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Relationship between Coat Color and Growth Performance, Carcass Characteristics of Fattened Crossbred Male Calves

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ABSTRACT

Coat color in cattle is highly variable. In recent years there has been a tendency to distinguish animals of different breeds by invariable coat colors and pattern in order to maintain a uniformity of appearance specific for each breed. Three hundred crossbred male calves from a commercial herd belonging to the Rations and Fattening Unit, Faculty of Agriculture, Alexandria University, Egypt, were used in this study to assess the possible relationship between coat color and the growth capacity of fattening crossbred calves. Animals were grouped according to color patterns into full black (FBL), white with black spots (WBS) and brown (BRN) groups of 100 calves each. Body weight and five body measurements on these animals were recorded monthly to test the effect of coat color on growth performance and, thereafter, 30 bulls (10/group) were slaughtered to evaluate carcass characteristics. The results revealed that coat color affected calves body weight, but not did of the studied body measurements. FBL and WBS had heavier weights than BRN. Slaughter weight, hot and cold carcass weights and fore quarters weights was the highest for WBS calves. *Longissimus dorsi* muscle weight and non-carcass components showed no differences among coat color patterns.

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Introduction

Evolutionary, coat color in cattle used to be highly variable. In recent years there has been a tendency to distinguish animals of different breeds by invariable coat colors and pattern in order to maintain a uniformity of appearance specific for each breed. Therefore, coat color and pattern became part of the traits subjected to intensive selection and ultimately, coat color became part of the identity of breeds. Historically, Turner and Schleger (1960) measured the degree of variability in coat color and pattern within herds and stated that a proportion of the variation in growth rate is associated with variation in coat type. As early as 1964, Turnr reported that within breed, correlation between coat type and body weight gain was higher than the repeatability of growth rate, so that, assessment of coat pattern was a superior estimator of growth capacity. It appears that there are at least nine major loci, which affect coat colors and patterns in cattle, at least four of them possess multiples alleles causing polymorphism in coat color and pattern. It is probable that there are other major loci or at least modifying genes, which likewise affect coat color and pattern in cattle. Estimated heritability of coat type was 0.63 and the genetic correlation between coat type and body weight gain were high, so selection for patterns of coat type would give correlated improvement in weight gain of progeny (Turner, 1964).

Black and white color completely dominates red and white in Frisian cattle. However, crossing with other breeds usually results in a mixture of black and colored hairs on the non-white areas of the offspring. In Egypt, intensive random crossing took place between Friesian cattle from different sources and local breeds without keeping records to trace the pedigree of the crossbred calves. Therefore, the local animal stock markets are overcrowded with crossbred calves with different coat colors and pattern sold for fattening purposes. It was also observed that crossbred calves having different color or distribution pattern may perform differently for body weight and dimensions. This may point out to a possible relationship between coat color and pattern with growth capacity of crossbred calves. However, Charon and Lipka (2015) negated the effects of coat color genes on animal performance and health.

In Egypt it was observed that, the local animals those sales for fattening purpose are mostly crossbreed calves (Delgado *et al*., 2012). It was also observed that animals have the same coat color have a nearest growth rate. So, the objectives of this study were to assess the possible relationship between

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coat color and distribution pattern with the growth capacity of fattening crossbred calves and to determine the effects of different coat colors on growth performance and carcass characteristics. This may provide a clue about which calf color and pattern should be considered in merchandizing for breeding or fattening.

Materials and methods

Animals and managements

Body weights and dimensions of 300 crossbred male calves were collected from a commercial herd belonging to the Rations and Fattening Unit, Faculty of Agriculture, Alexandria University, Egypt. Calves were categorized according to color and pattern into three groups of 100 calves each: full black (FBL), white with black spots (WBS) and brown (BRN). The animals were purchased from the local nearby markets with an average body weight of 240±11.2 kg. The calves were fed according to their body weight requirements (NRC, 2001) a commercial diet (14% crude protein and 65 % total digestible nutrients). The proportion of concentrate mixture was adjusted gradually according to body weight increase to present 2% of the average body weight of calves. Also, available forage used as roughages, was fed as 1% of the average body weight. Drinking water was accessibly available all times.

The animals fattening period lasted for 7 months. The calves were weighed monthly. Body dimensions taken and recorded at the time of weighing as described by Fisher (1976) and as used in the Meat Research Institute (North Somerset) were: height at withers (HW), body length (BL), diagonal length (DL), heart girth (HG) and circumference of round (CR). At finishing, 30 calves an average slaughter (SW) weight of 406 + 10.3 kg were slaughtered in the abattoir of the Faculty of Agriculture, Alexandria University. Slaughter weights (SW) were recorded immediately before slaughter after 16 hours fasting. Slaughtering was done by severing the jugular vein and after complete bleeding; calves were skinned and dressed out. Hot carcass weight (HCW) was recorded, and carcasses were chilled for 24 hours at 5° C. Cold carcass weight (CCW) was also recorded, then carcasses were partitioned into fore and hindquarters, then weighed. The quarters were separated at the 12th rib. Dressing percentage (DP) was calculated by dividing HCW and CCW by SW. The fore and hindquarters were split longitudinally into two quarters each and then dissected into boneless meat (muscles and fat) (BM) and bones. The excessive fat was separated from the boneless meat and weighed. Weights of BM and bones were recorded. Boneless meat percentage was calculated by dividing BM by CCW. Weights of some prime cuts such as Fillet (*Longissimus dorsi* muscle) and Roast beef (*semitendinosus* muscle) were recorded. Also, Weights of hide, head, four legs, liver, heart, lungs, testicles, spleen and kidneys were recorded. Rumen and intestines empty weights were recorded.

The ninth rib was separated from the carcass and weighed before dissection into meat and bone.

All animal studies are conducted in accordance with the ethical standards of animal rights of Egyptian law and international agreements.

Statistical Analysis

Available data on different coat color groups were analyzed by GLM procedure of SAS (SAS, 2004) according to the model: $Yij = \mu + Ci + eij$ Where: Yij = each of the studied traits, μ = the overall mean, Ci = the fixed effect of ith color group, (i= FBL, WBS and BRN), and eij= the residual error. Differences among means within each classification were tested using least significant difference ($LSD_{0.05}$).

Results

Body weight and dimensions of different coat color groups are presented in Table 1. Body weight was affected ($p<0.05$) by coat color of calves, but all body dimensions were not. WBS calves had the heaviest body weight (436.5 kg) followed by FBL (432.6 kg), while BRN had the lowest (415.5 kg). None of the body dimensions was affected by coat color, HW of different coat color groups ranged from 137.5 cm for BRN to 139.8 cm for FBL. BL was similar for coat color groups with an increment of 1 cm (107-108cm). While WBS calves had the widest HG and CR compared to the other coat color groups

Table 1. Body weight (kg) and body measurements (cm) of calves with different coat colors at the end of the fattening period.

Trait	Coat color		
	FBL	WBS	BRN
Body weight	432.60±11.67[a]	436.45±9.85[a]	415.50±11.95[b]
Height at wither	139.80±1.39[a]	138.30±1.24[a]	137.50±1.04[a]
Body length	108.20±1.80[a]	107.00±1.27[a]	108.00±2.35[a]
Diagonal length	126.80±1.98[a]	126.09±1.30[a]	123.25±1.11[a]
Heart girth	182.20±1.93[a]	183.91±1.56[a]	182.25±1.60[a]
Round circumference	87.60±1.81[a]	87.73±1.01[a]	86.00±1.78[a]

Data were presented as Least squares Means±SE. FBL: Full black; WBS: White with black spots; BRN: Brown.
[a-b] In each row, Least squares means with different letters are significantly different (P< 0.05).

Table 2. Body weight (kg) and measurements (cm) daily gain of calves with different coat colors.

Trait	Coat color		
	FBL	WSB	BRN
Body weight gain	0.928±0.025[b]	0.947±0.023[a]	0.847±0.035[b]
Height at wither	0.070±0.002[a]	0.075±0.002[a]	0.079±0.003[a]
Body length	0.077±0.002[a]	0.074±0.002[a]	0.075±0.004[a]
Diagonal length	0.092±0.003[a]	0.083±0.002[b]	0.093±0.004[a]
Hear girth	0.141±0.004[b]	0.152±0.004[a]	0.149±0.006[a]
Round circumference	0.151±0.006[b]	0.158±0.005[b]	0.172±0.010[a]

Data were presented as Least squares Means±SE. FBL: Full black; WBS: White with black spots; BRN: Brown.
[a-b] In each row, Least squares means with different letters are significantly different (P< 0.05).

(183.91 and 87.73 cm, respectively). Thus, no differences were observed in all body measurements between different coat color groups.

Least squares means of daily body weight (kg) and body dimensions (cm) gains of different coat color groups throughout the fattening period are presented in Table 2. WBS calves had the highest daily body weight gain (P<0.05), 0.947 kg. Coat color had no effect on HW or BL gains which were almost similar in all groups. However, the daily gain in DL was affected by coat color (p<0.05) and that of WBS the lowest (0.083 cm.) but those of BRN and FBL were similar. Also, both HG and CR were affected by coat color (p<0.05) and the average gain of HG was lower (p< 0.05) for FBL but similar for WBS and BRN. With respect to the average gain in CR, BRN calves had the highest (p<0.05) value but differences between the other two coat color groups were not significant.

Most of the differences in carcass traits of different coat color groups were not significant (Table 3). However, the WBS calves had the highest (p<0.05) SW. HCW, CCW and fore quarter weights. No differences were found between the different coat color groups for non-carcass components (Table 4), except the large intestine weight, which was the heaviest in WBS calves compared to the other coat color groups.

Discussion

The high BW of WBS and FBL calves could be attributed to a high percentage of Friesian blood compared to local (El-Hedainy, 2004). This improved the growth traits of WBS and FBL calves. Also, higher thermal balance may exist for these two colors. In an agreement with the results of Finch *et al*. (1984), who studied the effects of coat colors on thermal balance, animal behavior and weight gain of three white shorthorn and three dark Brahman steers and found that coat color had significant effects on growth, with higher growth rates for white steers than for dark red. In addition to color, deep or woolly type coats negatively affected growth, time spent in the sun, and grazing time. The magnitude of the adverse effect of coat color and type on growth and behavior was greater in dark than light-colored steers. Kandil et. al. (1985) compared the fattening performance and body measurements of Egyptian calves with different colors but having similar initial body weights and fattening periods and reported that calves with mixed coat colors had the highest (1071.1 g) daily gain, followed by yellow (948.1 g) then dark (910.6 g) calves, while red calves gained only 888.8 g /day, which confirmed the coat color effect on daily gain and growth performance. Decampos

Table 3. Weights (kg) of carcass components of calves with different colors.

Items	Coat color			*P* value
	FBL	WBS	BRN	
No. of calves	10	10	10	
Slaughter weight	420.60±11.67[a]	435.50±11.95[a]	403.45±9.85[b]	0.0489
Hot carcass	227.38±10.54[ab]	231.75±15.55[a]	218.57±5.68[b]	0.0007
Cold carcass	226.86±9.96[b]	269.00±11.22[a]	209.71±7.79[c]	0.0001
Fore quarter	108.56±4.88[b]	126.75±9.56[a]	106.27±3.15[b]	0.0001
Hindquarter	118.19±6.55[a]	105.00±10.50[a]	112.93±3.53[a]	0.193
Dressing, % (hot)	54.73±0.86[a]	53.43±0.56[a]	54.26±0.40[a]	0.619
Dressing, % (cold)	53.37±0.90[a]	53.80±0.96[a]	53.33±0.53[a]	0.915
Net meat from fore quarter	37.36±3.04[a]	37.00±1.76[a]	39.44±2.17[a]	0.736
Net meat from hindquarter	62.21±4.49[a]	62.25±2.25[a]	54.21±1.97[a]	0.227
Semitendinosus muscle	10.89±0.46[a]	14.20±0.52[a]	11.16±0.36[a]	0.221
Longissimus dorsi muscle	4.30±0.12[b]	7.15±0.20[a]	4.41±0.17[b]	0.002
Fat weight	20.93±2.93[a]	28.00±2.06[a]	15.69±1.78[a]	0.519
Bone weight	41.21±1.24[a]	49.00±1.40[a]	40.47±1.37[a]	0.743

Data were presented as Least squares Means±SE. FBL: Full black; WBS: White with black spots; BRN: Brown.
[a-b] In each row, Least squares means with different letters are significantly different (P< 0.05).

Table 4. Weights (kg) of non-carcass components of calves with different coat colors.

Items	Coat color			*P* value
	FBL	WBS	BRN	
No. of calves	10	10	10	
Tail	2.46±0.04[a]	2.60±0.05[a]	2.35±0.05[a]	0.696
Head	20.19±0.45[a]	21.00±1.15[a]	20.12±0.44[a]	0.893
Leg	8.78±0.44[a]	9.17±0.73[a]	8.46±0.28[a]	0.929
Skin	29.19±1.23[a]	30.17±0.44[a]	30.20±1.57[a]	0.913
Small intestine	5.66±0.34[a]	5.58±0.79[a]	4.85±0.15[a]	0.63
Large intestine	5.39±0.30[b]	7.97±0.74[a]	5.23±0.19[b]	0.0003
Liver	5.81±0.22[a]	6.13±0.59[a]	5.33±0.16[a]	0.282
Lungs	4.73±0.36[a]	5.57±0.70[a]	4.56±0.21[a]	0.697
Heart	1.53±0.11[a]	1.48±0.11[a]	1.55±0.06[a]	0.487
Spleen	1.30±0.11[a]	1.03±0.14[a]	1.31±0.11[a]	0.322
Kidneys	1.01±0.03[a]	1.00±0.09[a]	0.95±0.03[a]	0.652
Empty stomach	12.06±0.20[a]	14.87±1.63[a]	12.13±0.35[a]	0.097
Caul fat	3.33±0.63[a]	3.60±0.97[a]	2.46±0.29[a]	0.326
Testis	0.57±0.02[a]	0.65±0.07[a]	0.53±0.02[a]	0.152

Data were presented as Least squares Means±SE. FBL: Full black; WBS: White with black spots; BRN: Brown.
[a-b] In each row, Least squares means with different letters are significantly different (P< 0.05).

et al. (2013) studied the effects of coat color genes on body measurements of West African Dwarf sheep and found that they had significant effect on rump height, animals with black coat color had the highest mean value for rump height but brown had the least value.

In pigs, Hur *et al*. (2013) studied the effect of coat color on growth performance and meat quality of Korean Native Black Pig and Landrace Cross Bred Pigs with different coat color and concluded that white spotted in black pigs showed significantly higher body and carcass weights than did the other coat color groups, whereas the red color pigs showed significantly lower body and carcass weights at finishing compared to other coat color groups, but meat quality characteristics, shear force, cooking loss and meat color were not significantly different among the different coat color groups, while, drip loss was significantly higher in red spotted black coat color pigs.

Conclusion

Coat color of fattened crossbred male Friesian calves affects body weight significantly. On the contrary, all other body measurements are not affected by coat color.

Conflict of interest

There is no conflict of interest to declare.

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