



Impact of Different Stocking Density on Productive and economic Performance of Broiler Chickens

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Article info

Original: 23 January 2016

Revised: 27 August 2016

Accepted: 16 October 2016

Published online: 20 March 2017

Key Words:

stocking density, broiler performance, economic index, sex.

Abstract

The present study was conducted at the poultry farm of Faculty of Agricultural Sciences, University of Sulaimani in Bakrajo from 8/1/2015 to 20/2/2015. Ninety eight one-day old broiler chicks were distributed on three stocking densities to study broiler performance and economic index. Three treatments of stocking densities: T1, T2 and T3 were respectively as follow (8, 12 and 16 birds/ m²). Broiler chickens feed intake were taken on each pen at 1, 7, 14, 28, 35 and 42 days in addition to the daily record of body weight, average weight gain, average feed intake, average feed conversion ratio and viability. Body weight and average weight gain for males and females were weekly recorded. Values of European Broiler Index and European Production Efficiency Factor were calculated at 28 and 42 days of age. Body weight of birds did not significantly ($p \leq 0.05$) affected within different periods except at day (28) of age. Birds in T1 significantly ($p \leq 0.05$) showed higher body weight comparing with other treatments. Feed conversion ratio was significantly ($p \leq 0.05$) better for birds in T1 at all periods (1 to 42) days of age than birds in T2 and T3. However, the average weight gain and feed intake did not significantly affected by different stocking densities at all periods. The body weight and weight gain of males were significantly ($p \leq 0.05$) higher than females at all periods except at one day old. The different stocking densities of broiler chickens were positively influenced the growth performance (body weight, European Broiler Index and European Production Efficiency Factor were numerically higher for T1 birds compared with other treatments).

Introduction

Poultry is an important sector of animal husbandry of all countries. The focus on maximizing productivity, production efficiency, and profitability led to the development of intensive animal production rearing conditions. From this perspective, high stocking densities applied to maximize profit per unit area results in negative poultry health and production systems among the public, particularly within the poultry production sector [12] and [13].

Stocking densities is a critical factor on broiler performance due to its effect on feed intake and environmental condition in the house. [1] reported that stocking density has critical implications for the broiler industry because it is essential for broiler industry to obtain higher returns by increasing stocking density. High stocking densities may contribute to the reduced performance due to the high environmental temperature and the reduced airflow at bird level [2]. On the other hand, [3] have reported that birds when given space showed positive significant effects on body weight, feed conversion, mortality, carcass scratches and breast meat yield [4] showed that the relationship was not linear in nature between stocking density and productivity traits. Furthermore, [5] found negative effects of increasing the density beyond 30 kg/m² on live performance of heavy broilers. Preceding studying [2,6] were announced that high stocking density effects negatively feed conversion ratio, body weight gain, feed intake, and 35 days of age period, indicating

deteriorated live performance at a high stocking density. It was speculated that some of the deteriorated effects of high stocking density on live performance might be a function of the difficulty birds faced in accessing feeders [7]. It was recently reported that broilers prefer to cluster at the feeders independent of their stocking density [7]. Broilers reared at a high stocking density were socially attracted rather than socially averse, [9] suggesting that sufficient feeder space would be helpful for feed intake at a high stocking density.

[10] recommended a stocking density of 17 and 19 birds/m² for males and females, respectively, and they reported that an optimum stocking density that will maximize profitability because bird performance is negatively affected at higher stocking densities. Male broilers need less space than females at similar body weight per square meter near marketing age [11]. [10] observed a linear reduction in body weight and feed intake of male and female broilers but no differences were observed in feed conversion ratio or mortality by 7 week of age.

European Production Efficiency Factor is used in many countries of the world as a tool for measuring growing performances to broiler chicken [14]. Therefore, the factors involved in the European Production Efficiency Factor are body weight gain, feed conversion ratio and viability and are considered universal measures for evaluating broilers performance [14].

This study are designed to evaluate the effect of three stocking densities on broiler performance and its effect on economic efficiency of broiler chickens growth.

Materials and Methods

The present study was conducted at the poultry farm of Faculty of Agricultural Sciences, University of Sulaimani in Bakrajo from 8/1/2015 to 20/2/2015. Ninety eight day-old Ross 308 broiler chicks obtained from a commercial hatchery were weighed and distributed to the pens as three replicates, each of 8, 12 16 birds/ m² for three stocking densities. Commercial feed (CP = 22.0% and ME = 3,100 kcal/ kg) was used as a starter for feeding from 1 to 3 week of age and another feed (CP = 18.0% and ME = 3,200 kcal/ kg) as a finisher from 4 to 6 weeks of age. Feed and water were consumed *ad libitum*.

The average individual body weight for each flock and sex (males and females) was determined by weighing a random 25 to 30% of the chickens at 1, 7, 21, and 42 d of age. With these pooled data, a final body weight gained per bird either for each treatment or for (males and females) was estimated. Feed intake and feed conversion ratio per bird over the entire rearing period was calculated from amounts of provided and uneaten feed, which was determined daily. Mortality or viability found by daily visits to the pens was necropsied.

For analysis of performance indicators such as: body weight body gain, average daily gain, feed conversion ratio, viability, European Production Efficiency Factors and European Broiler Index the following formulas were used:

Body weight body gain (grams for each period) = body weight body (g) at the end day of the period - body weight body (g) in first day of the period;

Average daily gain (g/chick/d) = Body weight body gain / days number of growth period;

Feed conversion ratio (kg feed/kg gain) = cumulative feed intake (kg)/total weight gain (kg);

Viability (%) = chicks remaining at the end of period (%);

European Production Efficiency Factors = { Viability (%) x Body weight body (kg) } / { age (day) x Feed conversion ratio } x 100

European Broiler Index = { Viability (%) x Average daily gain (g/chick/d) } / { Feed conversion ratio x 10 }.

Statistical Analysis

The analysis of variance was done for all recorded data to find out the differences between groups Statistical program PASW Statistics Student Version 18 (SPSS). An ANOVA using the general linear models procedure included the main effects of treatments and sex on broiler performance and economic index. Duncan Multiple Range Test [15] was used to test the significant differences between the means of the levels. The simple correlations between treatments were estimated by (SPSS) computer program.

Results and Discussion

The effects of stocking density on the body weight, average weight gain, average feed intake and feed conversion ratio of treatments are shown in (Table 1). Effect of different stocking density on body weight was not significant at all periods of age except at day 28 of age. Chicks in T1 have significantly ($p \leq 0.05$) higher body weight compared with other two treatments at day 28 of age. However, although no statistical differences were found in the body weight at 42 days of age, the T1 showed numerically higher than T2 and T3. Although, there were no significant differences between treatments of body weight gain, the average of feed conversion ratio significantly ($p \leq 0.05$) differed between treatments. Birds in T1 significantly obtain better overall feed conversion ratio compared with birds in T2 and T3 at (1-42) days of age, while birds in T2 and T3 did not significantly differed. This results were agreement with [16] who found no significant difference in the final body weight of birds achieved in the various density treatments, they attribute their results to that the temperature and air quality were well controlled at all densities. A decrease in final BW at high densities has been reported by other authors [17] ; [18] and [4]. These results may be attributed to that the higher stocking density negatively affected final body weight [19], increasing the number of birds per unit area was found to depress growth rate and feed intake [4], due to the high environmental temperature and the reduced airflow at bird level [2]. [4] found that birds at the lowest density (10 per m^2) grew faster and consumed feed more than birds in three stocking densities (15 and 20 birds per m^2), Also they found that live weight gains and feed intake of birds were similar, with no significant on feed/weight gain. Furthermore, [20] reported that the body weight and average daily weight gain of birds at stocking densities (15/ m^2 and 30/ m^2) and increased stocking density reduced the average feed intake. [21] found no clear effect of stocking density on body weight gain, feed efficiency and mortality in the beginning two weeks of the experiment, but body weight gain, feed efficiency and mortality were significantly increased in low than high group of 4 to 5 weeks of ages. Therefore, body weight gain, feed efficiency and mortality were significantly increased in low than high group ($P < 0.05$) of total experimental period. Body weight gain, feed intake, and feed efficiency of broiler chickens were not affected by different raised stocking densities (12, 15 and 18 birds/ m^2) in different rearing seasons [22]. [2] announced that the treatment with (23.8 birds/ m^2) gave the lowest body weight, the yield of broilers per unit of floor space was highest (46.0 kg/ m^2) comparing with stocking densities of (17.9, 14.3 and 11.9 birds/ m^2). Weight gain, feed intake, livability and carcass characteristics of broilers grown at densities of (16, 20 and 24 birds/ m^2) were similar ($P \leq 0.05$).

Table 1: Effect of different stocking densities on body weight, average weight gain, feed intake and feed conversion ratio.

	age (days)	T1	T2	T3	mean \pm std. error
body weight (g)	1	49.78	48.44	49.67	49.30 \pm 0.46
	7	163.89	144.44	163.89	157.41 \pm 4.52
	14	421.67	421.67	404.72	416.01 \pm 7.52
	28	1291.67 ^a	1182.22 ^b	1180.56 ^b	1218.15 \pm 22.12
	42	2883.33	2783.33	2675	2780.56 \pm 74.22
average weight gain (g)	7	114.11	96	114.22	108.11 \pm 4.45
	14	257.78	277.22	240.83	258.61 \pm 10.52
	28	870.00	760.55	775.84	802.13 \pm 21.38
	42	1591.67	1601.11	1494.44	1562.41 \pm 68.47
	1-42	2833.56	2734.83	2625.33	2731.24 \pm 96.96
average feed intake (g)	7	179.38	180.25	219.48	193.04 \pm 11.46
	14	465.21	536.67	495.83	499.24 \pm 22.68
	28	1575	1468.06	1586.81	1543.29 \pm 30.81

	42	3215.63	3588.96	3658.23	3487.60± 80.22
	1-42	5435.21	5773.93	5960.35	5723.16±140.60
	7	1.56 ^b	1.87 ^a	1.92 ^a	1.79±0.06
<i>feed conversion</i>	14	1.81 ^b	1.9 ^{ab}	2.1 ^a	1.94±0.05
<i>ratio</i>	28	1.87 ^b	1.90 ^b	2.1 ^a	1.94±0.04
<i>(g feed : g gain)</i>	42	2.02 ^b	2.2 ^a	2.34 ^a	2.20±0.06
	1-42	1.91 ^b	2.12 ^a	2.27 ^a	2.1±0.06

^{a,b} Means within a row with no common superscript differ significantly (P<0.05).

Effect of sex of birds on body weight and weight gain was significant at all periods of age except weight gain at day 28 (Table 2).

Males significantly were heavier and obtained more gain of weight than females. These results may attribute to that female broilers need more space than males when they have the same body weight per square meter near marketing age as suggested by [11]. Also [16] found that males significantly were heavier than females. Having a faster growing rate, a male broiler is speculated to need more space than a female broiler [24]. While, [9] reported that the reduction in live performance at high stocking density treatment was higher among male broilers than among females.

Table 2: Effect of stocking density on male and female body weight and average weight gain (g)

<i>Traits</i>	<i>age (days)</i>	<i>sex</i>		<i>total</i>
		<i>male</i>	<i>female</i>	
<i>body weight (g)</i>	1	49.63	48.96	49.30±0.46
	7	168.52 ^a	146.3 ^b	157.41±4.51
	14	440 ^a	392.04 ^b	416.02±7.52
	28	1245.6 ^a	1190.7 ^b	1218.15±22.12
	42	3022.2 ^a	2538.9 ^b	2780.56±74.22
<i>weight gain (g)</i>	7	118.89 ^a	97.33 ^b	108.11±4.21
	14	271.48 ^a	245.74 ^b	258.61±6.13
	28	805.56	798.7	802.13±21.38
	42	1776.7 ^a	1348.2 ^b	1562.41±68.47
	1- 42	2972.6 ^a	2489.9 ^b	2731.26±74.21

^{a,b} Means within a row with no common superscript differ significantly (P<0.05).

The present results showed that an interaction existed between stocking density, sex, and age for BW gain and FCR. Before 35 d of age, male broilers had a worse BW gain and FCR compared with females, whereas the reverse was true from 36 to 42 d of age. The result showed that high stocking density had a severe effect on the growth of male broilers in starter and grower periods and on females at marketing age (36–42 d of age) when giving the same space allowance for both sexes, indicating that a special age-related space requirement exists for female birds. This result suggests that female broilers need more space than males when they have the same BW per square meter near marketing age.

There is no significant effect of different stocking densities on Viability (%), European Production Efficiency Factors and European Broiler Index at day (42) of age (Table 3).

The higher values was recorded in broilers from T1 for European Production Efficiency Factor (316.57) and European Broiler Index (311.18), followed by broilers from T2 for European Production Efficiency Factor (269.25) and European Broiler Index (264.55) and T3 for European Production Efficiency Factor (229.17) and European Broiler Index (224.94). However, chickens in the T2 were lower than T1 with up to (17.58 %) , T3 lower than T2 with up to (17.49%) and T3 lower than T1 with up to (38.14%) for European Production Efficiency Factor, while, chickens in the T2 were lower than T1, T3 than T2 and T3 than T1 with up to (17.63, 17.61 and 38.34%) for European Broiler Index.

The economic efficiency assessment on European Production Efficiency Factor and European Broiler Index was positively influenced by the growth performances (body weight, average daily gain, feed conversion ratio) and recorded viability for boiler in different stocking densities. Increasing values of the two indices (European Production Efficiency Factor and European Broiler Index) at T1 chicks, shows that the performances obtained are better than to the T2 and T3 chicks.

A research carried out by [17] and [2] reported that economic benefits per square meter are under most conditions still higher if the broilers are stocked more densely. Economic profit may come at the cost of reduced bird performance, health, and welfare if densities are excessive [1]. Densities of broilers are differ among countries and management systems[24].

Table 3: Effect of stocking density on Viability (%), European Production Efficiency Factors and European Broiler Index at day 42 of old.

<i>age (days)</i>	<i>viability (%)</i>	<i>European Production Efficiency Factors</i>	<i>European Broiler Index</i>
<i>T1</i>	<i>87.50</i>	<i>316.57</i>	<i>311.18</i>
<i>T2</i>	<i>86.11</i>	<i>269.25</i>	<i>264.55</i>
<i>T3</i>	<i>81.25</i>	<i>229.17</i>	<i>224.94</i>
<i>mean ± std. error</i>	<i>84.95 ±4.19</i>	<i>271.67±21.92</i>	<i>266.89±21.67</i>

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