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Research Note

The effect of floor density on growth performance and carcass characteristics of French guinea broilers

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ABSTRACT The floor density required for optimal growth performance of different avian species and varieties is highly variable. Little is known of the required floor density for optimum performance of the French guinea fowl (*Numida meleagris*) broiler. The objective of this study was to assess the effect of varying floor densities on growth performance and carcass characteristics of the French guinea broiler. In 3 replicates, 687 one-day-old French guinea keets were weighed individually and randomly assigned to floor pens covered with pine wood shavings at 69, 60, 53, and 47 birds/pen, equivalent to densities of 15.6, 13.6, 12, and 10.7 birds/m^2, respectively. Birds in these floor densities were allowed feeder space of 2.7, 3.1, 3.5, and 4 cm/bird, respectively, and water space of 1.4, 1.6, 1.8, and 2.0 cm/bird, respectively. All birds received a 23-h lighting regimen and were fed the same diet comprising 3,100 kcal of ME/kg of diet and 23% CP from 1 d old to 4 wk of age (WOA) and 3,150 kcal of ME/kg of diet and 21% CP at 5 to 8 WOA. Feed and water were provided for ad libitum consumption. Body weight and feed consumption were measured weekly, whereas carcass characteristics were evaluated at 8 WOA. Overall, feed consumption was significantly higher ($P < 0.05$) in birds raised in 10.7 birds/m^2 than other treatment groups. Birds in floor densities of 12 and 15.6 birds/m^2 also consumed 6% more feed than those raised at 13.6 birds/m^2. Mean BW gain of birds in floor density of 15.6 birds/m^2 was significantly lower ($P < 0.05$) than that of birds in other floor densities. In general, significantly lower feed conversion ratios and higher carcass yields were observed in birds raised in floor densities of 13.6 and 12 birds/m^2 than those raised in floor densities of 15.6 and 10.7 birds/m^2. Therefore, French guinea broilers exhibited superior performance when raised at floor densities of 13.6 and 12 birds/m^2 than those reared at floor densities of 15.6 and 10.7 birds/m^2.

Key words: French guinea broiler, floor density, growth performance

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INTRODUCTION

Guinea fowl production as a meat bird is a potentially profitable enterprise in various parts of the world including the United States (Embury, 2001). In commercial production, guinea fowl are raised in confinement with management practices similar to those of chickens. Although there is limited information on optimum stocking density of the French guinea fowl boiler, profitability can be realized by efficient management of floor space. The review of Estevez (2007) points out that assigned bird densities have been primarily driven by cost-benefit analysis. Poultry producers tend to increase the number of birds per unit of space to reduce housing, equipment, and labor costs per unit of space. However, realized profits may come with reduced bird performance, health, and welfare if densities are excessive. Reduced bird performance includes reduced final BW, feed intake, and feed conversion and often a greater incidence of footpad dermatitis, scratches, bruising, poor feathering, and condemnations. These negative consequences and the quest for profitability necessitate the evaluation of optimum density allowances for various species of poultry, especially new entrants into the industry such as the guinea fowl.

Although information on stocking density of the guinea fowl is meager (Nahashon et al., 2006), previous studies have shown that chickens at high density grow more slowly, produce fewer eggs, and have higher mortality (Van Kampen, 1981; Deaton, 1983). Leeson and Summers (1984) reported a significant reduction in 50-wk BW among growing Leghorn pullets kept at 293 cm^2/bird when compared with those kept at 586 cm^2/bird. Earlier work (Wells, 1972) also cited evidence

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that feed consumption (**FC**) was significantly reduced among Leghorn pullets reared in floor pens at high stocking density. More recent studies (Mtileni et al., 2007) evaluated how stocking density, time, and their interaction influence BW, egg weight, and feed intake of broiler breeder hens. They observed that birds reared in groups of 15 per pen were about 183 g heavier than those reared in groups of 20 per pen.

Studies that have evaluated several factors that may be associated with poultry stocking density reveal that broilers raised at higher densities consumed less feed (Dozier et al., 2005; Han et al., 2005) when compared with birds raised at lower densities. Hence, the reduction in BW may be related to reduced feed intake because of limited feeding space, suggesting that providing a larger number of feeders may help alleviate the negative consequence of high density (Sørensen et al., 2000; Dozier et al., 2006). Also, differences in behavior that are mostly associated with reduced movement due to barrier effects (Newberry and Hall, 1990) and increased frequency of disturbances have also been reported to have negative effects on bird performance as a result of increased bird density. Although most studies have not succeeded in linking physiological stress in birds to high densities, Heckert et al. (2002) reported a reduction in bursa weight in broilers, which may be interpreted as a sign of increased stress in birds.

The specific objective of this study was to evaluate the effect of various stocking densities on FC, BW gain, feed conversion ratios (**FCR**), and carcass characteristics of French guinea broilers. Information realized from this research will be used to estimate the optimum floor density requirement for the French guinea broilers.

MATERIALS AND METHODS

Birds and Treatments

Six hundred eighty-seven straight-run day-old guinea keets of the French variety were obtained from Ideal Poultry Breeding Farms (Cameron, TX). Because previous studies (Nahashon et al., 2006) have shown a lack of sexual dimorphism in the French variety of the guinea fowl, both sexes of these French broilers were intermingled. The birds were weighed individually and randomly assigned to floor pens covered with pine wood shavings at 69, 60, 53, and 47 birds/pen, equivalent to floor densities of 15.6, 13.6, 12, and 10.7 birds/m^2, respectively. Feeder space was provided at 2.7, 3.1, 3.5, and 4.0 cm/bird and water space was provided at 1.4, 1.6, 1.8, and 2.0 cm/bird in the floor densities of 15.6, 13.6, 12, and 10.7 birds/m^2, respectively. The diets fed at hatch to 4 wk of age (**WOA**) and 5 to 8 WOA comprised 3,100 and 3,150 kcal of ME/kg of diet and 23 and 21% CP, respectively (Table 1). Each density was replicated 3 times. The diets were fed in mash form and were provided for ad libitum consumption. Water was also provided at free choice throughout the study.

Management of Experimental Birds

At 1 d old, experimental birds were weighed individually and randomly assigned to floor pens covered with pine wood shavings litter to a depth of 10 cm. Each pen was equipped with a brooder that maintained the room or pen temperature at 32.2°C for the first week, the temperature was reduced gradually by 2.8°C every week until 23.9°C, and from this point on, no artificial heating was provided to the birds. The birds received 23 h of constant lighting from hatch to 8 WOA. Ventilation within the brooder-grower house was maintained by thermostatically controlled exhaust fans. Body weight and FC were measured weekly from hatch to 8 WOA. Feed conversion ratio was calculated by dividing weekly FC by weekly BW gain for each replicate. Mortalities were weighed and the weights were used to adjust pen-based weekly BW gain, FC, and FCR.

Processing Procedures

At 8 WOA, 8 experimental birds (4 males and 4 females) from each replicate (a total of 24 birds within each floor density treatment) were randomly selected for evaluation of carcass traits. Feed and water were withdrawn 12 h before slaughter. The birds were then manually caught and crated in plastic coops such that each coop contained 8 birds. These birds were trans-

Table 1. Composition of experimental diets from 1 d old to 4 wk of age and 5 to 8 wk

Item	0 to 4 wk	5 to 8 wk
Ingredients and analyses	%	
Corn, yellow #2 (8% CP)	52.32	57.00
Soybean meal (48% CP)	35.70	30.90
Alfalfa meal (17% CP)	1.00	1.00
Meat and bone meal (50% CP)	3.00	3.00
Poultry blended fat	4.90	5.05
Dicalcium phosphate (18% P, 22% Ca)	1.86	1.86
Limestone flour (38.8% Ca)	0.52	0.52
Salt	0.30	0.30
Vitamin-mineral premix[1]	0.25	0.25
DL-Met (98%)[2]	0.15	0.12
Calculated levels		
ME (kcal/kg of diet)	3,100	3,150
CP	23	21
Ca	1.00	1.00
Total P	0.71	0.71
Available P	0.47	0.47
Met	0.51	0.45
Met + Cys	0.88	0.80
Lysine	1.27	1.14
Crude fat	7.08	7.22
Analyzed levels		
CP	22.5	20.6
Crude fat	6.98	7.13

[1]Provided the following per kilogram of diet: retinyl acetate, 3,500 IU; cholecalciferol, 1,000 ICU; DL-α-tocopheryl acetate, 4.5 IU; menadione sodium bisulfite complex, 2.8 mg; vitamin B_{12}, 5.0 mg; riboflavin, 2.5 mg; pantothenic acid, 4.0 mg; niacin, 15.0 mg; choline, 172 mg; folic acid, 230 mg; ethoxyquin, 56.7 mg; manganese, 65 mg; iodine, 1 mg; iron, 54.8 mg; copper, 6 mg; zinc, 55 mg; and selenium, 0.3 mg.

[2]Degussa Corporation, Kennesaw, GA.

Table 2. Feed consumption of French guinea broilers reared in varying floor densities from hatch to 8 wk of age

Item	Age (wk) 1	2	3	4	5	6	7	8	TFC[1]
Floor density (birds/m^2)	(g/bird)								
15.6	50.3[b]	125.5[ab]	223.3[b]	258.4[c]	327.9[b]	421.9[a]	447.5[a]	499.9[a]	2,354.7[b]
13.6	48.6[b]	122.0[b]	213.3[c]	262.3[c]	314.3[c]	392.1[c]	423.5[b]	444.5[b]	2,220.6[c]
12	55.9[a]	126.0[a]	222.5[b]	298.4[b]	343.6[a]	421.5[a]	436.4[ab]	458.9[b]	2,363.2[b]
10.7	54.0[a]	128.2[a]	232.5[a]	318.9[a]	345.7[a]	419.9[a]	447.9[a]	517.0[a]	2,464.1[a]
PSEM[2]	0.59	1.32	2.80	2.81	2.69	3.24	5.82	6.88	18.6
	Probability								
Floor density	0.01	0.04	0.01	0.05	0.01	0.01	0.03	0.02	0.05

[a–c]Gram weight means within columns of floor density with no common superscript differ ($P < 0.05$).

[1]Total feed consumed.

[2]Pooled SEM.

ported less than 0.1 km to the processing facility. While hanging by their feet, all 24 birds from each dietary treatment group were electrically stunned by passing their heads through 1% NaCl solution charged with electrical current (14 V, 60 Hz) for 18 s. The birds were killed by hand using a conventional unilateral neck cut to sever the carotid artery and jugular vein and were bled for 180 s. Birds were scalded for 120 s at 63°C in an air-agitated commercial scalder (Cantrell Model SS300CF, Cantrell Machine Co. Inc., Gainesville, GA) and picked for 30 s in a commercial in-line picker (Cantrell Model CPF-60, Cantrell Machine Co. Inc.). After the head, shanks, and feet and feathers were removed, the carcass was eviscerated manually by cutting around the vent to remove all of the viscera including the kidneys. Abdominal fat, which consisted of fat surrounding the gizzard, proventriculus, and in the abdominal body cavity, was removed and weighed immediately. The weights of heart, liver, and gizzard were also measured. Eviscerated carcass (with neck and the ends of wings) without giblets was weighed to determine hot dressed yield. Each carcass was cut into its component parts: breast, thigh, drumstick, wings, and neck. All weights were recorded to the nearest 0.1 g.

Statistical Analyses

Data were analyzed by the ANOVA option of the GLM of SAS/STAT software (SAS Institute, 2002) as a completely randomized design with floor density as main effect. Sex differences in abdominal fat weight and carcass component parts were not significant ($P > 0.05$); therefore, data for males and females were pooled and analyzed for main effects. The statistical model used was $Y_{ijk} = \mu + D_i + R_{ij} + \varepsilon_{ijk}$, where Y_{ijk} = response variables from each individual pen or replications; μ = the overall mean; D_i = the effect of floor density; R_{ij} = the interexperimental unit (replications) error term; and ε_{ijk} = the intraexperimental unit error term. The interexperimental unit (replication) error term was used to test the effect of floor density. Least significant difference comparisons were made between treatment means for main effects when there was a significant F-value. Differences in mortality among dietary treatments were analyzed using the χ^2 method. Significance implies $P < 0.05$ unless stated otherwise.

RESULTS AND DISCUSSION

Mean FC of French guinea fowl broilers subjected to varying floor densities is presented in Table 2. At 1, 4, and 5 WOA, birds raised at floor densities of 10.7 and 12 birds/m^2 had higher FC than those reared at floor densities of 13.6 and 15.6 birds/m^2. Although at 3 WOA, differences in FC of birds reared at floor densities of 15.6 and 12 birds/m^2 were not significant, they were 5% higher than those of birds reared at 13.6 birds/m^2 and 5% lower than those of birds reared at 10.7 birds/m^2. These observations were consistent with reports of Dozier et al. (2005) that FC of broiler chickens was adversely affected by increasing the placement density from 30 to 45 kg of BW/m^2 of floor space. At 4, 5, 6, 7, and 8 WOA, FC of birds reared at 10.7 birds/m^2 was 22, 10, 7, 6, and 15% higher than that of birds raised at a floor density of 13.6 birds/m^2, respectively. A recent report (Estevez, 2007) suggested a reduction in FC of broilers when environmental conditions deteriorated at constant density. This implied that deterioration of environmental conditions that goes along with higher bird densities may be associated with the reduction in feed intake.

Overall, total FC by French guinea broilers at floor density of 10.7 birds/m^2 was significantly ($P < 0.05$) higher than in other floor densities. Likewise, Shanwany (1988) reported a decrease in FC of broilers as stocking density increased because physical access to feed and water was impeded. However, more recent studies (Feddes et al., 2002) demonstrated that increasing stocking density did not decrease FC of broilers. Total FC of birds reared at 15.6 and 12 birds/m^2 were also higher ($P < 0.05$) than those of birds raised at a density of 13.6 birds/m^2.

Body weight gain (**BWG**) of birds reared at floor density of 10.7, 12, and 13.6 birds/m^2 was 7, 9, and 12%

higher ($P < 0.05$) than that of birds raised at floor density of 15.6 birds/m^2 at 1, 2, and 3 WOA, respectively (Table 3). These results are in agreement with the report of Mtileni et al. (2007) that broiler breeder birds kept in a group of 15 birds per pen were 183 g heavier ($P < 0.05$) than those kept in groups of 20 birds per pen. Leeson and Summers (1984) reported a significant reduction in 50-wk BW among White Leghorn pullets kept at 293 cm^2/bird compared with those reared at 586 cm^2/bird. At 4 WOA, BWG of birds reared at floor density of 13.6 and 12 birds/m^2 was 10% lower than that of birds reared at 10.7 birds/m^2 and 18% higher than that of birds at floor density of 15.6 birds/m^2. These observations are also in agreement with the reports of Estevez et al. (1997) and Keeling et al. (2003) that stocking density could adversely affect BWG of broilers and Leghorn layers, respectively.

At 5, 7, and 8 WOA, birds at floor density of 12 birds/m^2 exhibited higher ($P < 0.05$) BWG than those at other floor densities such that 12 > 13.6 > 10.7 > 15.6 birds/m^2. The depressed BWG of birds at higher floor densities from 5 to 8 WOA as opposed to early age was expected because over time the experimental birds gained weight irrespective of floor density and their requirement for floor space increased proportionately. It is likely that, at higher stocking densities, the feed and water intake decrease because physical access to feed and water is impeded, a premise that is supported by Feddes et al. (2002). Other studies (Bilgili and Hess, 1995) have also shown depressed BWG as placement density of broiler chickens was increased from 10.5 to 13.2 birds/m^2.

Over the entire 8-wk study period, total BWG of birds on a floor density of 12 birds/m^2 was higher than that of other treatment groups such that 12 > 10.7 = 13.6 > 15.6 birds/m^2. The higher BWG of birds at lower floor densities was also a response from increased FC (Table 2). In evaluating the effect of floor density on broiler growth performance, Feddes et al. (2002) reported that broiler birds reared at a density of 14.3 birds/m^2 had significantly higher ($P < 0.05$) eviscerated BW than those reared at densities of 17.9 and 23.8 birds/m^2. A similar observation was reported by Dozier et al. (2005) that BWG was adversely affected by increasing the placement density of heavy broilers from 30 to 45 kg of BW/m^2.

Most mortality occurred between hatch and 4 WOA; however, differences in percentage of mortality among floor densities were not significant (Table 3). The report of Feddes et al. (2002) was in agreement with these observations that stocking density had no significant effect ($P > 0.05$) on mortality of broiler birds. However, contrary to these observations, Dozier et al. (2005) reported a significant increase ($P < 0.05$) in mortality when stocking density of heavy broilers was increased from 30 to 35, 40, and 45 kg/m^2 at 49 d of age.

Although the mean FCR of birds in floor density of 13.6 birds/m^2 were not different from those of birds in floor densities of 12 and 10.7 birds/m^2 at 2, 3, and 6 WOA, they were significantly lower than those of birds at 15.6 birds/m^2 (Table 4). The poor FCR of birds at a density of 15.6 birds/m^2 may be partly attributed to depressed FC (Table 2; Feddes et al., 2002) and BWG (Table 3) when compared with other treatment groups. Sørensen et al. (2000) and Dozier et al. (2005) cited evidence that BW of broiler chickens was decreased by high stocking density at 7 WOA. Differences in FCR of birds raised at floor densities of 12 and 10.7 birds/m^2 were not different at 5 to 8 WOA, but they were 12 to 31% lower than those of birds reared at densities of 15.6 and 10.7 birds/m^2.

At 6 and 7 WOA, FCR of guinea fowl broilers reared at 10.7 birds/m^2 were significantly lower than those of birds raised at floor density of 15.6 birds/m^2. Recent reports of Dozier et al. (2006), which are in agreement with these findings, indicated that feed conversion was adversely affected with increasing stocking densities of broilers by 35 d of age. When FCR was averaged for the entire 8-wk period, birds reared on floor densities of 13.6 and 12 birds/m^2 did not differ. However, their FCR were significantly lower ($P < 0.05$) by about 17 and 8% than those of birds reared at floor densities of

Table 3. Body weight gain and mortality of French guinea broilers reared in varying floor densities from hatch to 8 wk of age

Item	Age (wk) 1	2	3	4	5	6	7	8	TBWG[1]	Mortality[2] (%)
Floor density (birds/m^2)	(g/bird)									
15.6	50.3^b	94.7^b	141.6^b	151.3^c	186.3^c	220.7^b	201.7^c	197.2^d	1,243.8^c	6.8
13.6	52.6^{ab}	104.8^a	159.9^a	173.8^b	202.2^b	225.0^b	228.2^b	227.8^b	1,374.3^b	6.0
12	55.9^a	106.1^a	162.5^a	178.6^b	218.7^a	245.8^a	243.1^a	240.3^a	1,451.0^a	5.7
10.7	54.0^a	103.7^a	159.1^a	196.7^a	203.7^b	248.9^a	217.6^b	213.8^c	1,397.5^b	6.2
PSEM[3]	0.92	1.98	2.72	2.73	2.81	3.36	3.85	4.41	13.61	0.22
	Probability									
Floor density	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.03	0.05	0.04

[a–d]Gram weight means within columns of floor density with no common superscript differ ($P < 0.05$).

[1]Total BW gain.

[2]Cumulative for the 8-wk study period.

[3]Pooled SEM.

Table 4. Feed conversion ratio of French guinea broilers reared in varying floor densities from hatch to 8 wk of age

Item	Age (wk)								
	1	2	3	4	5	6	7	8	AFCR[1]
Floor density (birds/m^2)	(g/bird)								
15.6	1.02[a]	1.34[a]	1.61[a]	1.76[a]	1.79[a]	1.92[a]	2.32[a]	2.59[a]	1.79[a]
13.6	0.92[b]	1.19[b]	1.35[b]	1.56[b]	1.58[b]	1.76[b]	1.87[c]	1.97[b]	1.53[c]
12	1.02[a]	1.22[b]	1.39[b]	1.69[a]	1.60[b]	1.71[b]	1.81[c]	1.93[b]	1.55[c]
10.7	1.02[a]	1.25[b]	1.45[b]	1.64[ab]	1.70[a]	1.70[b]	2.08[b]	2.45[a]	1.66[b]
PSEM[2]	0.024	0.022	0.036	0.034	0.026	0.031	0.037	0.050	0.031
	Probability								
Floor density	0.05	0.03	0.05	0.02	0.04	0.04	0.05	0.05	0.05

[a–c]Gram weight means within columns of floor density with no common superscript differ ($P < 0.05$).

[1]Average feed conversion ratio over the 8-wk period.

[2]Pooled SEM.

15.6 and 10.7 birds/m^2, respectively. This observation was also consistent with the report of Estevez (2007) that broilers reared at high stocking densities will tend to exhibit poor feed conversion.

Mean yields of carcass and associated components of French guinea broilers reared in varying floor densities are presented in Table 5. Although differences in carcass yields of birds at floor densities of 13.6, 12, and 10.7 birds/m^2 were not different, birds reared at 12 and 10.7 birds/m^2 exhibited carcass yields that were significantly higher ($P < 0.05$) than those of birds reared at a floor density of 15.6 birds/m^2. Because there is a positive and significant correlation between live weight and carcass yields of the French guinea broilers (Table 6), the depressed carcass yields of birds on floor density of 15.6 birds/m^2 when compared with those on lower stocking densities may be associated with depressed BWG (Table 3) and FC (Table 2). A similar trend reported earlier (Dozier et al., 2006) indicated that increasing stocking density depressed carcass yields of male broilers. Previous research has also shown that high stocking densities exert adverse effects on growth and external carcass quality of boilers grown to 2.4 to 2.7 kg (Stanley et al., 1989; Puron et al., 1995; Feddes et al., 2002).

Differences in mean weights of breast, thigh, drumstick, wings, and gizzard among floor density treatments were not significant. However, the report of Dozier et al. (2006), which was contrary to these findings, showed that breast fillet weight and its associated yield were negatively affected by high stocking density. On the other hand, mean abdominal fat weight of birds reared at floor density of 12 birds/m^2 was about 22% higher than that of birds reared at floor densities of 15.6 and 10.7 birds/m^2. There also seemed to be positive correlations between bird live weight, carcass and breast yields, and abdominal fat, which would suggest that heavier birds in the 12 birds/m^2 floor density would tend to deposit more fat than the other treatments. Differences in abdominal fat weight of birds reared at floor densities of 15.6 and 13.6 and 10.7 birds/m^2 were not significant ($P > 0.05$). Recent studies (Dozier et al., 2006) demonstrated that relative amounts of abdominal fat of broiler males were not affected by stocking density. With the exception of birds reared at a floor density of 10.7 birds/m^2, birds reared in floor densities of 12 birds/m^2 exhibited significantly higher heart weight than those in other floor densities. Although mean liver weights of birds reared in floor density of 15.6, 13.6, and 10.7 birds/m^2 were not different, they were about 14% higher than those of birds reared in floor density of 12 birds/m^2.

Positive and highly significant correlations ($P < 0.01$) were noted between live weight and the weight of car-

Table 5. Mean yield of major carcass components expressed as percentage of live BW after feed deprivation of French guinea broilers reared in varying floor densities from hatch to 8 wk of age

Item	Carcass	Breast	Thigh	Drumstick	Wings	Abdominal fat	Heart	Liver	Gizzard
Floor density (birds/m^2)	%								
15.6	72.9[b]	20.4	11.9	9.1	10.8	1.19[b]	0.48[b]	1.76[a]	1.47
13.6	74.7[ab]	20.3	12.6	8.9	11.1	1.35[ab]	0.48[b]	1.70[a]	1.43
12	76.5[a]	21.1	12.6	9.3	11.0	1.46[a]	0.55[a]	1.49[b]	1.37
10.7	76.5[a]	21.2	12.2	9.0	10.9	1.20[b]	0.51[ab]	1.70[a]	1.33
PSEM[1]	1.26	0.48	0.26	0.20	0.23	0.11	0.02	0.09	0.08
	Probability								
Floor density	0.05	NS	NS	NS	NS	0.05	0.05	0.05	NS

[a,b]Percent means within columns of floor density with no common superscript differ ($P < 0.05$).

[1]Pooled SEM.

Table 6. Correlation coefficients among weights of major component parts of French guinea broilers reared in varying floor densities from hatch to 8 wk of age

Component part	Carcass[1]	Breast	Thigh	Drumstick	Wings	Abdominal fat[2]	Heart	Liver	Gizzard
Live weight	0.56**	0.68**	0.64**	0.54**	0.60**	0.34*	0.29*	0.48*	−0.01
Carcass		0.51**	0.65**	0.54**	0.53**	0.25*	0.27*	−0.07	0.06
Breast			0.78*	0.69**	0.68**	0.42*	0.45*	0.26*	0.09
Thigh				0.68**	0.69**	0.33*	0.50**	0.15	−0.04
Drumstick					0.67**	0.01	0.52**	0.14	0.16
Wings						0.10	0.34*	0.32*	0.17
Abdominal fat							−0.06	0.23*	−0.27*
Heart								−0.07	0.17
Liver									0.04

[1]Eviscerated carcass weight.

[2]Abdominal fat weight.

*$P < 0.05$; **$P < 0.01$.

cass, breast, thigh, drumstick, and wing of French guinea broilers (Table 6). Consistent with this observation, Gaya et al. (2006) reported high genetic association between eviscerated BW and both breast and leg weights of male broilers. In broilers chickens, live weight seems to be highly correlated with carcass, breast, and thigh or leg weight (Cahaner and Nitsan, 1985; Rance et al., 2002). Correlations between live weight and the weight of abdominal fat, heart, and liver were also positive and significant ($P < 0.05$). In previous studies using broiler sire and dam populations, Wang et al. (1991) also reported positive but small to moderate correlations of body and carcass weight.

Correlations between carcass weight and breast, thigh, drumstick, and wings and between breast weight and the weight of thigh, drumstick, and wings were also positive and significant ($P < 0.01$). Significant ($P < 0.05$) and positive correlations were also observed between weight of carcass and weight of abdominal fat and heart and between beast weight and weight of abdominal fat, heart, and liver of the French guinea broilers. The liver and heart play key roles in metabolism and translocation of nutrients and as such they will respond to work load as has been observed previously in the cardiac muscle (Morgan et al., 1980) and the liver (Ferrell and Koong, 1986). Studies in broiler chickens (Rance et al., 2002) and guinea fowl (Nahashon et al., 2005) have also demonstrated high genetic associations between the weight of the heart and the tissues that it supplies.

Therefore, based on this study, French guinea broilers exhibited superior performance when raised at floor densities of 13.6 and 12 birds/m^2 than those reared at floor densities of 15.6 and 10.7 birds/m^2. Thus, it is suggested that it would be more economically feasible to raise French guinea fowl broilers at a floor density of 13.6 birds/m^2.

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