotid artery below the left ear by single incision and were allowed to bleed for a period of three minutes by holding the bird's head down. After complete bleeding and cessation of movement, the carcass weight was recorded. The carcass was then scalded at 55-58^{0}C for 90 seconds and defeathered. Left over pin feathers was removed manually with a pinning knife. Evisceration was performed by giving a transverse incision at the abdomen between the keel and vent and then a circular incision around the vent to cut open the abdominal cavity. The entire visceral organs were then pulled out through the opening. The inedible organs like wind pipe, oesophagus, crop and all portions of the intestinal tract, vent, spleen, lungs, epicardium, ovaries/testis and gall bladder were removed. The total meat yield was calculated subtracting the giblet weight (the weight of heart without pericardium, liver without gall bladder and gizzard without the serous lining) from the weight of the edible carcass. Weight of the carcass along with the edible viscera like liver, heart, gizzard and abdominal fat was recorded as dressed weight. Percent of eviscerated carcass was calculated as the ratio between the eviscerated carcass and live BW after fasting. The percentages of weights of giblet, neck, wing, back, breast, thigh and drumstick were calculated in relation to eviscerated carcass weight.

Chemical composition analysis of meat

At 8 weeks of age, meat from breast and thigh regions of each genotype was collected, minced, mixed and then random samples were taken for chemical analysis. Six replicates were done for each parameter. Moisture, protein, ash and fat contents were determined according to AOAC [4].

Data analysis

Data collected on various parameters were subjected to analysis of variance using SPSS 17.0.1 version package (2008). Differences among genotype means were compared by Duncan's Multiple Range (DMR) test.

RESULTS

Carcass characteristics

The live BW, eviscerated BW and dressed BW of CSML chicks (2375.33±104.04, 1862.00±57.29 and 2046.67±56.54 g, respectively) were significantly higher than that of Hansli×CSML (1526.67±11.49, 1073.50±9.65 and 1159.33±10.21 g, respectively) and Hansli (770.33±15.04, 482.00±17.13 and 605.00±4.16 g, respectively) chicks (Table 1). The weights of heart and gizzard of CSML chicks (15.50±0.81 and 64.33±4.88 g, respectively) were significantly higher than that of Hansli×CSML (6.00±0.89 and 36.67±1.52 g, respectively) and Hansli (4.00±0.00 and 29.33±0.67 g, respectively) chicks. Highest weight of liver was observed in CSML chicks (59.00±1.13 g) followed by Hansli×CSML (34.67±0.67 g) and Hansli (27.67±2.16 g) chicks. The weight (g) of drumsticks and thighs of Hansli×CSML chicks (159.67±5.10 and 162.33±4.80) were significantly (P=0.000) higher than that of Hansli chicks (85.33±6.59 and 76.67±2.29) but lower than that of CSML chicks (262.67±3.76 and 310.67±19.19). The weight of wings and breast of chicks also followed the similar trend; the corresponding values were 230.67±3.68 and 446.33±27.25 g, 77.00±4.09 and 110.00±1.93 g, 154.00±1.46 and 275.00±12.51 g for CSML, Hansli and Hansli×CSML chicks, respectively. The weight (g) of back and neck of Hansli×CSML chicks (200.33±2.70 and 99.33±2.17) were significantly (P=0.000) higher than that of Hansli chicks (101.67±4.69 and 43.33±1.23) but lower than that of CSML chicks (346.17±17.15 and 156.50±4.24). In general, all carcass traits of Hansli×CSML chicks were found to be superior to that of native Hansli chicks and inferior to that of CSML chicks.

Between sex comparisons among CSML chicks showed that live BW, eviscerated BW and dressed BW were higher in females than males (Table 2). The weight of liver, thigh, wings, breast, back and neck were also higher in female chicks than male chicks whereas the weight of heart, gizzard, drumsticks were higher in males than females. In Hansli chicks, the live BW, eviscerated BW and dressed BW were higher in male chicks than female chicks. The weight of heart was similar among male and female chicks. The weights of all other organs studied were higher in male Hansli chicks than female Hansli chicks. Between sex comparisons among Hansli×CSML chicks showed that live BW, eviscerated BW and dressed BW were higher in females than males. Except the weight of gizzard, breast and neck, the weight of all other organs studied were higher in females than males.

The dressing % of Hansli (78.66±1.42) and Hansli×CSML (75.94±0.48) chicks was comparable to each other whereas that of CSML chicks (86.9±4.40) was significantly higher (P=0.029) than that of Hansli and Hansli×CSML chicks (Table 3). The drumstick % and thigh % were similar among Hansli, CSML and Hansli×CSML chicks. The drumstick % ranged from 14.20-17.58 % and the thigh % ranged from 15.11-16.64 % of the eviscerated BW. Highest wing % was observed in Hansli chicks (15.93±0.39) followed by Hansli×CSML (14.34±0.08) and CSML (12.41±0.22) chicks. The breast % was similar (P≥0.05) among CSML (23.87±0.82), Hansli (22.93±0.75) and Hansli×CSML (25.63±1.22) chicks. The back % were significantly higher (P=0.002) in native Hansli chicks (21.06±0.42) than that of CSML (18.57±0.62) and Hansli×CSML (18.66±0.23) chicks. The neck % was found to be similar among CSML, Hansli and Hansli×CSML chicks and it varied from 5.68-6.19 % of the dressed BW.

Correlation study of carcass traits

All the carcass traits measured in the present experiment were found to have significant correlation among each other at the 0.01 level (2-tailed) (Table 4).

Chemical composition of meat

The proximate composition of thigh and breast muscles has been presented in Table 5 and 6 respectively. Highest moisture content in thigh meat was observed in Hansli chicks (77.21±0.58 %) followed by Hansli×CSML (75.59±0.44 %) and CSML (67.22±0.53 %) chicks. The crude protein (%) also followed the similar trend; the corresponding values were 54.03±1.21, 76.35±0.60 and 70.78±0.95 for CSML, Hansli and Hansli×CSML chicks, respectively. However, a reverse trend was observed for crude fat % in thigh meat of chicks. Highest crude fat % in thigh meat was observed in CSML chicks (40.29±0.59) followed by Hansli×CSML (21.16±0.57) and Hansli (13.62±0.45) chicks. The crude fibre and total ash contents in thigh meat of chicks followed the similar trend to that of crude protein and moisture. Highest crude fibre % was observed in thigh meat of Hansli chicks (0.23±0.02) followed by Hansli×CSML (0.21±0.01) and CSML (0.17±0.02) chicks. The total ash content in thigh meat was 3.66±0.16, 6.33±0.25 and 4.90±0.14 % for CSML, Hansli and Hansli×CSML chicks, respectively. Lowest acid insoluble ash content was observed in thigh meat of Hansli×CSML (0.07±0.00 %) chicks followed by CSML (0.20±0.00 %) and Hansli (0.48±0.02 %) chicks.

Similar to that of thigh meat, moisture content was also highest in breast meat of Hansli chicks (76.21±0.64 %) followed by Hansli×CSML (74.50±0.84 %) and CSML (74.34±0.53 %) chicks. The crude protein % was also highest in breast meat of Hansli chicks (86.92±0.42) followed by Hansli×CSML (86.30±0.37) and CSML (82.32±0.38) chicks. However, the crude fat content was highest in breast meat of CSML chicks (7.67±0.21 %) followed by Hansli×CSML (4.47±0.18 %) and Hansli (2.52±0.22 %) chicks. The crude fibre % was significantly higher (P≤0.05) in breast meat of CSML chicks (0.19±0.02) than that of Hansli×CSML (0.09±0.003) chicks whereas the crude fibre % of Hansli chicks (0.12±0.006) was comparable to both CSML and Hansli×CSML chicks. In contrast to that of the ash content in thigh meat of chicks, the total ash content in breast meat of chicks followed a reverse trend. The total ash % was 7.09±0.06, 5.98±0.48 and 6.39±0.32 for CSML, Hansli and Hansli×CSML chicks, respectively. Similar to that of thigh meat, the acid insoluble ash content was also highest in breast meat of Hansli (2.38±0.10 %) chicks followed by CSML (0.94±0.01 %) and Hansli×CSML (0.89±0.04 %) chicks.

Overall comparison of moisture between thigh and breast revealed that there was higher percentage of moisture in thigh muscle than breast in Hansli and Hansli×CSML chicks whereas in CSML chicks, higher percentage of moisture was observed in breast muscle than thigh muscle. It was observed that there was high content of crude protein and low content of crude fat in breast meat than that of thigh meat in all chicks. There was higher percentage of crude fibre in thigh meat than breast in Hansli and Hansli×CSML chicks whereas in CSML chicks, higher percentage of crude fibre was observed in breast meat than that of thigh meat. The total ash analysis showed that breast contained higher ash contents than thigh in CSML and Hansli×CSML chicks whereas in Hansli chicks, higher percentage of ash was found in thigh meat than breast meat. Higher percentage of acid insoluble ash was observed in breast meat than thigh meat in all chicks.

Table 1; Mean carcass characteristics of experimental groups at 8 weeks of age

Traits	Hansli	CSML	Hansli×CSML	P value
Live BW	770.33^{c}±15.04	2375.33^{a}±104.04	1526.67^{b}±11.49	0.000
Eviscerated BW	482.00^{c}±17.13	1862.00^{a}±57.29	1073.50^{b}±9.65	0.000
Dressed BW	605.00^{c}±4.16	2046.67^{a}±56.54	1159.33^{b}±10.21	0.000
Heart	4.00^{b}±0.00	15.50^{a}±0.81	6.00^{c}±0.89	0.000
Liver	27.67^{c}±2.16	59.00^{a}±1.13	34.67^{b}±0.67	0.000
Gizzard	29.33^{b}±0.67	64.33^{a}±4.88	36.67^{c}±1.52	0.000
Drumsticks	85.33^{c}±6.59	262.67^{a}±3.76	159.67^{b}±5.10	0.000
Thighs	76.67^{c}±2.29	310.67^{a}±19.19	162.33^{b}±4.80	0.000
Wings	77.00^{c}±4.09	230.67^{a}±3.68	154.0^{b}±1.46	0.000
Breast	110.00^{c}±1.93	446.33^{a}±27.25	275.00^{b}±12.51	0.000
Back	101.67^{c}±4.69	346.17^{a}±17.15	200.33^{b}±2.70	0.000
Neck	43.33^{c}±1.23	156.50^{a}±4.24	99.33^{b}±2.17	0.000

^{a,b,c}*Mean with different superscripts in a row differ significantly (P≤0.05)*

Table 2; Between sex comparisons of carcass characteristics of experimental groups at 8 weeks of age

Traits	Hansli		CSML		Hansli×CSML		P value
	Male	Female	Male	Female	Male	Female	
Live BW	798.00^{c} ±11.54	742.67^{c} ±15.24	2271.3^{a} ±61.21	2479.3^{a} ±198.89	1520.7^{b} ±15.71	1532.7^{b} ±19.40	0.000
Eviscerated BW	518.67^{c} ±10.91	445.33^{c} ±1.76	1755.3^{a} ±70.93	1968.7^{a} ±0.66	1067.7^{b} ±20.25	1079.3^{b} ±4.66	0.000
Dressed BW	612.00^{c} ±5.29	598.00^{c} ±3.05	1990.7^{a} ±113.39	2102.7^{a} ±1.33	1140.7^{b} ±1140.7	1178.0^{b} ±11.13	0.000
Heart	4.00^{b} ±0.00	4.00^{c} ±0.00	16.66^{a} ±0.66	14.33^{a} ±1.20	4.00^{b} ±0.00	8.00^{b} ±0.00	0.000
Liver	31.33^{b} ±0.66	24.00^{c} ±3.05	58.66^{a} ±0.66	59.33^{a} ±2.40	34.00^{b} ±1.15	35.33^{b} ±0.66	0.000
Gizzard	30.66^{c} ±0.66	28.00^{b} ±0.00	72.00^{b} ±2.30	56.66^{a} ±7.42	39.33^{a} ±1.76	34.00^{b} ±1.15	0.000
Drumsticks	100.00^{c} ±1.15	70.66^{c} ±0.66	269.33^{a} ±2.96	256.00^{a} ±4.16	149.33^{ab} ±4.66	170.00^{b} ±1.15	0.000
Thighs	78.66^{a} ±1.76	74.66^{c} ±4.37	270.00^{b} ± 1.15	351.33^{a} ±13.67	152.00^{b} ±2.30	172.67^{b} ±1.76	0.000
Wings	86.00^{c} ±1.15	68.00^{c} ±1.15	223.33^{a} ±2.90	238.00^{a} ±2.30	152.00^{b} ±2.30	156.00^{b} ±1.15	0.000
Breast	112.00^{c} ±2.30	108.00^{c} ±3.05	389.33^{a} ±21.36	503.33^{a} ±2.90	302.6^{b} ±2.90	247.33^{b} ±2.90	0.000
Back	112.00^{c} ±1.15	91.33^{c} ±1.33	308.67^{a} ±4.80	383.67^{a} ±6.38	197.33^{b} ±2.40	203.33^{b} ±4.66	0.000
Neck	45.33^{c} ±1.76	41.33^{c} ±0.66	147.3^{a} ±0.66	165.67^{a} ±2.33	104.00 ±1.15	94.66^{b} ±0.66	0.000

^{a,b,c}*Mean with different superscripts in a row differ significantly (P≤0.05)*

Table 3; Mean dressing, cut up parts% of experimental groups at 8 weeks of age

Traits	Hansli	CSML	Hansli×CSML	P value
Dressing %	78.66^{b}±1.42	86.9^{a}±4.40	75.94^{b}±0.48	0.029
Drumsticks %	17.58±0.81	14.20±0.61	14.86±0.40	0.004
Thighs %	15.97±0.59	16.64±0.69	15.11±0.40	0.207
Wings%	15.93^{a}±0.39	12.41^{c}±0.22	14.34^{b}±0.08	0.000
Breast%	22.93±0.75	23.87±0.82	25.63±1.22	0.164
Back%	21.06^{a}±0.42	18.57^{b}±0.62	18.66^{b}±0.23	0.002
Neck%	5.93±1.85	5.68±1.77	6.19±1.93	0.981

^{a,b}*Mean with different superscripts in a row differ significantly (P≤0.05)*

Table 4; Correlation study of various carcass traits

	Live BW	Eviscerated BW	Dressed BW	Heart	Liver	Gizzard	Drumsticks	Thighs	Wings	Breast	Back	Neck
Neck												1
Back											1	.985**
Breast										1	.978**	.987**
Wings									1	.972**	.980**	.992**
Thighs								1	.965**	.969**	.995**	.972**
Drumsticks							1	.949**	.984**	.926**	.961**	.967**
Gizzard						1	.903**	.824**	.842**	.784**	.826**	.841**
Liver					1	.911**	.962**	.944**	.934**	.895**	.945**	.925**
Heart				1	.922**	.888**	.933**	.884**	.885**	.807**	.875**	.857**
Dressed BW			1	.924**	.953**	.876**	.979**	.972**	.984**	.964**	.976**	.980**
Eviscerated BW		1	.995**	.898**	.947**	.851**	.977**	.981**	.993**	.981**	.988**	.991**
Live BW	1	.976**	.967**	.858**	.940**	.871**	.969**	.973**	.975**	.959**	.979**	.985**

***Correlation is significant at the 0.01 level (2-tailed)*

Table 5; Mean proximate composition of thigh muscle of chicks at 8 weeks of age

Traits	Hansli	CSML	Hansli×CSML	P value
Moisture	$77.21^{a}\pm0.58$	$67.22^{b}\pm0.53$	$75.59^{a}\pm0.44$	0.000
Crude protein	$76.35^{a}\pm0.60$	$54.03^{c}\pm1.21$	$70.78^{b}\pm0.95$	0.000
Crude fat	$13.62^{b}\pm0.45$	$40.29^{a}\pm0.59$	$21.16^{c}\pm0.57$	0.000
Crude fibre	0.23 ± 0.02	0.17 ± 0.02	0.21 ± 0.01	0.210
Total ash	$6.33^{a}\pm0.25$	$3.66^{c}\pm0.16$	$4.90^{b}\pm0.14$	0.000
Acid insoluble ash	$0.48^{a}\pm0.02$	$0.20^{b}\pm0.00$	$0.07^{c}\pm0.00$	0.000

^{a,b,c}*Mean with different superscripts in a row differ significantly (P≤0.05)*

Table 6; Mean proximate composition of breast muscle of chicks at 8 weeks of age

Traits	Hansli	CSML	Hansli×CSML	P value
Moisture	76.21 ± 0.64	74.34 ± 0.53	74.50 ± 0.84	0.235
Crude protein	$86.92^{a}\pm0.42$	$82.32^{b}\pm0.38$	$86.30^{a}\pm0.37$	0.001
Crude fat	$2.52^{c}\pm0.22$	$7.67^{a}\pm0.21$	$4.47^{b}\pm0.18$	0.000
Crude fibre	$0.14^{ab}\pm0.02$	$0.19^{a}\pm0.02$	$0.09^{b}\pm0.00$	0.046
Total ash	$5.98^{a}\pm0.48$	$7.09^{a}\pm0.06$	$6.39^{a}\pm0.32$	0.259
Acid insoluble Ash	$2.38^{a}\pm0.10$	$0.94^{b}\pm0.01$	$0.89^{b}\pm0.04$	0.000

^{a,b,c}*Mean with different superscripts in a row differ significantly (P≤0.05)*

DISCUSSION

Carcass quality traits

Carcass yield and composition is affected by a number of factors including diet, age, sex, live weight, genotype and slaughtering conditions [5, 6]. In the present study, all carcass traits of Hansli×CSML chicks were found to be superior to that of native Hansli chicks and inferior to that of CSML broiler chicks. The dressing % was 86.9±4.40, 78.66±1.42 and 75.94±0.48 for CSML, Hansli and Hansli×CSML chicks, respectively. The carcass dressing % of Hansli chicks was similar to that of Hansli×CSML chicks. At 40th Random Sample Poultry Performance test at Gurgaon, the dressing percentage was found to be 71.43 for a genotype cross from Bangalore and 69.07 from CARIBRO Dhanaraja. Khawaja et al [7] compared carcass dressing percentage of Fayoumi, Rhode Island Red and their reciprocal crossbred (RIR male×Fayoumi female: RIFI; and Fayoumi male×RIR female: FIRI). In contrast to the present findings, they reported significantly lower carcass dressing percentage of local Fayoumi than crossbred chickens. The highest dressing percentage was found in FIRI (62.60) followed by RIFI (62.40), RIR (57.50) and Fayoumi (54.08) chickens. Azharul et al [8] found the higher dressing percentage in crossbred of RIR×Fayoumi compared with Fayoumi breed. Some studies showed that crossbreds from D. Nana chickens with RIR, WLH or Fayoumi resulted in improved dressed and total meat yield in comparison with exotic or D. Nana chickens at 84 and 112 days of age [9, 10].

Similar to the present results, Jaturasitha et al [11] observed lower slaughtered weight of Thai native chicken than that of Arbor acre broilers (1200 vs. 1967g, P<0.01) at 6 weeks of age. In contrast to the present findings, the dressing % was not significantly different (64.54 and 65.64% for Thai native chicken and Arbor acre broilers, respectively). In the present study, thigh% and drumstick% were similar among CSML and Hansli chicks but Jaturasitha et al [11] reported heavier thigh% and drumstick% in Thai native chicken than those of Arbor acre broilers (16.04 vs 15.02, 16.33 vs. 14.41%, respectively, P≤0.05). Similar to the present study, these authors observed heavier wing% of Thai native chicken than that of Arbor acre broilers (14.64 vs. 12.21%, P<0.01). Neck% was similar among CSML, Hansli and Hansli×CSML. In support of the present findings, Jaturasitha et al [11] also reported similar head and neck% for Thai native chickens and Arbor acre broilers. In corroboration with the present findings, Hrdinka et al [12] found statistically significant differences between the BW of females and males on the 42nd day of feeding. Islam and Dutta [13] studied carcass characteristics of a crossbred chicken, Sonali, derived from RIR male×Fayoumi female at 8 weeks of age. The live weight was 551.33±4.51g. The neck weight was 4.73±0.10g. The dressing yield was 56.96±1.60g. Sogunle et al [14] compared the quality of carcass parts of broiler chickens of Arbor acre and Marshal MY genotypes at 8 weeks. The dressing % was 84.36±1.25 and 85.81±1.79 for Arbor acre and Marshal MY respectively.

Compared with males, females usually have larger breast muscles and smaller thigh muscles. In the present study, the breast weight was higher in CSML females but lower in Hansli and Hansli×CSML females when compared with their male counterparts. De Marchi et al [15] studied the carcass characteristics of the Padovana breed, a native fancy bird of Italy. Poultry birds are slaughtered at 150 and 180 days of age. Males had heavier live weight, eviscerated weight, carcass weight, breast and right thigh weights than females. The dressing % was 72 and 71 for male and female respectively. The live weight was 1882 and 1328 g for male and female respectively. The eviscerated BW was 1576 and 1094 g for male and female respectively. The carcass weight was 1345 and 939 g for male and female respectively. The breast weight was 248 and 199g for male and female respectively. The weight of right thigh was 211 and 140g for male and female respectively. The breast% was 18 and 21 for male and female respectively. In the present study, carcass weight and yield was relatively higher than those of other breeds such as Padonava [15] and Tunisian local chickens [16]. Several studies have shown that high live weight has been associated with high carcass yield [15-17]. Because CSML, Hansli and Hansli×CSML chicks used in this study were raised under identical rearing and feeding conditions, high carcass yield and parts of our study are attributed to high live weight of chickens.

Similar to the present findings, Mikulski et al [18] observed that at 65 days, the breast muscles % was 23.59 and 24.53 for slower-growing and fast-growing chicken genotypes, respectively and the thigh muscle % was 13.80 and 14.56 slower-growing and fast-growing chicken genotypes, respectively. In contrast to the present results, lower drumstick muscle% was reported by Mikulski et al [18]. The drumstick muscle% was 9.88 and 10.06 for slower-growing and fast-growing chicken genotypes respectively. Choo et al [19] compared carcass characteristics of 4 breeds of local chicken (white-mini broiler, Hanhyup-3-ho, Woorimatdag and silky fowl. The carcass weights were 592, 576, 571 and 394g for white-mini broiler (31d), Hanhyup-3-ho (37d), Woorimatdag (36d) and silky fowl (59d) respectively. The carcass yield% was 67.4, 65.4, 65.8 and 64.3 for white-mini broiler (31d), Hanhyup-3-ho (37d), Woorimatdag (36d) and silky fowl (59d) respectively. The wings% was 8.34, 8.68, 8.64 and 8.68 for white-mini broiler (31d), Hanhyup-3-ho (37d), Woorimatdag (36d) and silky fowl (59d) respectively. The breast % was 14.5, 11.7, 10.6 and 10.7 for white-mini broiler (31d), Hanhyup-3-ho (37d), Woorimatdag (36d) and silky fowl (59d) respectively.

Chemical composition of meat

Poultry meat quality attributes may be affected by several factors such as genotype, diet, stocking density, rearing condition, temperature, exercise, pasture intake, age at slaughter and motor activity of the birds that impact on muscle metabolism as well as on chemical composition [1, 20]. Meat quality is a function of the interaction of genotype and other environmental factors. Xlong et al [21] reported that breeds affected chemical composition of chicken meat. In the present experiment, significant difference ($P \leq 0.05$) in the breast and thigh meat composition was observed among CSML, Hansli and Hansli×CSML chicks. In contrast, Khawaja et al [7] reported no significant ($P \geq 0.05$) difference in the composition of breast and thigh meat among pure and crossbred chickens.

In the present study, higher percentage of dry matter in thigh muscle than breast was observed for CSML chicks. Similar results are reported by Khawaja et al [7]. At 20 weeks of age, in breast meat, the DM % was 27.30±0.20, 26.83±0.99, 27.35±0.25 and 26.75±0.21 in RIR, Fayoumi, RIFI and FIRI chickens, respectively. In thigh meat, DM% was 29.32±4.00, 28.36±1.90, 29.35±2.00 and 28.46±2.30 in RIR, Fayoumi, RIFI and FIRI chickens, respectively. Another study by Fujimura et al [22] suggested that water contents differed significantly with breed, whereas according to Zollitish et al [23] there was no significant difference of dry matter between thigh and breast meat.

Nutritional value of meat can be assessed on the basis of parameters such as protein and fat contents. A statistically significant negative correlation exists between fat and protein contents in muscles, i.e. the fattier the muscles, the lower the portion of lean meat they contain, which makes them less suitable in respect to human nutrition. The content of ash is an important parameter to assess the content of mineral substances in muscles. The results of chemical analysis in the present study clearly demonstrated that the breast and thigh muscles significantly differ in their nutritional composition. In case of protein, it was observed that there was high content of crude protein in breast meat than that of thigh meat in all chicks. The crude fat analysis showed that thigh contained more fat contents than breast. Similar results were reported by Khawaja et al [7] in Fayoumi, Rhode Island Red and their reciprocal crossbred (RIR male×Fayoumi female: RIFI; and Fayoumi male×RIR female: FIRI). At 20 weeks of age, in breast meat, the crude protein % was 83.60±2.25, 84.10±2.10, 83.65±2.15 and 84.25±2.18 in RIR, Fayoumi, RIFI and FIRI chickens, respectively. The crude fat% in breast meat was 6.75±0.22, 6.55±3.00, 6.48±0.26 and 6.59±0.28 in RIR, Fayoumi, RIFI and FIRI chickens, respectively. In thigh meat, the crude protein% was 67.42±2.50, 67.35±2.20, 67.45±2.40 and 67.55±2.35 in RIR, Fayoumi, RIFI and FIRI chickens, respectively and the crude fat% was 17.69±2.40, 17.89±2.90, 18.20±2.70 and 18.56±2.80 in RIR, Fayoumi, RIFI and FIRI chickens, respectively. These differences in protein contents between breast and thigh muscles are in agreement with findings of Ingr [24], who reported that muscles differ in the content of proteins, which could result from different functions of particular muscle tissues. The contents of proteins in breast and thigh muscles we determined agree with the results reported by Simeonovova [25]. Furthermore, our results also support the findings of Suchý et al (26) who found differences between breast and thigh muscles. According to Simeonovova [25], breast muscles contain approximately 22% proteins, while in thigh muscles, which contain more fat, approximately 17.2% of proteins were found. In contrast to the present findings, Zollitish et al (23) demonstrated no difference of fat between both types. Same observations were recorded by Fujimura *et al*. (1996) in case of different broiler genotypes. Suchý et al (26) studied changes in the chemical composition of breast and thigh muscles in three hybrid combinations of broiler chickens (Ross 308, Cobb and Hybro) on 42nd and 52nd day. Breast muscles are characterized by an increased content of proteins (22.5-22.7%) and ash (1.11-1.13%) and by a reduced content of dry matter (25.8-26.0%) and fat (2.1-2.5%). In thigh muscle, increased content of DM (28.5-28.6%), fat (8.9-9.3%) and a decreased content of proteins (18.3-19.1%), ash (0.97-0.98%) was observed. Similar results were also reported by Mikulski et al [18] who compared the quality of breast and thigh meat of slower-growing and fast-growing chicken genotypes at 65 days. They reported that in the breast muscle, the DM% was 25.49 and 25.21 for slower-growing and fast-growing chicken genotypes respectively. The fat% in breast muscle was 0.79 and 1.50 and protein% was 24.23 and 23.34 for slower-growing and fast-growing chicken genotypes respectively. In the thigh muscle, the DM% was 26.74 and 26.44 for slower-growing and fast-growing chicken genotypes respectively. The fat% in thigh muscle was 7.79 and 7.33 and protein% was 18.89 and 19.14 for slower-growing and fast-growing chicken genotypes respectively. Sogunle et al [27] compared the chemical composition of breast and thigh muscles of broiler chickens of Arbor acre and Marshal MY genotypes at 8 weeks. The DM% in breast muscle was 27.78±0.055 and 29.88±0.035 in Arbor acre and Marshal MY genotypes, respectively. The crude protein% in breast muscle was 26.60±0.101 and 25.49±0.210; fat% was 9.72±0.021 and 9.92±0.078 and ash% was 11.21±0.02 and 11.73±0.62 in Arbor acre and Marshal MY genotypes, respectively. In thigh muscle, the DM% was 26.25±0.067 and 28.73±0.019 in Arbor acre and Marshal MY genotypes, respectively. The crude protein% in thigh muscle was 29.92±0.101 and 28.99±0.156; fat% was 7.95±0.061 and 8.08±0.075 and ash% was 13.40±0.032 and 12.42±0.682 in Arbor acre and Marshal MY genotypes, respectively. This variation could be attributed to differences in genotypes of the birds used for the experiment.

In the present study, significantly higher crude protein percentage in breast muscle was observed in native Hansli and Hansli×CSML chicks than that of CSML chicks. In contrast to the present findings, Jaturasitha et al [28] observed similar protein percentage in Thai native chickens and Arbor acre broilers at 6 weeks of age. Similar to the present findings, they reported that the fat content in Thai native chicken was lower than that in Arbor acre broiler. The fat% was 0.12 and 0.34 and the moisture% was 69.40 and 72.35 for Thai native chickens and Arbor acre broilers, respectively. Wattanachant *et al* [29] also found that Thai indigenous chicken contained a lower fat content than broilers. Souza et al [30] studied the proximate composition of thigh and breast meat of Cobb® genotype of broiler at 45 days. In thigh muscle, percentage of moisture, proteins, lipids and ash were 76.14, 19.86, 2.88 and 0.90%. In breast muscle, percentage of moisture, proteins, lipids and ash were 75.57, 22.49, 0.67 and 0.96%.

CONCLUSION

The results of the present investigation shows that carcass traits and meat composition of Hansli×CSML crosses coincides with the average of two parents (Hansli and CSML). If the average of the F1 cross coincides with the average of two parents, the character is governed by additive gene action and we suspect there is absence of dominance, over dominance and epistasis and so absence of heterosis. In meat stocks, heterosis is close to zero at one week of age, but increases to 2-10% by 8-10 weeks of age (that is body weight and body size traits in F1, have a value almost mid way between two parental values) which is evident from the present findings. The native Hansli and Hansli×CSML chickens have an advantage over CSML broilers in terms of meat quality traits such as high protein and low fat content.

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