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Original article

Evaluation of the stocking rate on growth performance, carcass traits and meat quality of male peking ducks

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A B S T R A C T

Two hundred and forty male Peking ducklings were raised in four litter pens at random to provide stocking densities of 2, 4, 6 and 8 birds/m^2 on the floor and 4, 8, 12 and 16 birds/m2 in cages. The birds were fed ad libitum during the day and equally exposed to all necessary management practices. The trial was conducted to observe the comparative carcass traits and meat quality. There were no significant differences ($p>0.05$) in back, wings, neck and feed conversion ratio. Dressing percentage decreased ($p<0.05$) with increasing density above 4 birds/m2 on floor and in cages respectively. Results from this study showed that stocking rate had no effect on physical characteristics of breast and thigh meat.

1. Introduction

Animal protein shortage has become an endemic problem in Nigeria and it has negative influence on the health and general well being of the even increasing population (Ahaotu et al., 2010). Ahaotu and Ekenyem (2009) observed that over 70% of Nigerians are poor meaning that majority of Nigerians are faced with shortage of animal protein. To alleviate this problem, there is need therefore to increase the production of small highly prolific livestock with rapid turn over rate at a very low cost.

Ducks are capable of increasing the much needed animal protein on account of their reputation for fast growth, high fecundity and efficient feed conversion. They can thrive under a wide range of climatic conditions. They are resistant to common poultry disases such as Leukosis, Mareks disease, infectious bronchitis and other respiratory diseases (Hofstad et al,1984; Rodenburg et al. 2005. Islam et al. 2002, Ashton and Ashton, 2001). There is much published research on the effect of the stocking rate on the growth performance of broilers, information on the relationship between the stocking rate and productivity of Peking ducks is sparse. Lazar et al. (1984) found negative correlation between the body weight of ducklings reared on the floor or on a slatted floor and stocking density, but feed conversion was not affected. Hudsky (1977), Dayen and Fiedie (1992) found similar results when ducklings were fattened in cages at densities of 12, 14, 16 and 18 birds/m2 floor area, while Machalek and Hudsky (1981) recommended that ducks could be caged up to 28 days of age at 14.5 birds/m2. The objectives of this study were to study the effect of the stocking rate on the growth performance, carcass traits and meat quality of male Peking ducks.

2. Materials and methods

Two hundred and forty day male Peking chicks purchased from a commercial hatchery were reared in cages at a stocking rate of 20 chicks/m2 up to 2 weeks old. A 2 weeks of age, ducklings were randomly allocated to provide stocking density. The average initial body weight of ducklings was similar among all treatments. Birds in each replicate had nearly equal feeding and drinking space regardless of stocking density. Ducklings were fed ad libitum on a Pfizer (R) starter mash diet during the first two weeks of age, then growers diet fed up to the end of the experiment. Ducklings had full access to drinking water. Ambient temperature and relative humidity were recorded using in thermo - hygrograph. Ducklings in each replicate were weighed at bi-weekly intervals and average body weight, feed intake, cumulative feed conversion and mortality were computed.

At 10 weeks of age, eight birds from each treatment were at random, deprived of feed, but not water for about 12 hours and then slaughtered. After bleeding out, the birds were scalded, plucked with an electrical cyclomatic picker and eviscerated. Heads and shanks were separated and then carcasses were soaked in tap-cold water for about 15 minutes. Eviscerated carcasses with giblets and abdominal fat, but without heads, were individually weighed and dressing % was calculated (eviscerated carcass + liver + purified gizzard + heart + abdominal fat in relation to pre-slaughter weight). Eviscerated carcasses were portioned into breast, legs, back wings and neck according to WRSA, (1985), Hunter and Scholes (2002). Abdominal fat was added to back since most of the fat in Peking ducks is deposited in the subcutaneous region. The different cuts and giblets were each weighed and related to the carcass weight as a percentage.

The right side of large breast and thigh muscles from each carcass were separated, kept in plastic bags, chilled in a refrigerator at +4oC for 24 hours, then frozen at –15oC until required, to evaluate physical meat quality. For measuring pH- value after storage, meat colour and juice-holding capacity, the frozen samples were left to thaw in a refrigerator at +4oC for 24 hours without removing them from the plastic bags. The pH- value was measured directly using pH – meter (650-Knicke). Meat colour was measured by a colour-meter (Goefo-Meter). The value varied from very light at zero to very dark at 100. To determine juice holding capacity, a piece of 0.3g muscles from each individual meat sample was put on filter paper (previously held over saturated potassium chloride solution in a dessicator) and pressed between two glass plates for five minutes according to Grau and Hamm method (1957). The areas of meat and meat + juice were estimated by the axis method according to Hofmann (1982). The juice holding capacity was calculated using the following formulas:

$$\text{Juice holding capacity} = \frac{\text{meat's area} \times 100}{\text{Total area}}$$

The higher value means higher juice holding capacity and vice versa. The statistical analysis was carried out according to SAS Programme (1999). Differences among treatments were calculated at 5% level of significance.

3. Results and discussion

3.1. Growth performance

Growth performance data of male Peking ducks as affected by the stocking rate are shown a Table 1. The stocking rate had an insignificant effect on body weight of birds reared on the floor during the first four weeks of age. Increasing densities above 4 birds/m2 on the floor at 6 weeks of age and above 2 birds/m2 at 8 weeks old significantly ($p<0.05$) decreased body weight at the previous age respectively. At 10 weeks old, birds reared on floor at a stocking density of 4 birds/m2 were able to compensate the retardation in body weight and had similar body weight to those reared at the density of 2 birds/m2. When the stocking rate exceeded 4 birds/m2 on the floor, the retardation in body weight represented from 4.66 to 18.86% and from 9.05 to 17.27% at 8 and 10 weeks of age respectively.

Rearing ducklings in cages at a stocking rate above 8 birds/m2 significantly ($p<0.05$) decreased body weight at 4 weeks of age. At 6 and 8 weeks old, the stocking rate should not exceed 4 birds/m2 of the cage area. When the growing period was prolonged up to 10 weeks of age, the density could reach 8 birds/m2 of the cage area. Increasing the density above 8 birds/m2 of the cage area caused 10.90% to 21.96% and from 6.5% to 18.81% retardation in body weight at 8 and 10 weeks of age respectively. The retardation in body weight associated with the increasing stocking rate was attributed to the fact that feed intake was progressively decreased ($p<0.01$) with increasing density at all growing age interval.

Increasing the density above 2 and 4 birds/m2 on floor and in cages respectively decreased feed intake about 24.15% to 37.45% and 13.09% to 38.64% respectively at 8 weeks of age. The corresponding reduction percentages at 10 weeks old were 18.58% to 36.28% and 11.06% to 36.47% respectively. 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.

Cumulative feed conversion was significantly ($p<0.05$) improved, when stocking rate increased from 2 to 4 birds/m2 of floor area at 4, 8 and 10 weeks of age, but no further improvement was observed in relation to the stocking rate. At 6 weeks of age, the improvement ($p<0.05$) in cumulative feed conversion had occurred when stocking rate increased from 2 to 6 birds/m2. The improvement in cumulative feed conversion represented 16.75% and 14.33% at 8 and 10 weeks old respectively when stocking rate increased from 2 to 4 birds/m2 of floor area at the previous ages. Also, increasing birds density in cages, improved cumulative feed conversion, but the differences were significant ($p<0.05$) only at 4 and 8 weeks old, when density exceeded 4 and 8 birds /m2 of cage area at such ages respectively. The improvement of feed conversion at higher stocking densities may be due to the better nutrient utilization and the reduction in body fat deposition as a result of indirect feed restriction. Sharma, (2001); Buckland and Guy (2002) 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 the conservation of heat. Mortality rate was not affected by density and it was just zero throughout the experimental period (from 2 to 10 weeks old).

These results are in good agreement with Oke et al. (1992). Oluyemi and Fetuga (1981); Okoronkwo, (1991), Changzue and Keliarg, (1988) who reported that body weight of ducks and goose were depressed, but feed conversion was improved at high stocking densities. Also, Damron and Wilson (1983), Rosinski et al. (1997), Baeza et al. (1985) and Saunders (1998), indicated that feed intake decreased but mortality rate was not affected when geese and broiler reared at high stocking rate.

3.2. Carcass traits

Least squares means + SE of carcass traits of male Peking ducks as influenced by stocking rate are shown in Table 2. There existed negative linear relationship ($p<0.05$) between stocking rate on floor, starved body weight and carcass weight. Also, in starved body weight and carcass weight from another side. Starved body weight and carcass weight significantly ($p<0.05$) decreased with increasing density above 8 birds/m2 of cage area. The dressing percentage for birds reared on floor, significantly ($p<0.05$) decreased with increasing density above 4 birds/m2 but no further decrease with increasing density was observed. This could be attributed to the higher variation in starved body weight and carcass weight in relation to density.

Dressing percentage for birds reared in cages was not affected by stocking rate. This may be due to that birds in cages reared at high density and the differences in both starved body weight and carcass in relation to density were not sufficient to produce significant effect on dressing percentage, moreover, the higher variants in the previous criteria.

Breast percentage decreased ($p<0.05$), while legs percentage increased ($p<0.05$) with increasing densities on the floor or in cages. This could be attributed to the differences in starved body weight in relation to density and to the fact that different organs had different growth rates. Valuable cuts (breast +legs %) were lower ($p<0.05$) at density of 8 birds/m2 on the floor compared to other densities. This may be due to the fact that breast % decreased at a higher rate than the leg % in relation to the stocking rate. However, increasing density above 8 birds/m2 of cage area significantly (p<0.05) decreased the valuable cuts % (breast + legs %) but no further reduction with increasing density was observed. Birds reared on the flood at a density of 8 birds/m2, due to their higher (p<0.05) back % had the highest (p<0.05) percentage of less valuable cuts (back +wings +neck+ giblet %). Stocking rate on the floor did not differ significantly (p>0.05) on wings %, neck % and giblets %. The density in cages had insignificant effect on back %, wings % and neck %. The higher (p<0.05) giblets % at stocking rate of 12 and 16 birds/m2 in cages resulted in an increase (p<0.05) in the total less valuable cuts % (back +wings+ neck+ giblets %) at the previous densities.

Table 1

Least Squares Means ±S.E. of Growth Performance of Male Peking Ducks as Influenced by the Stocking rate.

Parameters		**Floor**		**Stocking Rate (Birds/m^2)**			**Cages**	
	2	4	6	8	4	8	12	16
No of Birds	8	16	24	32	16	32	48	64
1 – 4 Weeks old	0.620	0.590	0.571	0.509	0.531	0.454	0.454	0.390
Body Weight (kg)	± 0.03	± 0.03	± 0.03	± 0.03^{ns}	±0.02^{a}	±0.02^{a}	±0.02^{c}	±0.02^{d}*
Feed Intake (kg)	2.307	1.724	1.623	1.405	1.838	1.627	1.487	1.179
	± 0.08^{a}	± 0.08	± 0.08	± 0.08^{ns}	±0.03^{a}	±0.03^{b}	±0.03^{c}	±0.03^{d}*
Feed Conversion:	4.121	3.331	3.073	3.060	3.660	3.550	3.499	3.479
	± 0.18^{a}	± 0.18^{b}	± 0.18^{b}	± 0.18^{b}*	±0.07^{a}	±0.07^{b}	±0.07^{c}	±0.07^{ns}
1 – 6 Weeks Old	1.154	1.023	0.961	0.849	0.973	0.843	0.751	0.657
: Body Weight (kg)	± 0.04^{a}	± 0.04^{b}	± 0.04^{c}	± 0.04^{d}*	±0.03^{a}	±0.03^{b}	±0.03^{c}	±0.03^{d}*
Feed Intake (kg):	5.567	4.339	3.961	3.637	4.586	4.183	3.627	2.991
	± 0.09^{a}	± 0.09^{b}	± 0.09^{b}	± 0.09^{b}*	±0.05^{a}	±0.0^{bb}	±0.05^{c}	±0.005^{ns}
Feed Conversion:1	5.101	4.390	4.271	4.681	5.150	5.211	5.171	5.070
	± 0.17^{a}	± 0.17^{b}	± 0.17^{b}	± 0.17^{c}*	±0.02^{a}	±0.02^{b}	±0.02^{c}	±0.02^{ns}
1-8 Weeks Old	1.673	1.518	1.423	1.234	1.473	1.338	1.198	1.013
: Body Weight (kg)	± 0.05^{a}	± 0.05^{b}	± 0.05^{c}	± 0.05^{d}*	±0.03^{a}	±0.03^{b}	±0.03^{c}	±0.03^{d}*
Feed Intake (kg):	9.837	7.885	6.351	6.001	8.473	7.231^{c}	6.112	5.037
	± 0.015^{a}	± 0.015^{b}	± 0.015^{b}	± 0.015^{b}*	±0.015^{a}	±0.015^{b}	±0.015^{c}	±0.015^{ns}
Feed Conversion:1	6.031	5.001	4.883	5.159	6.004	5.881	5.611	5.392
	± 0.16^{a}	± 0.16^{b}	± 0.17^{b}	± 0.16^{d}*	±0.12^{a}	±0.12^{b}	±0.12^{c}	±0.12^{d}*
1-10 Weeks Old	2.147	2.007	1.799	1.603	1.823	1.759	1.551	1.247
:Body Weight (kg)	± 0.05^{a}	± 0.05^{b}	± 0.05^{b}	± 0.05^{d}*	±0.09^{a}	±0.09^{b}	±0.09^{c}	±0.09^{d}*
Feed Intake (kg):	14.113	11.498	10.147	7.993	12.734	10.747	9.273	7.818
	± 0.016^{a}	± 0.016^{b}	± 0.016^{b}	± 0.016^{b}*	±0.24^{a}	±0.024^{b}	±0.024^{c}	±0.024^{ns}
Feed Conversion:1	6.772	5.801	5.630	5.627	7.001	6.992	6.879	6.452
	± 0.18^{a}	± 0.18^{b}	± 0.18^{b}	± 0.18^{d}*	±0.18^{a}	±0.31^{b}	±0.31^{c}	±0.31^{ns}

Means within same row having different superscript are significantly different (p<0.05).

These results confirmed the results of Oke et al. (1992), Willin, (1995), Hunter and Scholes (2002), Rouvier et al.(1993) and Rosinski et al. (1996) who reported that increasing density adversely affected carcass quality of geese and ducky based on grade on grade A carcasses and breast blisters. Okoronkwo (1991); Oke et al. of 12, 14, 16 and 18 birds/m2 and found that the first grade A carcasses and breast blisters. Okoronkwo(1991), Oke et al.(1992), Singh and Panda (1987) reared ducklings in cages at densities of 12, 14, 16 and 18 birds / m2 and found that the grade carcasses progressively decreased with increasing densities.

3.3. Meat quality

Least squares means +- SE of the physical properties of breast and thigh muscle of male Peking ducks as influenced by stocking rate are shown in Table 3. The PH value of breast progressively increased with increasing density on floor but the difference was significant (p<0.05) only when the density exceeded 6 birds/m2 of floor area. Increasing the density in cages resulted in increasing the PH -value of breast, but the differences were not significantly different (p>0.05). This may be due to the lower glycogen reserve as a result of limited feed intake and to increasing stress susceptibility caused by crowding. Saunders (1998) and Risse, (1980) reported as a non-specific stressor that results in adrenal hypertrophy. The pH –value of thigh was not affected by the stocking rate on both floor or in cages.

Table 2
Lease Squares Means ±S.E. of Carcass Traits of Peking Ducks as Influenced by the Stocking Rate.

Parameters		Floor		Stocking Rate (Birds/m^2)			Cages	
No of Birds	2	4	6	8	4	8	12	16
Body Weight (kg)	2.137	1.996	1.824	1.567	1.767	1.607	1.430	1.287
	$\pm 0.05^{a}$	$\pm 0.05^{b}$	$\pm 0.05^{c}$*	$\pm 0.05^{d}$*	$\pm 0.06^{a}$	$\pm 0.09^{b}$	$\pm 0.06^{b}$	$\pm 0.09^{c}$*
Carcass wt (kg):	1.527	1.382	1.226	1.011	1.261	1.132	1.022	0.813
	$\pm 0.03^{a}$	$\pm 0.03^{b}$	$\pm 0.03^{c}$	$\pm 0.016^{d}$*	$\pm 0.05^{a}$	$\pm 0.05^{b}$	$\pm 0.02^{c}$	$\pm 0.05^{c}$*
Dressing (%)	70.32	69.19	66.37	65.81	71.52	71.60	71.52	71.02
	$\pm 0.48^{a}$	$\pm 0.48^{b}$	$\pm 0.48^{b}$	$\pm 0.48^{d}$*	$\pm 0.84^{a}$	$\pm 0.84^{b}$	$\pm 0.84^{c}$	$\pm 0.84^{ns}$
Breast (%)	22.75	20.01	20.73	16.53	19.54	17.26	15.29	13.76
	$\pm 0.78^{a}$	$\pm 0.78^{b}$	$\pm 0.078^{c}$*	$\pm 0.78^{c}$*	$\pm 0.80^{a}$	$\pm 0.80^{b}$	$\pm 0.80^{b}$	$\pm 0.80^{c}$*
Legs (%):	19.02	20.17	20.13	20.39	22.10	22.68	23.78	24.99
	$\pm 0.37^{a}$	$\pm 0.37^{b}$	$\pm 0.37^{a}$	$\pm 0.37^{a}$*	$\pm 0.51^{a}$	$\pm 0.51^{b}$	$\pm 0.51^{b}$	$\pm 0.51^{c}$*
Breast + Legs (%)	41.77	40.27	40.87	37.53	41.63	39.25	36.98	36.72
	$\pm 0.65^{a}$	$\pm 0.65^{a}$	$\pm 0.65^{a}$	$\pm 0.65^{b}$*	$\pm 0.84^{a}$	$\pm 0.77^{b}$	$\pm 0.77^{c}$	$\pm 0.77^{ns}$
Back (%):	24.62	25.76	23.33	26.25	25.77	26.79	26.82	26.89
	$\pm 0.67^{a}$	$\pm 0.67^{b}$	$\pm 0.67^{a}$	$\pm 0.37^{a}$*	$\pm 0.85^{a}$	$\pm 0.85^{b}$	$\pm 0.85^{b}$	$\pm 0.85^{c}$*
Wings (%)	13.72	13.61	14.96	13.81	11.75	11.98	12,19	11.99
	$\pm 0.46^{a}$	$\pm 0.46^{a}$	$\pm 0.46^{a}$	$\pm 0.46^{b}$*	$\pm 0.79^{a}$	$\pm 0.79^{b}$	$\pm 0.79^{c}$	$\pm 0.79^{ns}$
Neck (%):	11.08	11.41	11.96	12.16	12.02	12.47	12.37	12.00
	$\pm 0.57^{a}$	$\pm 0.57^{b}$	$\pm 0.57^{a}$	$\pm 0.46^{a}$*	$\pm 0.46^{a}$	$\pm 0.46^{b}$	$\pm 0.46^{b}$	$\pm 0.46^{c}$*
Giblets (%)	8.87	8.99	9.06	9.29	8.82	8.89	10.91	9.00
	$\pm 0.28^{a}$	$\pm 0.28^{a}$	$\pm 0.28^{a}$	$\pm 0.28^{b}$*	$\pm 0.32^{a}$	$\pm 0.32^{a}$	$\pm 0.32^{b}$	$\pm 0.32^{a}$
Back + Wings +	58.29	59.77	59.31	61.51	58.36	60.13	62.29	59.88
Giblets (%):	$\pm 0.65^{a}$	$\pm 0.65^{b}$	$\pm 0.65^{a}$	$\pm 0.65^{c}$*	$\pm 0.78^{a}$	$\pm 0.78^{b}$	$\pm 0.78^{c}$	$\pm 0.78^{d}$*

Means within the same row having different are significantly different (p<0.05).

Table 3
Least Squares Means S.E. of meat Quality of Male Peking Ducks as influenced by the Stocking.

Parameters			Floor		Stocking Rate (Birds/m^2)			Cages
No of Birds	2	4	6	8	4	8	12	16
PH Value	5.96	6.01	6.08	6.25	6.06	6.34	6.38	6.19
Breast	$\pm 0.04^{a}$	$\pm 0.04^{a}$	$\pm 0.04^{a}$*	$\pm 0.04^{b}$*	±0.07a	$\pm 0.07^{b}$	$\pm 0.07^{b}$	$\pm 0.07^{ns}$
Thigh	6.40	6.33	6.39	6.39	6.43	6.49	6.57	6.53
	$\pm 0.05^{a}$	$\pm 0.05^{b}$	$\pm 0.05^{c}$*	$\pm 0.05^{b}$*	±0.07a	$\pm 0.07^{b}$	$\pm 0.07^{b}$	$\pm 0.07^{ns}$
Meat Colour	86.42	86.40	88.25	85.75	84.37	84.22	83.87	82.83
Breast	± 1.35	± 1.35	$\pm 1.35^{c}$*	$\pm 1.35^{ns}$	±1.48a	$\pm 1.48^{b}$	$\pm 1.48^{b}$	$\pm 1.48^{ns}$
Thigh	90.18	90.35	91.88	91.69	96.69	90.79	89.97	89.01
	$\pm 0.64^{a}$	$\pm 0.64^{b}$	$\pm 0.64^{c}$*	$\pm 0.64^{b}$*	±0.07a	$\pm 0.77^{b}$	$\pm 0.77^{b}$	$\pm 0.77^{ns}$
Juice Holding Capacity	25.94	20.51	21.99	22.61	17.83	18.57	22.37	19.73
Breast	$\pm 2.26^{a}$	$\pm 2.26^{b}$	$\pm 2.26^{c}$*	$\pm 2.26^{ns}$	±1.75	±1. 75	$\pm 1.75^{b}$	±1.75*
Thigh	33.12	24.93	26.47	31.13	24.73	33.67	35.22	30.13
	$\pm 1.89^{a}$	$\pm 1.89^{b}$	$\pm 1.89^{c}$*	$\pm 1.89^{b}$*	±3.42	±3.42	±3.42	$\pm 3.42^{ns}$

Means within the same row having different superscripts are significance with different (P<0.05)

Stocking rate on the floor or in cages insignificantly affected meat colour of breast and thigh muscles. Also, juice holding capacity of breast was not affected by stocking rate, while that of the thigh was highly significantly (p<0.01) affected by density on floor only but without clear trend. These results agreed with Shanaway (1994), Appleby et al. (1992); Damme and Aumann, (1992). Nagarajan et al.(1991). Yun et al. (1988). Okamoto et al. (1989), Safjadi and Becker (1980) further reported that meat colour, cooking loss, moisture and fat content of quail and broilers were unaffected by stocking rate.

4. Conclusion

From the results obtained in this study Peking male ducks reared in cages had lower improvements in feed conversion. Feed intake decreased (p<0.05) with increasing stocking rate at all the growing age intervals. Also, cumulative feed conversion was improved when the stocking rate exceeded 2 birds/m2 on floor at all the studied ages. Dressing % was decreased (p<0.05) with increasing density above 4 birds/m2 on floor and in cages respectively.

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