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Performance of different multi-coloured broiler varieties in red lateritic agro-climatic region of West Bengal

MADHUCHHANDA KHAN*[1], GOPAL PATRA[2], ANNADA DAS[3], S.M.S ANWAR[4] AND AVIJIT HALDAR[5]

[1]*Rathindra Krishi Vigyan Kendra, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal 731236, India*
[2,3,4]*Deptt. of Livestock Products and Technology, West Bengal University of Animal &Fishery Sciences, 37 K.B. Sarani, Kolkata, India.* [5]*ICAR-ATARI, Kolkata-97, Zone – V*

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ABSTRACT

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The aim of the study was to identify location-specific multi coloured broiler variety suitable to rear under small-scale farming situation in Birbhum district under red lateritic agro-climatic region of West Bengal. The current study was conducted to analyse the comparative performance of multi-colored broiler varieties namely Krishibro, CARIBRO -Dhanraja and Chabro under semi-intensive system of management in terms of growth, body weight gain, slaughter traits, proximate composition, physico-chemical and sensory attributes. The mean values for moisture, protein, fat and ash percentage ranged from 74.81-76.39%, 17.67-19.90%, 3.25-3.80% and 1.73-2.57% respectively. The sensory scores revealed that except for flavour, there were non-significant ($p \geq 0.05$) differences in CARIBRO Dhanraja and Krishibro meat samples for the sensory attributes. The moisture %, pH and juiciness of all the three meat samples did not differ ($p \geq 0.05$). The mean dressed weights ranged from 934.16 to 1256.00 g. The mean dressing % of the Chabro, Krishibro and CARIBRO Dhanraja birds ranged from 62.56 to76.80 % The mean pH values ranged from 5.59-5.85. The ranges of mean WHC (%) and cooking yield (%) were 59.37-64.83 % and 93.24-94.69 % respectively. CARIBRO Dhanraja variety was the best and had significantly higher ($p \leq 0.05$) values among the test group of birds for live body weights at different rearing days, Benefit Cost (B/C) ratio, carcass characteristics, proximate composition, physico-chemical qualities and sensory attributes of meat followed by Krishibro and Chabro varieties.

Keyword: Coloured Broiler, Bodyweight, Proximate composition, Physico-chemical qualities, Sensory attribute

INTRODUCTION

Poultry farming in India has developed as vital and fast growing segment with contribution of 1% to National GDP and 14% to livestock GDP. India ranks 7th in the global poultry population (851.81 million tons) (Statista 2022). India produces 138.38 billion eggs/year (2nd in egg production) and stands 5th in chicken meat production (Economic Survey 2021). The Poultry population in rural backyard was 317 million as per 20th livestock census and playing an important role in national egg and meat production. The intensive commercial broiler production depends mainly on white plumaged broiler birds. But acceptability of multi-coloured synthetic broiler birds is comparatively higher in rural areas and more profitable than from commercial poultry due to their native look and higher production potential. Poultry farming in rural areas utilizing these kuroiler chicken varieties demands low input in terms of nutrition and management and thrive better under diversified agro climatic conditions of West Bengal, India.

Krishibro and CARIBRO Dhanraja, synthetic multi plumage colored broiler varieties having good immune status, considerable meat sensory qualities and well adaptation ability to tropical climate have been reported by ICAR-Directorate of Poultry Research, Hyderabad and ICAR-Central Avian Research Institute, Izatnagar respectively. Several studies were conducted by different researchers to study the productive performance and meat quality of different genotypes of chicken. Recently, Haunshi *et al*. (2022) in a study compared the meat quality, carcass characteristics and nutrient profile of Kadaknath chicken with that of broiler birds . Devatkal *et al*. (2019) also studied the carcass quality, composition, and consumer acceptance of meat from slow-growing broilers relative to commercial broilers. Devatkal *et al*. (2018) also conducted another study for studying the carcass traits and meat quality traits of desi and rural improved varieties of chickens. Similarly, Rajkumar *et al*. (2016) also evaluated the comparative carcass and meat quality characteristics of Aseel chickens and broilers birds.

Nowadays, backyard poultry farmers in West Bengal are moving towards establishment of small-scale poultry flock of Kuroiler and scarcity of information is observed with respect to production performance of these coloured broiler birds under semi-intensive system of rearing. It is essential to identify location-specific multi-coloured broiler variety suitable to improve small-scale poultry farming in Birbhum district of West Bengal, India.

*Corresponding author E mail: madhuchhanda_k@yahoo.com

Hence, the current study was conducted to analyse the comparative production performance of multi-colored broiler varieties namely Krishibro, CARIBRO -Dhanraja and Chabro under semi-intensive system of management in terms of growth, body weight gain, slaughter traits, proximate composition, physico-chemical and sensory attributes in upland farming situations of Birbhum district of West Bengal, India.

MATERIALS AND METHODS

Study area

The study was conducted in Birbhum district of West Bengal, commonly known as "Rarh region" having a characteristic topography of red lateritic soil. The district is located in the central western portion of West Bengal. Jharkhand, previously Santhal Parganas district of Bihar is situated in the north and west of the district. Murshidabad is situated in the east and Bardhaman district is situated in the south of the district, Birbhum. Birbhum district is located in between 23°32'30" to 24°35'00" north latitude and in between 87° 05'25" to 88° 01'40" east longitude. The district located 46 meters above sea level. The temperature ranges between 12.7°C to 28.3°C in winter and from 25.5°C to 41.5°C in summer. Agriculture in the district is mainly rain dependent. The study was conducted between December 2019 and February 2020.

Experimental birds

The day old Krishibro, CARIBRO-Dhanraja, and Chabro chicks were obtained from ICAR-Directorate of Poultry Research, Hyderabad and ICAR-Central Avian Research Institute, Izatnagar and CPDO, Bhubaneswar respectively.

Experimental design

Thirty numbers of chicks of each of Krishibro, CARIBRO-Dhanraja and Chabro at 21 days of age were equally distributed to seven farmers for rearing under semi-intensive system of rearing. The farmers were selected randomly with previous history of keeping broiler birds under deep litter system of rearing. Thus, each unit comprised of thirty nos. of Krishibro, thirty nos. of CARIBRO and thirty nos. of Chabro synthetic multi-coloured broiler birds. Before distribution to the farmers, a need-based training programme was organized by Krishi Vigyan Kendra to train the farmers on vaccination, management, and disease prevention of the birds and they were advised for maintaining all the birds under the identical management system.

Farm management

The chicks were brooded up to 21 days age at the farm of Rathindra KrishiVigyan Kendra and fed standard chick starter ration. The chicks were vaccinated against Ranikhet and Gumboro disease as per standard vaccination protocol. Thereafter, birds were reared by the farmers. Birds scavenged on the natural feed base like grain, vermin, insect, earthworm, kitchen leftover residue, green grass, azolla (*Azolla pinnata*) and green vegetables like kalmi (*Ipomoea aquatica*) and spinach (*Spinaciaoleracea*) etc. with supplementary feeding of standard broiler feed.

Sample collection

The poultry birds of different groups were slaughtered at 60 days of age according to common procedure under federal inspection and the samples were analyzed for different quality parameters like slaughter traits, proximate composition, physico-chemical and sensory attributes at the Department of Livestock Product Technology, West Bengal University of Animal and Fishery Sciences, Kolkata. The growth performance at different rearing age were recorded.

Growth performance

Body weight at different rearing days: Body weight of poultry birds were recorded in grams(g)at different rearing days using a digital weighing balance *viz.*, at 14, 21, 28, 42 and 56 days of age. Benefit Cost (B/C) Ratio is calculated to assess the viability of this multi-coloured broiler varieties rearing by dividing the gross return by the gross cost of rearing.

Slaughter performance

Carcass characteristics: Live weights of birds prior to slaughter were recorded in kilogram unit (Kg) using a digital weighing balance. After taking the weight of live birds, hygienic slaughter at the Department of Livestock Product Technology, West Bengal University of Animal and Fishery Sciences, Kolkata and dressing of poultry birds were performed. Exsanguination was done by severing of carotid arteries manually followed by scalding (54^0C/4min), defeathering and evisceration. Post-mortem inspection was carried out. The weights of the carcasses after dressing with intact skin and removal of giblets (heart, liver and gizzard) were recorded as dressed carcass weight in grams (g). Dressing percentage was measured from the hot carcass weight and live weight before slaughter by using the formula: Dressing percentage (%) = Dressed weight / Live weight × 100.

Cut-up parts: The dressed chicken carcasses were cut into major retail cut-up parts like neck, wings, back, breast, thigh and drumstick as per specification of (ISI 1975)and their weights in grams (g) were recorded.

Meat quality

Proximate composition of meat: The proximate analyses i.e. moisture, protein, fat and ash percentages of the meat samples were evaluated by using the standard procedure of AOAC (2016).

Physico-chemical qualities of meat: The pH of the finely minced poultry meat samples were analysed by following the method of Trout *et al*. (2000). The Water Holding Capacity (WHC) in percentages (%) of the poultry meat samples were estimated as per the slightly modified method of Wardlaw *et al*. (1973).The poultry

meat samples (approximately 150g) were uniformly cut into half square inches size, packed in sealed low-density polyethylene bags and a hot water bath is used for cooking at 80 6¨C for 25 minutes. The cooking yield was determined as a % of initial weight. After cooking, the cooked meat samples were drained of excess water and the weight was taken. Following formula:

Cooking yield (%): weight of cooked meat/ weight of raw meat X 100 is used to determine the cooking yield.

Sensory quality of meat: Sensory evaluation of the cooked meat samples were conducted by trained panel of 7 members amidst the semi-trained members of the Faculty of Veterinary and Animal Sciences, Kolkata. No cooking ingredients like salt, spice, oil etc. were used. Colour, appearance, texture, juiciness, flavor and overall acceptability of all the meat samples were analysed by using a 9-point Hedonic scale as described by Ingham and Schoeller (2002).

Statistical analysis

Results of this study were analyzed by one way ANOVA and differences between groups were confirmed by Duncan's Multiple Range Test using SPSS Statistics (Version 23) software. The results were expressed as mean ± standard error (S.E). The samples were analyzed in duplicates and the experiment was replicated thrice i.e., giving rise to n=6 for each variety of bird for body weight, carcass characteristics, cut-up parts, physico-chemical parameters and proximate composition, whereas, n=30 was taken for sensory evaluation.

RESULTS AND DISCUSSION

Growth performance

The mean values of live body weight (g) of the three experimental varieties of poultry birds at different rearing days are tabulated in Table 1(a). The average body weights for the three varieties of birds at 14,21,28,42 and 56 days of age were in the range of 125.83g - 1421.32 g. Significant differences ($p \leq 0.05$) observed in live body weight among different age groups in all the three varieties of birds. The significantly higher ($p \leq 0.05$) body weights for CARIBRO birds were recorded at all rearing days, followed by Krishibro and Chabro birds. The lowest ($p \leq 0.05$) body weights were recorded at all rearing days for Chabro birds in the current study. The benefit / cost (B/C) ratio indicated that rearing of CARIBRO Dhanraja and Krishibro is more profitable that the variety Chabro as indicated by Table 1(b)

Table 1: Growth performance and B/C ratio of three synthetic multi-coloured broiler variety under semi-intensive system of rearing

a. Growth Performance

Technology Option	No. of trials	Body weight				
		Day 14	Day 21	Day28	Day42	Day56
Control: Farmer's practice: Chabro	7	125.83^{a}±1.81	347.57^{a}±2.88	504.27^{a}±3.82	848.71^{a}±9.71	1105.88^{a}±11.43
Krishibro		162.28^{b}±1.75	393.07^{b}±3.87	585.35^{b}±4.04	1018.72^{b}±10.78	1302.84^{b}±13.89
CARIBRO-Dhanraja		192.87^{c}±1.63	458.52^{c}±3.73	652.85^{c}±4.18	1085.43^{c}±10.82	1421.32^{c}±14.46

Mean ± S.E. bearing different superscripts (a, b ... row wise) differ significantly ($p \leq 0.05$), n=22.

b. Benefit/Cost (B/C) ratio

Particulars	Control Farmer's practice Chabro (30 chicks each unit)	Krishibro (30 chicks ach unit)	CARIBRO-Dhanraja (30 chicks each unit)
A. Non-recurring expenditurea)			
a) Land	Existing	Existing	Existing
b) Poultry shed made of locally available	Not required	Not equired	Not equired
c) Equipment	660	660	660
B) Recurring Expenditure	3190	3250	3280
a. i. Cost of chicks Rs. @ 22/chick	135	135	135
ii. Cost of feed@Rs. 24/Kg	250	250	250
b. i. Cost of medicine and vaccine (Rs. 4.5/bird)			
C) Miscellenous expenditure			
Total cost/ Gross costGross Income/Gross Cost) (A+B)	4235	4305	4335
Income A.			
a) Income from sale of birds (Rs. 285/Kg live weight)	8320	9815	10530
Gross Income	8320	9815	10530
Net Income	4085	5510	6195
B/C Ratio(Gross return/Gross cost)	1.96	2.27	2.42

Pathak *et al.* (2015) observed that values for body weight and body weight gain were varied significantly (p≤0.05) in Aseel and Kadaknath for all the age groups. Similarl observation was recorded by Debata *et al.* (2012) in Red Cornish ,Vanaraja and Black rock chickens. The study by Jaturasitha *et al.* (2002) also reported that the body weights at 0-6 weeks age of Thai native chickens were significantly lesser (p≤0.01) than those of crossbred broiler chickens.

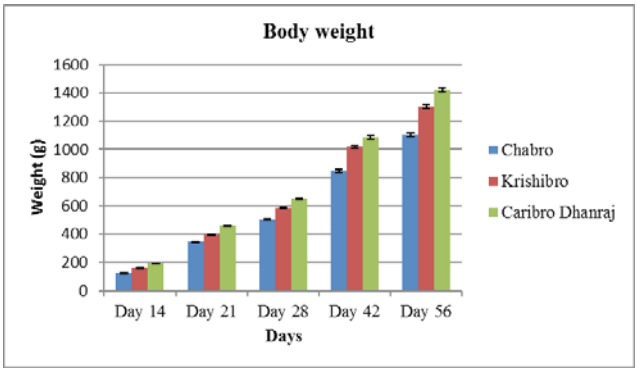

Fig.1: Growth performance of three synthetic multi-coloured broiler variety under semi-intensive system of rearing

Slaughter performance

Carcass characteristics: The mean live weights prior to slaughter ranged from 1.33 to1.63 kg. The mean dressed weights ranged from 934.16 to1256.00g. The mean dressing % of the Chabro, Krishibro and CARIBRO Dhanraja birds ranged from 62.56 to76.80% (Table 2).

Table 2: Carcass evaluation of poultry birds

Parameter	Variety of Bird		
	CARIBRO Dhanraja	Chabro	Krishibro
Carcass characteristics			
Live weight prior toslaughter (Kg)	1.63± 0.02[a]	1.33± 0.22[c]	1.52± 0.04[b]
Dressed weight (g)	1256.00±0.08[a]	934.16± 0.06[c]	1075.33± 0.04[b]
Dressing%	76.80± 0.06[a]	62.56± 0.04[c]	72.66± 0.08[b]
Cut-up parts (g)			
Neck	59.17± 0.24[a]	44.83± 0.46[c]	49.00± 0.26[b]
Wings	101.50± 0.20[a]	69.00± 0.23[c]	78.83± 0.22[b]
Back	308.16± 0.42[a]	201.17± 0.46[c]	253.67± 0.48[b]
Breast	404.33± 0.61[a]	326.50± 0.17[c]	367.50± 0.67[b]
Thigh	205.17± 0.65[a]	140.33± 0.61[c]	163.67± 0.65[b]
Drumstick	178.16± 0.13[a]	151.00± 0.14[c]	159.17± 0.14[b]

Mean ± S.E. bearing different superscripts (a, b ... row wise) differ significantly (p< 0.05), n = 6.

From Table 2, it is observed that live weight and dressed weight (with skin and without giblets) of CARIBRO Dhanraja was highest (p≤0.05) followed by the lowest (p≤0.05) live weight and dressed weight of Krishibro and Chabro . Similarly, as body weight is directly proportional to dressing %, significant changes (p≤0.05) in dressing % of the birds were also in the same order for CARIBRO Dhanraja, Krishibro and Chabro birds.The significantly lower (p≤0.05) dressing % Chabro birds caused by the the lower body weights and less muscle mass than the other two varieties of birds.The carcass characteristics (live weight at slaughter, dressed weight and dressing%) can be correlated with the live body weights at different rearing days of different varieties of birds. The larger chickens had higher (p≤0.05) dressing % than the smaller varieties.

Rajkumar *et al.* (2016) also observed significant (p≤0.05) higher values for dressing% in broilers birds than Aseel chickens and concluded that larger chickens had higher dressing%. Similar values for dressing % (63-70 %) were also reported by Iqbal *et al.* (2009) in indigenous chickens of Kashmir. Haunshi *et al.* (2022), also reported that the Kadaknath birds had significantly (p≤0.05) lower dressing% and dressed weights than commercial broilers. Findings of this study was also corroborated with the observation of (Devatkal *et al.* 2018). Devatkal *et al.* (2018) reported that live body weight, slaughter weight and dressed weights were greater in white commercial broilers and lower in Aseel birds. The researchers also reported that the dressing% ranged between 66.41-72.56 % and were not significantly (p≥0.05) different among the genotypes. Tang *et al.* (2009) similarly reported higher values for live weight and dressed weight in commercial and intermediate broilers than slow-growing genetic groups in China.Koomkrong *et al.* (2015) also observed significant (p≤0.05) differences in live weights of two slow-growing and fast-growing chicken genotypes in Thailand, while the dressing% did not differ significantly. In contrast to our findings, Jaturasitha *et al.* (2008) found non-significant (p≥0.05) differences in the dressing % of four different genotypes *viz.*, Thai native, Black boned, Bresse and Rhode Island Red breeds of chickens.

Cut-up parts: The weight of cut up parts in grams (g) showed that cut-up part weights of three experimental varieties of birds taken in this study (Table 2) varied significantly (p≤0.05).The weight of cut up parts were significantly (p≤0.05) higher for CARIBRO Dhanraja followed by that of Krishibro and Chabro Further, the ratio between meat cuts (breast, drumstick and thigh) and boney cuts (neck, back and wing) was 2:1 in all the three varieties of birds and this ratio was significantly (p≤0.05) highest for CARIBRO Dhanraja followed by that of Krishibro and Chabro. Among the cut-up parts, breast cuts had significantly (p≤0.05) highest yields followed by back, thigh, drumstick, wings and neck respectively for all the three varieties of birds. The body weights, carcass characteristics and cut-up parts had significant interactions (p≤0.05) between genotypes of the three varieties of birds. The larger varieties of birds

had significantly (p≤0.05) higher yields for the cut-up parts in this study. The yields of cut-up parts like breast are significantly (p≤0.05) correlated to body weight (Chen *et al.* 2007).

These findings are similar with the findings of Devatkal *et al.* (2018), who reported significant (p≤0.05) differences in yield of cut-up parts in four different genotypes of birds. Study revealed higher yields for breast (29.15%), thigh (15.57%), drumstick (13.82%) and wings (18.44%) in white commercial broiler, followed by rainbow rooster, Indbro Assel and rainbow rooster plus respectively. Similar results were also obtained by Rajkumar *et al.* (2016) in their comparative study on carcass characteristics and meat quality of Aseel chickens and commercial broilers where significantly (p≤0.05) higher values for breast yield was observed in commercial broilers. This study shows similarity with the reports of (Haunshi *et al.* 2022), that showed that the Kadaknath birds had significantly (p≤0.05) lower breast yield than commercial broilers and it could be correlated with its lower dressing% and dressed weights. However, the weights of legs, back and neck showed significantly (p≤0.05) higher difference in Kadaknath birds with that of broilers. Haunshi *et al.* (2013) and Pathak *et al.* (2015) in two different studies reported that significantly (p≤0.05) higher yields were obtained for breast, legs, neck and back in Aseel than Kadaknath birds. In another study, Koomkrong *et al.* (2015) also reported significant variances in breast and thigh percentage of two slow-growing and fast-growing chicken genotypes in Thailand. Similar to our findings, Tang *et al.* (2009) reported highest breast weight in commercial and intermediate broiler strains and lowest breast weight for slower-growing genotypes in China.

Meat quality

The meat quality is affected by many factors like breed, genetics, environment, nutrition, body weight gain, stress condition, carcass characteristics etc. (Rajkumar *et al.* 2016). Meat quality traits are important parameters for analyzing productive traits and consumer acceptance of meat type birds. The meat quality evaluation in this study involved analysis of proximate composition, physico-chemical properties *viz.*, pH, WHC (%) and cooking yield (%) and sensory traits like colour, appearance, texture, juiciness, flavour and acceptability.

Table 3: Proximate composition of poultry meat

Parameter	Variety of Bird		
	CARIBRO Dhanraja	Chabro	Krishibro
Moisture%	74.81±0 .557[a]	76.39± 0.557[a]	75.64±0 .557[a]
Protein%	19.90± 0.33[a]	17.67± 0.39[c]	18.65± 0.30[b]
Fat%	3.80± 0.05[a]	3.25± 0.06[c]	3.51± 0.06[b]
Ash%	2.57± 0.07[a]	1.73± 0.02[c]	2.17± 0.07[b]

Mean±S.E. bearing different superscripts (a, b ... row wise) differ significantly (p≤0.05), n = 6.

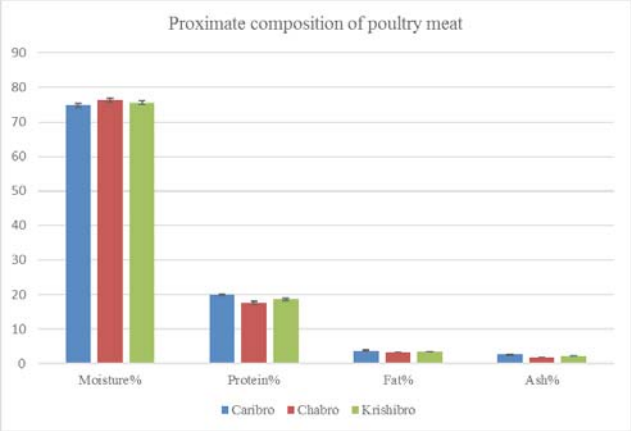

Fig 2: Proximate composition of poultry meat

The meat quality parameters are presented in Table 3 and Table 4.

Proximate composition of meat: The data tabulated in Table 3 revealed the values for proximate analyses like moisture %, protein %, fat % and ash % of meat samples collected from CARIBRO Dhanraja, Chabro and Krishibro varieties of birds. The mean values for moisture, protein, fat and ash percentage ranged from 74.81-76.39 %, 17.67-19.90, 3.25-3.80 and 1.73-2.57%, respectively. The moisture % of the three meat samples did not differ (p≥0.05). However, the meat samples of CARIBRO Dhanraja birds showed the highest (p≤0.05) values for protein%, fat% and ash% followed by that of Krishibro and Chabro. Chabro meat samples showed the lowest (p≤0.05) results for protein%, fat% and ash% than the other two samples. The difference in proximate composition of birds *viz*. significantly lower(p≤0.05) protein and fat contents of Chabro meat might be due to their genotype, feeding, maturity, body weight and carcass characteristics (Haunshi *et al.* 2013; Devatkal *et al.* 2018).

Table 4: Physico-chemical and Sensory properties of poultry meat

Parameter	Variety of Bird		
	CARIBRO Dhanraja	Chabro	Krishibro
Physico-chemical Properties			
pH	5.85± 0.15[a]	5.59± 0.17[a]	5.68± 0.13[a]
Water Holding Capacity (%)	64.83± 0.36[a]	59.37± 0.38[c]	62.54± 0.38[b]
Cooking Yield (%)	94.69± 0.29[a]	94.38± 0.28[a]	93.24± 0.24[b]
Sensory Properties			
Colour	7.67± 0.11[a]	6.66± 0.21[b]	7.33± 0.24[a]
Appearance	7.83± 0.20[a]	6.67± 0.02[b]	7.50± 0.22[a]
Texture	7.66± 0.21[a]	6.50± 0.25[b]	7.33±0.15[a]
Juiciness	7.33± 0.19[a]	7.17± 0.17[a]	7.33± 0.10[a]
Flavour	8.00± 0.16[a]	7.83± 0.16[ab]	7.50± 0.11[b]
Overall Acceptability	7.83± 0.18[a]	6.833± 0.14[b]	7.50± 0.12[a]

Mean±S.E. bearing different superscripts (a, b ... row wise) differ significantly (p≤0.05), n = 6.

In another study, Significantly (p≤0.01) lesser moisture, fat and ash contents in breast muscle of Kadaknath and significantly (p≤0.01) higher protein content than those of broiler meat was reported by Haunshi *et al.* (2022) .This study shows partial similarity with the findings of Devatkal *et al.* (2019), that recorded that Indbro (slow growing broiler) thigh meat showed significant (p≤0.05) higher protein content than that of the fast growing commercial broiler bird . However, no significant changes were observed in moisture, fat and ash contents were not significant (p≥0.05) of the two group of birds. These results corroborated with the findings of (Devatkal *et al.* 2018) for the moisture % and protein % of rainbow rooster and rainbow rooster plus birds. Significant (p≤0.05) changes were observed in moisture%, protein %, fat% and ash% among white commercial broiler, rainbow rooster, Indbro Assel and rainbow rooster plus chickens.Jaturasitha *et al.* (2008) also found significant (p≤0.05) lower fat% in thigh meats of Thai native and Black boned chickens than Bresse and Rhode Island Red breeds of chickens. In contrast to our findings, Haunshi *et al.* (2013) found non-significant (p≥0.05) differences in protein% and fat % of breast and thigh muscles of Aseel and Kadaknath breeds of chicken. Contrastingly, in another study by Jaturasitha *et al.* (2002), no significant (p≥0.05) differences were observed in moisture%, protein % and fat % of Thai native chicken and broiler chicken meat respectively.

Physico-chemical qualities of meat: Table 4 exhibited the values of different physico-chemical parameters *viz.*, pH, WHC (%) and cooking yield (%) of the test samples. The mean pH values ranged from 5.59-5.85. The ranges of mean WHC (%) and cooking yield (%) were 59.37-64.83 % and 93.24-94.69 % respectively. No significant (p≥0.05) changes were recorded in the pH of all the three meat samples and it was noticed that comparatively higher values for pH was observed for larger birds. The meat samples of CARIBRO Dhanraja birds yielded the highest (p≤0.05) values followed by that of Krishibro and Chabro for WHC (%). Non- significant (p≥0.05) changes were observed in the cooking yield % of CARIBRO Dhanraja and Chabro meat samples, whereas the Krishibro meat samples had significantly higher (p≤0.05) values than the other two samples.

The values for poultry meat pH obtained in this study were in normal range as reported by previous studies (Sarsenbek *et al.* 2013; Rajkumar *et al.* 2016). Heavier birds don't struggle much during slaughter thus having lower lactic acid and higher values for pH (Sarsenbek *et al.* 2013), which was truly marked in this study also. Muscle pH can directly be correlated with meat colour and meat with high pH is darker in colour (Haunshi *et al.* 2022). This study shows similar findings with the study conducted by Jaturasitha *et al.* (2008), who reported that there existed no significant differences (p≥0.05) among meat pH of slow-growing and fast-growing birds in Thailand. Likewise, Jaturasitha *et al. (*2002) in another study also found that there were no significant differences (p≥0.05) in the *P. major* meat pH of Thai native birds and broiler birds. Similar values for pH were also obtained by (Haunshi *et al.* 2022) in Kadaknath and broiler chicken and further reported that the pH decline was significantly lower (p≤0.05) for Kadaknath. Rajkumar *et al.* (2016) also found significantly lower (p≤0.05) pH values for Aseel meat than broiler meat and the pH values ranged from 5.80 to 6.29. WHC of meat is an important property that affects functionality of meat.

The WHC can be correlated with the protein% of meat of different varieties of birds in this study, as myofibrillar proteins mostly bind water and contribute most to WHC. Devatkal *et al*. (2019) reported significantly (p≤0.05) higher WHC of thigh meat in fast-growing white broiler birds. Devatkal *et al.* (2018) noticed significantly (p≤0.05) higher WHC for Aseel meat and the lowest for white commercial broiler meat, whereas rainbow rooster and rainbow rooster plus meat samples showed intermediate WHC. Similarly, Tang *et al.* (2009) reported lowest WHC in broiler-type birds, intermediate WHC in layers and layer crosses and highest WHC in native bird meat samples. Our results for cooking yield (%) are in partial agreement with the findings of Devatkal *et al.* (2019) and Devatkal *et al.* (2018) in their studies on slow-growing and fast-growing birds, where existed non-significant (p≥0.05) differences in cooking yield (%) of test meat samples. In another study, meat from fast-growing birds had lower cooking yield than slow-growing birds, which might be related to more water loss during cooking and higher fat content (Lonergan *et al.* 2003). Similarly, Jaturasitha *et al.* (2002) in their study reported that the meat of broiler birds had significantly (p≤0.05) higher values of cooking loss% than that of Thai native birds.

Sensory quality of meat: The sensory evaluation of meat is conducted to know the consumer preference and acceptability. The Table 4 also depicted the sensory scores of the three test meat samples for different sensory traits like colour, appearance, texture, juiciness, flavour and overall acceptability. Juiciness scores of all the three meat samples showed No significant (p≥0.05) changes which can be correlated with the non-significant (p≥0.05) differences in moisture % of the meat samples. Non-significant (p≥0.05) changes were observed in the flavour scores of Chabro meat samples with the other two samples, whereas CARIBRO Dhanraja meat samples showed significantly higher (p≤0.05) flavour scores as compared with the Krishibro meat samples. Similarly, for colour, appearance, texture and overall acceptability scores, there were non-significant (p≥0.05) differences of CARIBRO Dhanraja and Krishibro, whereas the Chabro meat samples had significantly lower (p≤0.05)

values than that of the other two meat samples. Sensory pane lists highly ($p \leq 0.05$) preferred the breast meat from the slow growing birds than that of the fast-growing commercial broilers (Devatkal *et al.* 2018, 2019).

In a similar experiment, Aseel meat had significantly higher ($p \leq 0.05$) values for texture and acceptability, while other sensory traits like appearance, flavour and juiciness reveal any significant changes among the genotypes of birds (Rajkumar *et al.* 2016).

CONCLUSION

From the above observations, it can be concluded that CARIBRO Dhanraja variety was the best and had significantly higher ($p \leq 0.05$) values among the test group of birds for live body weights at different rearing days, carcass characteristics, proximate composition, physico-chemical qualities and sensory attributes of meat followed by Krishibro and Chabro varieties. Except for flavour, there were no differences in sensory attributes for CARIBRO Dhanraja and Krishibro meat samples.

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