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Effect of Stocking Density and Slaughter age on Growth Performance and Carcass Traits of Female Mule Ducks (Crossbred of Muscovy Drake and Pekin Ducks) During Summer Season in Egypt

Taboosha, M. F.

Animal Production Dept., Fac. of Agric., Al-Azhar Univ. Nasr City, Cairo, Egypt

ABSTRACT

A total Fifty-four day-old of female mule duck chicks were used for a period of 12 weeks of age to study the effect of different stocking densities and age of slaughter on the performance of broiler ducks and carcass traits. The birds were divided randomly into three groups (G1: stocking density 5 birds/m^2, G2: stocking density 6 birds/ m^2 and G3 stocking density 7 birds/m^2) with three replicates for each groups. The study revealed that the increasing densities reduced body weight insignificantly at 2 weeks and significantly at 4, 10 and 12 weeks of age. The broiler ducks grown at densities of 5 and 6 birds/m^2 (G1 and G2) had significantly higher body weight than birds stocked at 7 birds/m^2 at 4, 6, 10 and 12 weeks of age. At 10 and 12 weeks of age body weight was reduced by 7.56 and 8.38 % ($P<0.01$and $P< 0.05$) as stocking density rose from 6 to 7 and from 5 to 7 birds/m^2, respectively. Weight gain in all groups increased gradually from the beginning one-day old to 4 weeks of age, then it took into tapers until 10 weeks of age. Birds raised at stocking density 5 birds/m^2 had significantly higher weight gain than group of 7 birds/m^2 during period 0 - 12 weeks of age . however, the group of 6 birds/m^2 was in middle of the others ($P>0.05$). There was a pattern of decreasing feed intake with the increasing of stocking density, whereas the group 3 (7 birds/m^2) consumed less feed except at periods 0 - 2 and 8 - 10 weeks of age which showed highly insignificant feed consumption compared to the other groups. Cumulative feed conversion ratio (FCR) values for group 3 (7 birds/m^2) were better than other groups at intervals from 0 - 8, 0 - 10 and 0 - 12 weeks of age. Mortality percentages was not affected by density and it was just zero throughout the experimental period from one-day old to 12 weeks of age. At 10 and 12 weeks of age, six birds from each group (two birds from each replicate) were randomly chosen to study carcass traits. Slaughter at 12 weeks of age improved carcass and edible parts as absolute weight (kg) or percentage (%) of broiler ducks housed at 6 birds/m^2 (G2) compared to other groups (G1 and G3). The stocking density had no significant effect on any of the starved body weight, giblets (heart, liver and empty gizzard) weight and total edible parts (carcass + giblets) weights. While, it had significant effect on all carcass traits studied as a percentage. Slaughter age had no significant effect on all carcass traits studied as weight and percentage except giblets percentage which were significantly affected. The second group (6 birds/m^2) had the highest profit in the two intervals from one-day old to 8 weeks and from one-day old to10 weeks of age, while the third group (7 birds/m^2) had highest economic efficiency values at all periods compared to second and first (5 birds/m^2) groups, respectively. Also, the third group had better profit than other groups during period from one-day old to 12 week of age. The profit and economic efficiency values of marketing age, regardless of stocking density decreased from 32.35L.E and 89.71% at 8 weeks to 23.79L.E and 45.35% at 10 weeks and to 15.14L.E and 21.99% at 12 weeks of age, respectively.

Keywords: Stocking densities, Slaughter age, ducks

Introduction

Needs of animal protein are enormously increasing year after year . Poultry has lastly contributed effectively and in a short period of time in increasing meat production . It seems that ducks can play an important role in this respect . The prevailing sources of poultry meat in Egypt are broiler and ducklings. Although there is much published research on the effect of the stocking density on the growth performance of ducks, information on the relationship between the stocking density and the productivity of mule ducks is sparse. Ducks is a major producer of protein of high quality for human nutrition in the from of meat, because of their high nutritive value especially their contents of essential amino acids. Also duck meat is a very favorable meat for consumers in some countries of the world. Stocking density of broilers ducks can be either defined by the number or the weight of birds in a given area. Stocking density is reported using the number of birds per unit area or the amount of area per bird through out their life which reduces their opportunity for movement during the later stage of rearing. Farmers rear broilers ignoring stocking density in different seasons due to high price of construction materials and lack of knowledge. High stocking density creates health hazard in poultry shed. It might be hypothesized that farmers need to consider housing density with feed types to maximize profitability. Some studies show large benefits in reducing stocking density, while others show little or no differences. Biligili and Hess (1995) concluded that body weight, feed conversion, mortality, carcass scratches and breast meat yield were significantly improved when

Corresponding author: Taboosha, M. F., Animal Production Dept., Fac. of Agric., Al-Azhar Univ. Nasr City, Cairo, Egypt
E-Mail: mossadtabosha@yahoo.com

birds were given more space. Beg *et al.* (1994) found lower growth rate at higher density in open-sided house. In contrast, Feddes *et al.* (2002) demonstrated that when bird density was reduced, live body and carcass weights were also decreased.

High stocking density has been reported to increase ammonia production, foot pad lesions, litter moisture, locomotion, heat stress, and preening (Murphy and Preston, 1988; Newberry and Hall, 1988; Lewis and Hurnik, 1990; Bessie and Reiter, 1992 and Cravener *et al.*, 1992). Poultry husbandry in tropical and subtropical countries are affected by stocking density and increased temperature (Beg, 1993). Yalcini *et al.* (1997) found that body weight and body weight gain of broilers reared during summer was lower as compared to those reared during winter. Deaton *et al.* (1989); Wabeck *et al.* (1994), Al-Ribdawi and Singh (1989) also reported lower body weight for broilers reared during summer. In addition, Imaeda (2000) reported lower body weight of broilers during summer irrespective of stocking density. With the gradual expansion of duck production in Egypt, duck growers need to increase stocking density of broiler ducks in summer to increase production and profitability of the broiler duck farm. Keeping this idea in mind the present study was undertaken with the following specific objectives:

-To determine the effect of stocking density on performance of female mule ducks or Mulard ducks (crossbred of Muscovy drake and Pekin duck).
-To identify the suitable stocking density of ducklings fattened on the floor under summer environmental conditions of Egypt.
-To estimate the carcass traits of female mule ducks reared in summer season at different ages

Material and Methods

This study was carried out at the Poultry Experimental Station, Faculty of Agriculture, Al- Azhar University, Nasre City Cairo, Egypt, in order to study the growth performance and carcass traits at different ages of female mule ducks or Mulard ducks (crossbred of Muscovy drake and Pekin duck), as affected by stocking density under summer environmental conditions.

Duck chicks and management:

A total number of Fifty-four day-old of female mule duck chicks were obtained from a commercially duck company Al-Mona tread were used and divided randomly into three groups (G1: stocking density 5 birds/m^2, G2: stocking density 6 birds/ m^2 and G3 stocking density 7 birds/m^2) with three replicates for each groups. The average initial body weight of ducklings was similar among all groups. Birds in each replicate had the same feeding and drinking space regardless of stocking density. During the whole experimental period, ducks had free access to feed and water. Ducklings were fed on a starter mash ration containing 23.34 % protein and 3020.8 Kcal ME/kg of ration during the first two weeks of age. Then birds were switched on a grower diet containing 19.26 % protein and 3250.37 Kcal ME/kg feed up to the end of the experiment Table (1).

Table 1: Feed ingredients and calculated composition of starter and grower diet from one-day old to 12 weeks of age.

Ingredients (%)	Starter diet from one-day old to 2 weeks of age	Grower diet From 2 to 12 weeks of age
Ground yellow corn	60.41	66.45
Soybean meal (44%)	22.6	19.4
Gluten	12.6	8
Plant oil	0	3.4
Limestone	1.29	2.2
Di-calcium phosphate	2	0.1
Lysine	0.3	0.03
Methionine	0.2	0.07
Nacl	0.3	0.1
Broiler premix **	0.3	0.25
Total	100	100
Calculated composition		
Crude protein %	23.34	19.26
Crude fiber %	4.54	3.86
Metabolizable energy, kcal ME /kg	3020.80	3250.37
Phosphor %	0.75	0.37
Available phosphorus, %	0.35	0.20
Calcium, %	0.99	0.93
Methionine, %	0.87	0.58
Lysine, %	1.32	0.89

***Broiler premix , each 3 Kilo grams contain Mn 600 mg Cu 4000 mg , Fe 3000 mg, Co 100 mg and Selenium 100 mg, vit. A 1200000 IU , vit. D 2000000 IU , vit. E 10000 IU , vit. B1 1000 mg vit. B2 5000 mg , vit. B6 1500 mg vit. B12 10 mg , Bant. Acid 10000 mg , Folic acid 1000 mg , Biotin50 mg and Niacin 30000 mg .*

The average summer temperature and humidity at bird level fluctuated between 25 - 31.9Co and 50 - 78% respectively. All- night light was provided with one 100 watt lamps light to eat and drink. All ducks in each replicate were weighed individually at one-day old, 2, 4, 6, 8, 10 and 12 weeks of age using electrical balance. The average body weight, feed intake, feed conversion, weight gain and mortality were computed. At 10 and 12 weeks of age, Six birds from each group (two birds from each replicate) were randomly chosen. Before slaughter, the birds were fasted for 12 hours,ducks were individually weighed to estimate fasted live body weight and slaughtered by A sharp knife. Following slaughter, the ducks were bled for about five min., and then scalded in water at about 63 C° for 1 min., to facilitate plucking. The birds were de feathered manually. Then the carcasses were eviscerated (removing the digestive tract, lungs, trachea, heart, abdominal fat and crop), and the heads and legs were cut off (the heads were cut off between the occipital condyle and the atlas, and the legs were cut off at the hock joint) and then became a carcass ready to estimate the following : eviscerated carcass weight (carcass empty including nick, abdominal fat and wings) , giblets weight (heart, liver and empty gizzard), edible parts or carcass dressing weight (eviscerated carcass and giblets weight) and inedible parts weight (feathers, blood, digestive tract, lungs, trachea, crop, head and legs). The carcass parts were weighed and dissected into meat and bones, Bone weight includes the weights of all bone elements of the carcass, separated during detailed dissection.

Following formula were used to find out different parameters:

$$\text{Feed consumption (g/bird)} = \frac{\text{Feed intake in a replication}}{\text{No. of live birds in a replication}}$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed intake (g)/bird}}{\text{Live weight (g)/bird}}$$

Weight gain = Body weight at the end of interval (W2) – Body weight at the onset interval (W1)
Profit = Total returns of ducks – Total costs

$$\text{Economical efficiency} = \frac{\text{Profit}}{\text{Total costs * 100}}$$

Statistical analysis :

Data were subjected to statistical analysis using one-way analysis of variance was used to the effect of stocking density on growth performance and tow-way analysis of variance was used to test the effect of stocking density and slaughter age and their interaction using the General Linear Model (GLM) Procedure of SAS (2002) as following model;

1- $Y_{ij} = \mu + G_i + e_{ij}$ where,
Y_{ij} = observation record,
μ = overall mean,
G_i = effect of groups (G1, G2 and G3) and
e_{ij} = residual (random error).
2- $Y_{ijk} = \mu + G_i + A_j + (GA)_{ij} + e_{ijk}$ where,
Y_{ijk} = observation record,
μ = overall mean,
G_i = effect of groups (I = 1, 2 and 3 densities),
A_j = slaughter age effect (10 and 12 weeks),
$(GA)_{ij}$ = interaction between stocking density and slaughter age and
e_{ijk} = residual (random error).

The significance differences among means were done according to Duncan (1995) multiple range test.

Results and Discussion:

Growth performance:

The average body weight of female mule ducks (crossbred of Muscovy drake and Pekin duck) as affected by density are shown in Table (2). Increasing densities reduced body weight insignificantly at 2 weeks of age. The broiler ducks grown at density of 5 and 6 birds/m^2 (G1 and G2) had significantly ($P<0.05$) higher body weight than birds stocked at 7 birds/m^2 (G3) at 4, 6, 10 and 12 weeks of age. Meanwhile, birds reared in the second group had ($P>0.05$) higher body weight compared to group one at 6, 8 and 10 weeks of age. Also, broiler ducks stocked at 6 birds/m^2 had higher body weight ($P<0.01$) than those at the other two densities (5 and 7 birds/m^2) at 8 weeks of age. On the other hand, broiler ducks reared in group one had higher body weight ($P>0.05$) than birds in the second group at 12 weeks of age. It is worth mentioning, that the broiler ducks reared at a stocking density 7 birds/m^2 were able to compensate the retardation in body weight thus they had almost similar body weight to those reared at the density 5 birds/m^2 at 8 weeks of age. At 10 and 12 weeks of age body weight was reduced by 7.56 and 8.38 % (P<0.01and P< 0.05) as stocking density rose from 6 to 7 and from 5 to 7 birds/m^2, respectively. These results partially agreement with Ahmet *et al.* (2011) who found that the live body weight of broilers grown at density of 13 birds/m^2 was higher than those stocked at the other two densities (9 and 17 birds/m^2) during the 2nd and 3rd weeks (P<0.01). Also, the same author reported that birds in highest stocking density group (17 birds/m2) had the lowest live body weight of all three groups during the 4th , 5th and 6th weeks of age (P<0.01). Some researchers reported that individual body weight decreased insignificantly with increasing stocking density (El-Deek and Al-Harthi, 2004; Ravindran *et al.*, 2006; Turkyilmaz *et al.*, 2008). Results of the present study are similar to results of some researchers who reported that individual body weight decreased significantly with increasing stocking density (Bilgili and Hess, 1995; Feddes *et al.*, 2002; Galobart and Moran, 2005; Dozier *et al.*, 2006; Skribc *et al.*, 2009). In the current study, the retardation in body weight associated with the increasing stocking density was attributed to the fact that feed intake was progressively decreased (P<0.05) with increasing density at all growing age intervals. These results are in agreement with Osman (1993) who found that the increasing density above 4 birds/m^2 on the floor at 6 weeks of age and above 2 birds/m^2 at 8 weeks old significantly (P<0.05) decreased body weight at the previous age respectively. On the contrast Feddes *et al.* (2002), who reported similar body weight of birds reared at densities of 12, 18, and 24 birds/m^2. Also, Buijs *et al.* (2009) found no difference in final BW at 39 days of age as stocking density of birds increased.

Table 2: Body weight (kg/bird) for different groups of stocking density of ducks at different ages.

	Stocking density		
Age	G1 (5 birds / m^2)	G2 (6 birds / m^2)	G3 (7 birds / m^2)
One-day old	0.06 ± 0.00^a	0.06 ± 0.00^a	0.05 ± 0.00^a
2 weeks	0.42 ± 0.02^a	0.41 ± 0.01^a	0.40 ± 0.01^a
4 weeks	1.35 ± 0.03^a	1.35 0 ± 0.03^a	1.26 ± 0.02^b
6 weeks	2.08 ± 0.04^a	2.16 ± 0.05^a	1.90 ± 0.03^b
8 weeks	2.69 ± 0.04^b	2.93 ± 0.05^a	2.65 ± 0.04^b
10 weeks	3.12 ± 0.05^a	3.13 ± 0.06^a	2.91 ± 0.05^b
12 weeks	3.62 ± 0.10^a	3.52 ± 0.08^a	3.34 ± 0.04^b

a-b Different means in the same rows.

Results of Table (3) indicate that weight gain in all groups increased gradually from the beginning one-day old to 4 weeks of age, then it took into tapers until 10 weeks of age. The broiler ducks stocked at 6 birds/m^2 had weight gain higher (P<0.05) than those reared at stocking density of 5 and 7 birds/m^2 during period 0 - 8 weeks of age, respectively. During period 0 - 10 weeks of age the birds under higher stocking density had significantly lower weight gain than those reared at stocking density of 6 and 5 birds/m2, respectively. Birds raised at stocking density 5 birds/m^2 had significantly higher weight gain than group of 7 birds/m^2 during period 0 - 12 weeks of age. However, the group of 6 birds/m^2 was in middle of each other's (P>0.05). These results are agreement with of Taboosha (2006) who reported that the highest daily gain and relative growth rate occurred during the four biweekly intervals from hatching up to 8 weeks of age in the nine breed groups of ducklings studied, after this age it become very low. Also, Mostafa (1989) with Pekin and Muscovy ducks found that the highest relative growth rate overall experimental period occurred during the period from 0 - 4 weeks of age. In addition Batta (2004) indicate similar trend to that observed in the present study with Muscovy, Pekin and Campell breed, respectively. Feeding performance values in treatments groups are given in Table (3) it was observed that, at all periods of the study, the group 3 (7 birds/m^2) consumed less feed except at periods 0 - 2 and 8 - 10 weeks of age which were insignificant compared to feed consumed by the other groups. Results of Table (3) clear the differences between groups in feed intake were significant in all periods studied except the following periods 0-2, 2-4 and 8-10 weeks of age which were insignificant. There was a pattern of decreasing feed intake with the increasing the stocking density. In this respect, Beg *et al.* (2011) reported that the lower stocking density of broiler chicks (8 birds/m^2) consumed significantly (p<0.05) highest amount of feed (4466 g/bird), whereas the higher stocking density (14 birds/m^2) consumed least amount of feed (4307 g). The reduction in feed intake associated with increasing densities of ducks may occur when some birds may have to travel further to access feeder, or if feeder space is limited, feed consumption may be negatively affected by increased stocking density. These results are in agreement with Osman (1993) who reported that the reduction in feed intake with increasing density may be due to that birds are indirectly denied free access to the feed troughs and drinkers. In addition, Beg *et al.* (2011) found that the decrease in feed consumption associated with increasing density of broiler may be due to less feeder space and immovability of birds within the pen and less ability of birds to express normal postural adjustments and to access feed. Findings of the present study are agreement with some previous evaluations involving stocking density ranges of 10 to 20 birds/m^2 for broiler chicken in which the general trend was a linear decrease in individual BW and feed intake with increasing population density (Proudfoot *et al.*, 1979; Shanawany,1988; Cravener *et al.*, 1992 and Dozier *et al.*, 2005). Also, Several authors agreed that the feed consumption diminished with increasing stocking density (Scholtyssek and Gschwindt, 1983; Valdivie and

Dieppa, 2002; Singh and Sharma, 2003; Thomas *et al.*, 2004; Santos *et al.*, 2005) which is similar to the present findings.

Table 3: Effect of stocking density on weight gain [1], feed intake [2] and feed conversion [3] at different periods of ducks.

Weeks of the rearing period	Parameters	Stocking density		
		G1 (5 birds / m^2)	G2 (6 birds / m^2)	G3 (7 birds / m^2)
0 - 2	1	0.36 ± 0.02^a	0.35 ± 0.01^a	0.35 ± 0.01^a
	2	0.42 ± 0.03^a	0.42 ± 0.03^a	0.43 ± 0.03^a
	3	1.25 ± 0.11^a	1.20 ± 0.10^a	1.23 ± 0.10^a
2 - 4	1	0.94 ± 0.03^a	0.94 ± 0.03^a	0.86 ± 0.02^b
	2	2.10 ± 0.2^a	2.03 ± 0.06^a	1.79 ± 0.00^a
	3	2.23 ± 0.26^a	2.16 ± 0.13^a	2.10 ± 0.02^a
4 - 6	1	0.73 ± 0.04^{ab}	0.81 ± 0.06^a	0.64 ± 0.04^b
	2	2.89 ± 0.17^a	2.80 ± 0.05^a	2.38 ± 0.09^b
	3	3.95 ± 0.22^a	$3.46 \pm 0{,}34^a$	3.72 ± 0.08^a
6 - 8	1	0.61 ± 0.05^a	0.77 ± 0.07^a	0.75 ± 0.04^a
	2	2.44 ± 0.08^a	2.18 ± 0.01^b	2.03 ± 0.03^b
	3	4.00 ± 0.09^a	2.80 ± 0.28^b	2.71 ± 0.12^b
8 - 10	1	0.43 ± 0.07^a	0.20 ± 0.07^a	0.30 ± 0.05^a
	2	2.16 ± 0.63^a	1.30 ± 0.04^a	2.60 ± 0.01^a
	3	5.00 ± 0.22^c	6.50 ± 0.19^b	8.70 ± 0.20^a
10 - 12	1	0.50 ± 0.10^a	0.39 ± 0.07^a	0.43 ± 0.07^a
	2	4.94 ± 0.11^a	4.63 ± 0.01^b	4.17 ± 0.07^c
	3	9.88 ± 0.72^a	11.90 ± 1.48^a	9.70 ± 0.88^a
0 - 8	1	2.63 ± 0.04^b	2.87 ± 0.05^a	2.59 ± 0.04^b
	2	7.86 ± 0.43^a	7.42 ± 0.08^{ab}	6.61 ± 0.10^b
	3	2.99 ± 0.12^a	2.60 ± 0.02^b	2.55 ± 0.03^b
0 - 10	1	3.06 ± 0.05^a	3.07 ± 0.05^a	2.85 ± 0.04^b
	2	11.37 ± 0.46^a	10.72 ± 0.09^{ab}	9.77 ± 0.09^b
	3	3.72 ± 0.20^a	3.49 ± 0.10^a	3.43 ± 0.02^a
0 - 12	1	3.56 ± 0.09^a	3.46 ± 0.08^{ab}	3.30 ± 0.04^b
	2	16.32 ± 0.57^a	15.35 ± 0.09^a	13.94 ± 0.16^b
	3	4.58 ± 0.11^a	4.44 ± 0.09^a	4.22 ± 0.04^a
8 - 12	1	0.93 ± 0.04^a	0.60 ± 0.07^b	0.70 ± 0.03^b
	2	8.46 ± 0.13^a	7.93 ± 0.04^b	7.33 ± 0.05^c
	3	9.10 ± 0.05^a	13.22 ± 0.09^a	10.47 ± 0.04^a

a-b Different means in the same rows 1= weight gain, 2= feed intake, 3= feed conversion ratio

Cumulative feed conversion ratio (FCR) values for group 3 (7 birds/m^2) were better than other groups at intervals from 0 - 8, 0 - 10 and 0 - 12 weeks of age Table (3). The differences were significant ($P<0.01$) at 1st interval (0 - 8 weeks) and insignificant ($P>0.05$) at the 2nd and 3rd intervals (0 - 10 and 0 - 12 weeks of age). The lower FCR value indicates positive performance. It is evident from the result that feed conversion was better at the higher density than at the lower densities which is supported by Gonzalez *et al.* (1978), Scholtyssek and Gschwindt (1983), Ravindran and Thomas (2004), Valdivie *et al.* (2004) and Sreehari and Sharma (2010). Also, these result is similar to the report in another experiment (Osman,1993), who found that the improvement ($P<0.05$) in cumulative feed conversion had occurred when stocking rate increased from 2 to 6 birds/m^2 of floor area at 4, 6, 8 and 10 weeks of age. Also, Beg *et al.* (2011) reported that the average FCR value for broiler chicks stocking density (8 birds/m^2) (2.09) and (10 birds/m^2) (2.08) were significantly ($p<0.05$) higher than (12 birds/m^2) (1.95) and (14 birds/m^2) (1.94). The FCR value of density 14 and 12 birds/m^2 were significantly better ($p<0.05$) in comparison with the density 8 and 10 birds/m^2. Mortality percentages was not affected by density and it was just zero throughout the whole experimental period from one-day old to 12 weeks of age. These results are in good agreement with Shanawany (1988) who indicated that feed intake decreased but mortality rate was not affected when broilers were reared at high stocking rate. Also, Osman (1993) found that mortality rate in male peking ducks was not affected by the increase the stocking density and it was just zero during the experimental period from 2 to 10 weeks old.Improvement in feed conversion ratio associated with increased density of birds is probably due to the inability of the bird to move freely as a result of lack of space allocated to it and thus lower the energy lost in the movement and which are stored in the body in the form of growth. But birds of lower density groups got chance to intake more feed, this more feed is one type of wastage because they didn't convert it into meat and finally unable to show better FCR value.These observations are consistent with reports of Bolton *et al.* (1972) who indicated that the improvement in feed conversion at higher stocking rate was attributed to decreasing energy requirements as a result of decreasing birds activity and conservation of heat. In this regard, (Stanley and Krueger,1981; Vo and Fanguy,1982; Dafwang *et al.*,1987 and Shanawany,1988) who reported that body weight of broilers was depressed. But feed conversion was improved at high stocking densities. Osman (1993) reported that the improvement in feed conversion at higher stocking densities of ducks may be due to the better nutrient utilization and the reduction in body fat deposition as a result of indirect feed restriction. Similarly, in a recent study, Dozier *et al.* (2006) found that growth rate and feed conversion from 1 to 15 d of age in broiler chickens were improved as the stocking density increased but feed consumption was not affected. These inventories are also determined by some researchers (Sengul *et al.*,2000; Naszligul *et al.*,2001; Altan *et al.*,2002; Anderson *et al.*,1995; Robinson,1979; Lee and Moss,1991and Roush *et al.*,1984). Also, Ahmet *et al.* (2011) reported that feed conversion ratio (FCR) for broiler chickens at the period 21 - 42 days (2.02, 2.03 and 2.21 for densities 9, 13 and 17 birds/m^2, respectively) was significantly affected (P<0.05). These results are in contrast to other reports that found that feed conversion ratio was not affected by stocking density (Cravener *et al.*, 1992; Feddes *et al.*, 2002). Similarly, in a recent study, the stocking density had no significant effect on total feed intake and feed conversion ratio but, average daily feed intake (ADFI) and body weight gain were significantly affected, Beloor *et al.*(2010). Also, Tong *et al.* (2012) found that Increasing the stocking density decreased daily weight gain and daily feed intake from 1 to 28 d of age (P < 0.05), but the Feed / Gain was not affected (P > 0.05). In this respect, Ahmet *et al.* (2011) found that feed conversion ratio (FCR) for broiler chickens were 1.6, 1,57 and 1,57; 1.9, 1.95 and 2.00 for densities 9, 13 and 17 birds/m^2 at the periods from 0 - 21 and 0 - 42 days, respectively. Also, the same authors reported that FCR was insignificantly affected (p>0.05) by increasing density during the same above mentioned periods.

Carcass traits:

There were significant interaction between stocking density and slaughter age on starved body weight, carcass and total edible parts either as absolute weight (kg) or percentage (%) and giblets and inedible parts as a percentage (%), (Table 4 and 5). Results indicate that slaughtering birds at 12 weeks of age improved significantly (P<0.05) carcass and total edible parts as absolute weight (kg) or percentage (%) of broiler ducks housed at 6 birds/m^2 (G2) compared to other groups (G1 and G3). On the other hand the interaction between stocking density and slaughter ages indicate that slaughter of birds at 10 weeks of age increased the giblets percentage in birds stocked at 6/m^2 (G2) and 7/m^2 (G3), respectively. Meanwhile, slaughtering at 10 weeks of age increased inedible parts percentage of broilers ducks housed at 6/m^2 (G2) compared other groups (G1 and G3). On the other hand, slaughtering at 12 weeks of age insignificantly increased inedible parts percentage of broilers ducks housed at 5 and 6/m^2 (G1 and G3), respectively. Effect of stocking density and slaughter age on carcass traits of weight female mule ducks are shown in Table (4). The stocking density as an independent variable had no significant effect on any of the starved body weight, giblets (heart, liver and empty gizzard) and edible parts (carcass + giblets). Meanwhile, the differences between group of densities were significant in carcass, bones and inedible parts weight. Whereas, the birds stocked in G3 (7 birds/m^2) had carcass weight highly significant compared to G2 (6 birds/m^2) . But broiler ducks stocked at 5 birds/m^2 (G1) showed intermediate carcass weight between other groups. These results take the same direction reported by El-Deek and Al-Harthi (2004) found that carcass weight (1221.1 g), dressing percentage (64.9%), front and hind part weight and percentages (645.2 and 575.9 g and 34.3 and 30.6%, respectively) for broilers stocked at 14 birds/m^2 which were high compared to broilers stocked at 10 birds/m^2 (1198.8 g), (63.8 %), (640.6 and 558.2 g 34.1 and 29.7 %, for the same above traits, respectively) , but the differences were not significant. On the contrary Cravener *et al.* (1992) found stocking density at 0.05 m^2/bird decreased carcass weight significantly compared to those stocked at 0.07, 0.09 and 0.11 m^2 per bird. Also, El-Deek and Al-Harthi (2004) found that increasing stocking density decreased insignificantly carcass weight(1149.9 g) and significantly dressing percentage (62.8 %) and hind part weight and percentage (526 g and 28.7 %) when broilers were stocked at 18 birds/m^2 compared to those of birds stocked at 14 birds/m^2 (1221.1), (64.9 %) and (575.9 g and 30.6 %), respectively. Results of the present study showed that birds stocked at 7 birds/m^2 (G3) had bone weight had significantly higher compared to birds in G1 and G2. While, the differences between G1 and G2 were insignificant for the same trait. The inedible parts decreased with increasing stocking density whereas, G1 was highly significant compared to G2 and G3, respectively. While, the differences between G2 and G3 on the same trait were no significant.

Effects of stocking density on carcass traits as a percentages (%) are shown in Table (5). The stocking density as an independent variable had significant effect on all carcass traits studied. Data of Table (5) indicate that carcass, total edible parts and bone percentages increased significantly with increasing stocking density. On the contrary, the total inedible parts decreased significantly with increasing stocking density. Meanwhile, the giblets percentage were significantly affected (higher) in G2 (5.46%) compared to G1 (5.13%) and G3 (4.98%), respectively. Meanwhile, the differences between G1 and G3 were insignificant. In brief, the changes in carcass (g and %) , bone (g and %) and edible parts weight as result of changes in stocking density may reflect the improve of the nutrient metabolism under the stress resulted from increasing stocking density.

Data of Table (4) show that slaughter age as an independent variable had no significant effect on all traits studied as weight. Meanwhile, the birds slaughtered at 12 weeks of age showed insignificant high starved body weight (3.46 kg), carcass weight (2.55 kg), bone weight (0.405 kg) and total edible parts weight (2.72 kg) compared to the birds slaughtered at 10 weeks of age (3.36, 2.47, 0.383 and 2.63 kg for the same above traits, respectively. On the other hand, the birds slaughtered at 10 weeks of age showed insignificant high giblets and inedible parts weight compared to another slaughter age. These results are agreement with Mehmet et al (2013) found that no significant differences between the slaughter ages of 10 weeks and 12 weeks in terms of slaughter weight, hot and cold carcass weight, and head weight. On the contrast, Erisir et al (2009) reported that slaughter age significantly affected the slaughter weight, cold carcass yield (%), breast (%), leg (%) and wing (%).

Table 4 . Effect of stocking density and slaughter age on carcass traits as weight (kg) of female mule ducks.

Carcass Traits(kg)	Bird density/m^2	Age		Overall	Prob		
		10 weeks	12 weeks		Density	Age	Density*Age
FBW	5	3.53±0.08	3.36±0.06	3.44			
	6	3.17±0.04^b	3.500.07^a	3.34			
	7	3.37±0.10	3.51±0.04	3.44			
	Overall	3.36	3.46		N.S	N.S	0.003
Carcass	5	2.57±0.07	2.41±0.05	2.49^{ab}			
	6	2.28±0.04^b	2.62±0.06^a	2.45^b			
	7	2.56±0.07	2.61±0.04	2.58^a			
	Overall	2.47	2.55		0.05	N.S	0.0004
Giblets	5	0.180±0.004	0.180±0.004	0.180			
	6	0.190±0.01	0.180±0.01	0.180			
	7	0.171±0.01	0.170±0.003	0.171			
	Overall	0.183	0.176		N.S	N.S	N.S
Bones	5	0.380±0.01	0.390±0.001	0.385^b			
	6	0.370±0.01	0.395±0.01	0.382^b			
	7	0.400±0.01	0.430±0.01	0.415^a			
	Overall	0.383	0.405		0.0001	N.S	N.S
Edible parts	5	2.73±0.07	2.58±0.05	2.66			
	6	2.47±0.05^b	2.81±0.07^a	2.63			
	7	2.69±0.08	2.76±0.05	2.74			
	Overall	2.63	2.72		N.S	N.S	0.001
Inedible parts	5	0.80±0.02	0.78±0.01	0.79^a			
	6	0.73±0.02	0.71±0.02	0.72^b			
	7	0.68±0.02	0.70±0.01	0.69^b			
	Overall	0.74	0.73		0.0001	N.S	N.S

Data of Table (5) show that slaughter age as an independent variable had no significant effect on all traits studied as a percentage except giblets percentage which were significantly high in broiler ducks slaughtered at 10 weeks of age compare to other group (10 weeks). Meanwhile, The overall means of carcass and total edible parts percentages were insignificant higher in broiler ducks slaughtered at 12 weeks of age compared to other group (10 weeks). On the contrast, the birds slaughtered at 10 weeks of age had overall means of bones and total inedible parts percentages which were insignificant higher compared to other group (12 weeks). In the present study, The absence of significant differences between birds slaughtered at 10 and 12 weeks of age in all carcass characteristics as a weight and percentages except giblets (%) is may be due to the convergence body weight at these ages (10 and 12 weeks) due to lower weight gain and feed efficiency during the period from10 to 12 a week of age. These results are agreement with Erisir et al (2009) reported that after 8 weeks, the increase of the body weight had no effect on carcass weight. Also, they found that major changes in ducks related with age occurred in percentage of the breast (increased) and legs (decreased). Wing percentage increased till 8 weeks of age and then decreased.

Economical evaluation:

Results of monetary inputs and outputs of ducks as affected with stocking density and age marketing are presented in Table (6). Concerning stocking density, regardless of marketing of age, the second group (6 birds/m^2) had the highest profit in the two intervals from one-day old to 8 weeks and from one-day old to10 weeks of age, while the third group (7 birds/m^2) had highest the economic efficiency values in all periods compared to second (6 birds/m^2) and first (5 birds/m^2) groups, respectively. Also, the third group had better profit than other groups during period from one-day old to 12 week of age. These results are in good agreement with Beg *et al.* (2011) who illustrated that the average Benefit Cost Ratio (BCR) data of different stocking density groups varied from 1.05 to 1.13. The benefit cost ratio was affected by different stocking densities. Higher density showed maximum benefit. Although there was no significant ($p<0.05$) difference between higher density (12 birds/m^2) (1.13) and (14 birds/m^2) (1.12). The maximum benefit was found in the density of 12 birds/m^2. It is evident that the profit margins increased as stocking density increased and this findings agreed by Diego *et al.* (1995), Oliveira *et al.* (2000), Miragliotta *et al.* (2002) and Moreira *et al.* (2004).

Results of the same table clear that profit and economic efficiency values of age at marketing, regardless of stocking density decreased from 32.35L.E and 89.71% at 8 weeks to 23.79L.E and 45.35% at 10 weeks and to 15.14L.E and 21.99% at 12 weeks of age, respectively. The high decline in net profits and economic efficiency associated with age of marketing due to the lower weight gain (0.93, 0.66 and 0.71 kg for G1, G2 and G3, respectively) and increase feed intake (8.46, 7,93 and 7.33 kg, for G1, G2 and G3, respectively) and consequently lower feed conversion (9.1, 11.97 and 10.02 g/g for the same groups mentioned above, respectively) during the period 8-12 week of age compared to the first fattening period (from one-day old to 8 week of age), where it was (2.63, 2.79 and 2.57kg for weight gain), (7.86, 7.42 and 6.61kg for feed intake) and (2.98, 2.66 and 2.57g/g for feed conversion) for G1, G2 and G3, respectively Table (3). These results are in agreement with Mehmet et al (2013) who reported that the ducks showed a better feed conversion ratio in the tenth week, but after this week, poor feed conversion efficiency was observed based on slow live weight gain.

Table 5 . Effect of stocking density and slaughter age on carcass traits as percentages (%) of female mule ducks.

Carcass Traits(%)	Bird density/m^2	Age		Overall	Prob		
		10 weeks	12 weeks		Density	Age	Density*Age
Carcass	5	72.54±0.33	71.61±0.32	72.08^c			
	6	71.59±0.50^b	74.73±0.35^a	73.16^b			
	7	75.05±0.32	74.58±0.53	74.82^a			
	Overall	73.06	73.64		0.0001	N.S	0.0001
Giblets	5	5.02±0.10	5.24±0.10	5.13^b			
	6	5.81±0.20^a	5.06±0.16^b	5.46^a			
	7	5.10±0.10^a	4.86±0.10^b	4.98^b			
	Overall	5.31^a	5.05^b		0.002	0.01	0.001
Bones	5	10.19±0.21	10.81±0.40	10.50^b			
	6	11.40±0.22	10.89±0.30	11.15^a			
	7	11.67±0.32	11.32±0.20	11.50^a			
	Overall	11.09	11.01		0.003	N.S	N.S
Edible parts	5	77.57±0.32	76.85±0.40	77.21^c			
	6	77.40±0.60^b	79.79±0.40^a	78.60^b			
	7	80.15±0.33	79.05±0.70	79.60^a			
	Overall	78.37	78.57		0.0001	N.S	0.0007
Inedible parts	5	22.43±0.32	23.15±0.40	22.79^a			
	6	22.60±0.60^a	20.21±0.40^b	21.40^b			
	7	19.85±0.33	20.95±0.70	20.40^c			
	Overall	21.63	21.43		0.0001	N.S	0.0007

Table 6. Economical study for the effect of stocking density and age at marketing.

Rearing periods (weeks)	Groups of stocking density	L.B.W of ducks (kg)	Feed intake (Kg)	Price of kg feed intake/ L.E	Sale price of kg meat/L.E	Feed costs/ L.E	Other costs**	Total costs/ L.E	Total returns of ducks	Profit	Economic efficiency %
0 - 8	5 birds/m^2	2.69	7.86	3.80	25	29.9	8.97	38.87	67.25	28.38	73
	6 birds/m^2	2.87	7.42	3.80	25	28.2	8.46	36.66	71.75	35.09	95.70
	7 birds/m^2	2.65	6.61	3.80	25	25.12	7.54	32.66	66.25	33.59	100.02
Mean		2.74	7.30	3.80	25	27.74	8.32	36.06	68.42	32.35	89.71
0 - 10	5 birds/m^2	3.12	11.37	3.80	25	43.20	12.96	56.16	78	21.84	38.89
	6 birds/m^2	3.12	10.72	3.80	25	40.73	12.22	52.95	78	25.05	47.30
	7 birds/m^2	2.91	9.77	3.80	25	37.12	11.14	48.26	72.75	24.49	50.75
Mean		3.05	10.62	3.80	25	40.35	12.11	52.46	76.25	23.79	45.35
0 - 12	5 birds/m^2	3.62	16.32	3.80	25	62.02	18.61	80.18	90.50	9.87	12.24
	6 birds/m^2	3.53	15.35	3.80	25	58.33	17.50	75.83	88.25	12.42	16.38
	7 birds/m^2	3.36	13.94	3.80	25	52.97	15.89	68.86	84	15.14	21.99
Mean		3.50	15.20	3.80	25	57.77	17.18	74.95	87.58	12.48	16.65

*** other costs = 30 % from feed costs.*

The decrease in growth performance resulted from increasing age of ducks from 8 to 12 weeks could be attributed to the increase in stress resulted from competition for feeds and water, increased house temperature, increasing temperature between and underneath the birds microbial activity, and ammonia production. This result partially agrees with the decrease in growth (body weight gain) showed during later age of 9 - 12 weeks (530 and 428.12g/bird) rather than early age of 3 - 6 weeks (881.67 and 690.63g/bird) for Muscovy and Sudani ducks, respectively, Laila et al (2012). Also, Laila et al (2012) reported that Feed intake and feed conversion ratio values increased from (117.46 and 114.85 g) and (2.80 and 3.49 g/g) at early age (3-6 weeks) to (152.21 and 146.05 g) and (6.03 and 7.16 g/g) during later age (6-9 week) for Muscovy and Sudani ducks, respectively. Also, Zhou et al (2000) reported that from the view point of feeding efficiency, the market age of meat type ducks at 6 weeks was more beneficial than that at 8 or 10 weeks to reduce the feeding cost. On the other hand Erisir et al (2009) found that feed efficiency for ducks was better at 6 weeks of age than the other ages (7, 8 and 9 weeks of age).

Conclusion:

Results obtained in the present study show that slaughter age had no significant effect on all carcass traits studied (carcass g and %, bone g and %, edible parts g and %, inedible parts g and % and giblets weight. Conversely, stocking density significantly influenced body weight, weight gain, feed intake and feed conversion ratio. In conclusion, the market age of female mule ducks at 8 weeks of age is more beneficial due to the better feed efficiency, lower feed intake and lower feed cost. Also, results in the current study, show that broiler female mule ducks could be stocked up 6 birds/m^2 without any negative affect on growth performance.

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