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THE INFLUNCE OF DIFFERENT STOCKING DENSITY AND SEX ON PRODUCTIVE PERFORMANCE AND SOME PHYSIOLOGICAL TRAITS OF JAPANESE QUAIL

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Abstract: *This study was designed to investigate the effects of various stocking density and sex on productive performance, some physiological traits, which are greatly correlated with the quail performance, tibia measurements, tibia calcium and phosphorous contents and other traits of Japanese quail during the fattening period extended from 7 to 42 days of age. A total number of 960 Japanese quail chicks were used in this study. The quail were kept in cages with a stocking density of 70 Cm^2/birds (143 birds/m^2), 100 Cm^2/birds (100 birds /m^2) and 130 Cm^2 /birds (77 birds /m^2) and each group was represented by 3 replicates. Live body weight and body gain were recorded. Also feed consumption, feed conversion ratio, mortality rate. The obtained data indicated that live body weight, weight gain, feed consumption were significantly (P ≤0.05) increased when quail kept at 77 bird /m^2, followed in a significant decreasing order by those kept at 100 birds /m^2 or those kept at 143 birds/m^2. Data of feed conversion ratio was best for quails kept at 77 bird /m^2, followed by quails stocked at 100 birds /m^2 and those stocked at 143 birds/m^2. Also mortality rate was significantly (P≤ 0.05) lower for quails stocked at 77 bird /m^2 as compared with those kept at 100 birds /m^2 or birds kept at 143 birds/m^2. Females of Japanese quails recorded significantly (P≤ 0.05) higher values for their weights, gain and feed consumption as compared with their males. The effects of stocking density and sex were to be statistically (P≤ 0.05) significant for all physiological traits i.e., heart rate, respiration rate, rectal body temperature and skin body temperature, where these traits significantly (P≤ 0.05) decreased, when quails stocked at 77 birds /m^2 as compared with other stocking density. Females of quail showed the highest physiological traits as compared with their males. Concerning blood plasma parameters data raveled that insignificant differences were observed among stocking density groups for total plasma protein, albumin, globulin, A/G ratio, lipids and triglycerides, while there were significant (P ≤0.05) increase of aspartate aminotranseferase (AST), alanine aminotransferase (ALT), total plasma* *calcium and alkaline phosphates for quails stocked at 77 birds /m^2 as compared with other stocking density. Also insignificant differences were observed between females and males for total plasma protein, albumin, globulin, A/G ratio, lipids and triglyceride; while females of Japanese quail recorded significantly (P≤0.05) higher values of AST, ALT, total plasma calcium and alkaline phosphates as compared with their males. In this respect, there were significant differences were observed for most carcass characteristics among stocking density groups. Regarding with tibia weight, tibia length, tibia width, tibia ash percentage, and tibia calcium and tibia phosphorous (% of ash). The obtained data indicated that there were significant increases of these traits for Japanese quails kept at 77 bird/m^2 as compared with the birds kept at 100 birds /m^2 or those stocked at 143 birds/m^2. While tibia dyschondroplasia (TD) significantly decreased for Japanese quails stocked at 77 bird/m^2, followed by quails kept at 100 birds /m^2, then those kept at 143 birds/m^2. However, females showed the highest values of tibia weight, tibia length, tibia width, tibia ash, tibia calcium, tibia phosphorous and tibia dyschondroplasia (TD) as compared with their males. Results also indicated that there were insignificant (P≤0.05) differences were detected for carcass chemical composition as affected by different stocking density or sex. Consequently, it was concluded that breeding of quails in cages with a stocking density of 77 birds /m^2 might yields better results, when compared with quails stocked at 100 birds /m^2 or those kept at 143 birds/m^2.*

INTRODUCTION

The influence of stocking density of different poultry species on growth and reproductive performance has generated considerable interest in recent years. However there is a dearth of information on the influence of stocking density of Japanese quail. Several reports indicated that high stocking density have been shown to induce poor leg condition, reduction in growth rate and a high incidence of dermatitis attributable to deteriorating litter condition ***(Ekstrand,1993;Elwinger,1995 and Martrenchar et al.,1997).*** Hence, procedures are reluctant to decreases stocking density. In a high stocking density situation, airflow at the level of the birds is often reduced resulting in reduced dissipation of body heat to the air. Other factors associated with high stocking densities that may contribute to reduce performance include poor air quality due to inadequate air exchange, increased ammonia, and reduced access to feed and water. ***Puron et al., (1995)*** showed that reducing floor space of broiler chickens can be reduced growth rate, feed efficiency, livability, and in some cases, carcass quality.

Fahmy et al., (2005) indicated that increasing stocking density of quail was associated with marked significant decrease in weight and significant reduction in blood AST and significant increase in total lipid. ***Seker et al., (2009)*** showed that with increasing stocking density of Japanese quails from10 to 20 birds per m^2 resulted a linear reduction in body weight and feed intake. Also they indicated that stocking density and group size are significantly environmental factors that affect the amount and quality of production in cage breeding of quails. However mortality rate increased with increasing group size.

Studies that investigate the effect of group size or stocking density on growth performance, carcass characteristics or other traits of Japanese quail are limited in number. This study was undertaken to investigate the effect of stocking density and sex of Japanese quail on growth performance and some physiological traits under the Egyptian condition.

MATERIALS AND METHODS

This study was conducted at Experimental Poultry Research Station belonging to Faculty of Agriculture, Al-Azhar University: Naser city Cairo, Egypt between March 2009 to May 2009. The main objective of this study was to investigate the effect of different stocking density and sex on growth performance, carcass characteristics, carcass chemical composition, tibia bone measurements, tibia mineral contents (calcium and phosphorus %) and some physiological traits of Japanese quail. The quail chicks to be used in the present study hatched in Experimental Poultry Research Station. A total number of 960 Japanese quails chick one day old were used in this study. The chicks were brooded in electrical batteries which were provided with an incandescent lamp of 100 W up to 21 day of age. The brooding temperature degree and relative humidity percent were daily measured and maintained at 35 C° (± 2.0 °C) and 65% (± 5.0 %) as average on the first weeks of age. then the temperature degree was gradually reduced at the end of the 21^{st} day of age by about 2.0 °C every week until dependent on the environmental temperature. Also the ambient temperature and relative humidity were daily measured along the experiment. The batteries were provided with feeders and drinker equipments, which putting inside the cages. No warming practice was employed after 21^{st} day of age. From 1 to 7^{th} days of age all chicks were brooded together to avoid morality occurred during the first 7^{th} day of age and adjusting the number of chicks employed in the experiment. At the end of 7^{th} days of age all quail chicks were weighed to nearest 1.0 g (± 1.3) and randomly assigned into three main stocking density groups. Each group represents by three replicates. All chicks were wing banded. The stocking density groups available were 70 Cm^2 /birds (143 birds/m^2), 100 Cm^2 /birds (100 birds /m^2) and 130 Cm^2/birds (77 birds /m^2). The quail chicks fed *ad libitum* on a basal commercial diet containing 24.0% *CP* and 2900.0 *ME Kcal / Kg* from 1 to 42nd days of fattening period based on the requirements outlined in ***NRC (1994).*** The composition and diet analysis as shown in Table (1). A photoschedual of (23 L: 1 D) was used for the duration of experiment. In order to adjusting and correct stocking density along the experiment and to investigate the effect of stocking density on mortality rate, where the stocking density changed due to mortality, out group was formed provided that the same stocking density was established. The records kept during the study included weekly live body weight, gain in weight, feed consumption, feed conversion ratio (g feed /g gain) and mortality rate. The growth performance were recorded for mixed sex from 7 to 21st days of age due to difficult to distinguish males and females from 1 to 21st days. The two sexes can be distinguished outwardly at about 3 weeks of age. The adult male is identified readily by the cinnamon-colored feathers on the upper throat and lower breast region ***(Woodard et al., 1973).*** While at 42nd days of age (the end of experiment) blood samples were taken from 6 females and 6 males from each group alone. Quails were not fed in the 24 hour immediately prior to sampling. Blood were taken from jugular vain into heparinized tubes, and then the plasma was isolated from blood samples by centrifugation at 3000 rpm for 15 minute. Total plasma protein, globulin, albumin, A/G ratio, lipids, triglycerides, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphates were determined calorimetrically on spectrophotometer (Model 722 GRATING) by using the suitable commercial kits Diamond Company, stanbio Laboratory, Pastier Lab. Diagnostic and Biodiaquastic Company. The constituents of blood total protein, albumin, lipids, triglycerides, AST, ALT, total plasma calcium and alkaline phosphates were analyzed according to ***(Henry, 1964, Doumas and Biggs1972, Zollner and Kirsch, 1962, Royer, 1969, Reitman and Frankel, 1957, Gindler and King 1972 and Yong,1975).***

The globulins values obtained by subtracting the values of albumin from the corresponding values of total protein. Also albumin/ globulin (A/G ratio) values were obtained by dividing the values of albumin on the values of globulins. Also some physiological traits i.e., heart rate, respiration rate, rectal body temperature and skin body temperature were measured. At the end of fattening period (42nd days of age) in order to determine the slaughter carcass characteristics, carcass chemical composition, tibia measurements and tibia calcium and phosphorus contents ten quails from each treatment with equal numbers in terms of sex (5 females and 5 males).

reflecting the average live body weight were selected and a total of 30 quail were slaughtered for the 3 treatments. Both left and right legs were removed from carcass after slaughter for examination tibial dyschondroplasia (TD). The head of the tibio-tarsus was cut with a sharp knife on both sides. The assessment of TD was made by using a scale from 0 to 3 as a described by ***Edwards (1984)***.

0-The bone structure at the dissected bone surface is normal.

1-Up to one-third of the dissected surface is covered by abnormal cartilage.

2-One –third to half of the dissected surface is abnormal

3-More than half or the entire dissected surface is abnormal.

Tibia bones were placed in boiling water for 3 minutes surrounding meat and connective tissues were subsequently cleaned. The outer dimensions of tibia were determined at two points of midshaft using the vernire calipers. After that tibia bone were dried firstly in air at 7 days and bone fragments were fat extracted by diethyl ether for 48 hour, and then putting in Muffle farnce at lower temperature degree at 70 ^{o}C for 24 hours to maintain the mineral contents from loss. After that the degree of Muffle farnce degree was increased to reach 600^{o} C for 3 hour and bone ash contents was weighed and prepared for calcium and phosphorous determination according to ***AOAC (1994)***. Calcium and phosphorous levels were determined by atomic absorption spectrometer apparatus (SK_1, Power input, A.H. Series).

Data were subjected to analysis of variance using one way analysis of variance ***(SPSS, 1999)*** INC., Chicago, Il Version 10.0 FOR WINDOWS. All percentages were first transformed to arcsine being analyzed to approximate normal distribution before ANOVA. Also significant differences among means were determined by Duncan's multiple range tests ***(Duncan's 1955)*** at 5.0% level of significant. All obtained data were analyzed by using the following Model:

$$Yij = u + Ti + eij$$

Where, Y= the observed value, u = population means, T= the effect of stocking density and e = the standard error. The significant differences between males and females were analyzed by *t - tests*. The differences were also significant at 5.0 % level.

RESULTS AND DISCUSSION

Productive performance:

Live body weight.

Results of productive performance of growing Japanese quail as affected by different stocking density and sex are given in Table (2). Live body weight at start of experiment was almost similar among groups indicating insignificant differences of individuals into the experimental groups. While at 14^{th} days of age the analysis of variance indicated that quails kept at 77 birds/m^2 or quails stocked at 100 birds/m^2 recorded significantly ($P \leq 0.05$) higher live body weigh as compared with those kept at 143 birds/m^2. Concerning live body weight at 21,28,35 and 42^{nd} days of age the obtained data indicated that birds stocked at 77 birds/m^2 recorded significantly ($P \leq 0.05$) higher live body weight, followed by groups of quail stocked at 100 birds/m^2 or those kept at 143 birds/m^2. It clearly indicated that the lower body weight was observed for Japanese quail stocked at 143 birds/m^2 as compared with quails stocked at 100 birds/m^2 or those kept at 77 birds/m^2, attributed to higher environmental temperature that occurred due to high crowding, where overcrowding and lower space per quail might cause stress in quail. Also in a high stocking density airflow at the level of the birds is often reduced resulting in reducing performance include poor air quality due to inadequate air exchange, increased ammonia and reduced access to feed and water. However, the obtained data indicated that females of Japanese quail showed the heaviest live body weight during 21,28,35 and 42^{nd} days of age as compared with their males. These results are harmony with those obtained by ***Souza et al., (1995)*** indicated that female of birds will always be fatter than male because female hormone stimulates fat deposition. ***Fahmy et al., (2005)*** observed that increasing stocking density of quails from 44, 88 and 176 birds/m^2 was associated with marked significant decreases of weight. ***Kouichi et al., (2007)*** found that the female of Japanese quail exceeded the male weight, and a significant sexual difference was observed after 40^{th} days of age. In this respect ***Seker et al., (2009)*** they indicated that live body weight of Japanese quails was higher for quail stocked at 3 birds per cage as compared with those stocked at 10 birds per cage at 42^{nd} days of age; however the difference between the two groups were insignificant.

Body weight gain.

In the study, the effects of stocking density and sex on weight gain were statistically ($P \leq 0.05$) significant at all different periods of experiment, where gain was higher of quails kept at 77 birds/m^2, followed quails kept at 100 birds/m^2 and those stoked at 143 birds/m^2. The increase of gain for quails kept at 77 birds/m^2 as compared with quail kept at 100 birds/m^2 or those stocked at 143 birds/m^2, due to increase space had more opportunity for free movements of birds for feeding and watering. Also from these results it can be observed that the lowest values of body weight gain were observed for the period 29-35 days of age as compared with other periods of growth rate. The results also indicated that the female of quails were superior in their weight gain as compared with their males (Table2). The results are in agreements with ***Davidson and Leighton (1984)*** indicated that higher population density caused lower body weight gain in turkeys birds than did a relatively low population density. Also ***Dozier et al., (2006)*** found that final body weight gain of Ross male chicks were negatively impacted by high stocking density at 35th days of age. ***Al-Homidan and Robertson (2007)*** indicated that increasing stocking density of Hybro broiler from 10 to 15 bird/m^2 body weight gain was decreased. Furthermore ***Seker et al., (2009)*** showed that body gain was highest for quails stocked at 3 quails per 125Cm^2 as compared with quails stocked at 10 quails /125 Cm^2.

Feed consumption.

Data of feed consumption are presented in Table (2). The results indicated that quails kept at 77 birds/m^2 consumed ($P \leq 0.05$) more feed as compared with those kept at 100 birds/m^2 or those kept at 143 birds/m^2 during all experimental periods. Also females of quail consumed more fed as compared with their males during the period 22-28, 29-35 and 36-42nd days of age. These results are in accordance with the results obtained by ***Thompson(1972)*** indicated that feed intake per bird of Cobb broiler chickens decreased as the space per bird decrease from 0.143.0.122.0.105 and 0.095 m^2/bird. However ***Puron et al., (1995)*** indicated that there is a linear reduction in feed intake of broiler chickens when stocking density increased from 10 to 20 birds/m^2. Also ***Feddes et al., (2002)*** showed that feed consumption decreased in broiler chickens when density increased from 14.3 to 23.8 bird /m^2. Furthermore ***Al-Homidan and Robertson (2007)*** indicated that increasing stocking density of Hybro broiler chicken from 10 to 15 bird/m^2 resulted a reduction of feed consumption. In other studies reported by ***Seker et al., (2009)*** showed that with increasing stocking density of Japanese quails resulted a linear reduction in feed intake.

Feed conversion ratio.

Table (2) shows the averages of feed conversion ratio of Japanese quail for whole experimental period extended from 7 to 42nd days of age as affected by stocking density and sex. The analysis of variance indicted that the best feed conversion ratio was obtained for birds kept at 77 birds/m^2, followed in a significant decreasing order by birds stocked at 100 birds/m^2 then group stoked at 143 birds/m^2. The obtained results are in agreement with the results reported by ***Davidson and Leighton (1984)*** indicated that high population density caused lower feed efficiency than did a relatively low population density. ***Erensayin (2001)*** found that feed conversion ratio decreased in quails with increasing group size. In converse results ***Al-Homidan and Robertson (2007)*** showed that feed conversion ratio was not significantly affected of Hybro broiler chickens when increasing density from 10 to 15 bird/m^2, although feed conversion ratio was lower for birds at higher density (1.76 vs. 1.85). While ***Ahuja et al., (1992)*** showed that insignificant differences was observed for feed conversion ratio for quails (4.7 vs. 4.8). when stocked at 100 and 125 Cm^2/quails.

Mortality rate.

Mortality rate recorded from 7-42nd days of experimental period indicated that the birds stocked at 77 birds/m^2 recorded the lowest percentage of mortality rate as compared with other stocking density groups (Table 2). These results are harmony with those obtained by ***Sengul and Tas (1997)*** who found that mortality rate of Japanese quail increased with increasing group size. ***Imeada(2000)*** indicated that total mortality rate of broiler chickens housed at 18 bird/m^2 were significant higher than those of birds housed at 12 and 15 bird/m^2. ***Seker et al., (2009)*** showed that mortality rate of Japanese quail increased with increasing group size, however the differences was not significant. While ***Feddes et al., (2002)*** showed that stocking density of broiler at 23.8, 17.9, 14.3 and 11.9 bird/m^2 had no affect on mortality rate.

Physiological traits.

Data of heart rate; respiration rate; rectal body temperature and skin body temperature of Japanese quail as affected by different stocking density and sex are outlined in Table (3). It could be realized from these data that all mentioned physiological traits of Japanese quail were significantly ($P \leq 0.05$) lower for quail kept at 77 birds/m^2 as compared with those kept at 143 birds/m^2 or birds kept at 100 birds/m^2. The increase of physiological parameters of birds stocked at high stocking density due to over crowding of quail and increase activity. In a high stocking density situation, air flow at the level of the birds is often reduced, resulting in reduced dissipation of body heat to the air. Concerning the effect of sex on the physiological traits the results indicated that females of quails showed significantly ($P \leq 0.05$) higher values of physiological traits as compared with their males. These results are confirmed by those obtained by ***McFarlund and Lacy (1968)*** indicated that the respiration rate per minute of female quail was 71, while it 56 for male. ***Woodard and Mather (1964)*** showed that body temperature of quail was 42.2°C. However ***MaFarland et al., (1966)*** reported that skin temperature of Japanese quail at 21 °C ambient temperatures was 39.0 °C. Also ***Cheng et al., (1990)*** reported that body temperature of hen kept in cages in groups of three is higher than those of four, which is possibly related to the fact that hens under low stocking density have higher feed intake

Hematological traits.

Table (4) shows the effects of different stocking density and sex on some blood plasma parameters of Japanese quails at the end of growing period. The analysis of variance indicated that there were insignificant differences were observed among experimental groups of quails for total plasma protein, albumin, globulin, A/G ratio, lipids and triglycerides. While there were significant ($P \leq 0.05$) differences were observed for aspartate aminotransferase (AST). alanin aminotransferse (ALT), total plasma calcium and alkaline phosphates, where these parameters significantly ($P \leq 0.05$) increased, when quails stoked at 77 birds/m^2, followed by quail kept at 100 birds/m^2 and quails kept at 143 birds/m^2. Concerning the effect of sex the obtained results indicted that there were insignificant differences were detected between sex for total plasma protein, albumin, globulin, A/G ratio, lipids and triglycerides. While females recorded significantly ($P \leq 0.05$) higher values of AST, ALT, total plasma calcium and alkaline phosphates as compared with their males. The data raveled that keeping Japanese quail under low density 77 birds/m^2 caused an improvements in liver function and calcium deposited in skelton; this may explain the lower of tibial dyschndroplasia phenomenon (TD) phenomenon for birds stocked at 77 birds /m^2. ***Fahmy et al., (2005)*** indicated that increasing stocking density of quail was associated with significant reduction in blood AST and significant increase in total lipid, while ALT was not affected.

Carcass characteristics.

Data of carcass characteristics of Japanese quail as affected by different stocking density and sex at the end of growing experimental period (42nd days of age) are presented in Table (5). The analysis of variance indicated that there were significant ($P\leq 0.05$) differences were observed for most carcass traits. The quails kept at 77 birds/m^2 recorded higher ($P\leq 0.05$) carcass organs weight as compared with those kept under 100 birds/m^2 or those stocked at 143 birds/m^2. The increases of organs weight of birds stoked at 77 birds/m^2 may be due to the increase of body weight of this group as compared with others groups stoked at 100 birds/m^2 or those kept at 143 birds/m^2. From these results it can be notice also that the small intestine length (Cm) was significantly ($P\leq 0.05$) higher for quails kept at 77 birds/m^2 as compared with other stocking density. Concerning breast thickness (mm) the birds stocked at 77 birds/m^2 recorded higher thickness of their breast, followed by birds stocked at 100 birds/m^2 and those kept at 143 birds/m^2. Regarding with the effect of sex on carcass characteristics females of quail exhibited higher organs weight as compared with their males, with exception of wing and spleen weight. Also values of breast thickness (mm) of females were higher than males. These results are in agreement with the results obtained by ***Proudfoot (1973)*** found that increased birds density resulted in a reduction of carcass quality. ***Proudfoot and Hulan (1985)*** showed that increased broiler chickens density resulted adverse effect on carcass quality. ***Puron et al., (1995)*** showed that reducing floor space of broiler chickens can be reduced growth rate, and carcass quality. However ***Feddes et al., (2002)*** found that carcass weight of broiler was lower when stocked at 23.8 bird /m^2 as compared with those stocked at 17.9; 14.3 and 11.9 birds /m^2, where the birds stocked at 14.3 bird/m^2 had the highest carcass weight. ***Fahmy et al., (2005)*** indicated that increasing stocking density of quails was associated with marked significant decrease in weight and length of the gastrointestinal tract as well as the length of the stomach as proportion to the gastrointestinal tract length. While ***Seker et al., (2009)*** showed that group size was found insignificant effect on slaughter and carcass characteristics except for live weight of quails.

Tibia measurements, tibia dyschondroplasia (TD) and calcium and phosphorous contents.

The effect of using different stocking density and sex on tibia measurements, tibia mineral contents and tibia dyschondroplasia (TD) are given in Table (6) and Fig (1,2,3,4,5 and 6). The obtained data indicated that tibia weight, tibia length, tibia width, tibia ash, tibia calcium and tibia phosphorous (% of ash) were significantly ($P \leq 0.05$) higher for quails kept at 77 birds/m^2, followed by quails stocked at 100 birds/m^2 then quails stocked at 143 birds/m^2. The decrease of these parameters of quail stocked at higher density attributed to over crowding of quail, which acting to decrease of physiological and hematological traits especially concerning with the level of total plasma calcium. Also it can be observed that the incidence and severity of TD was depressed in Japanese quail kept at 77 birds/m^2, followed by quail stocked at 100 birds/m^2 and quail stocked at 143 birds/m^2. The data revealed that keeping quails at 77 birds/m^2 caused improvement in calcium deposited in skeleton this may explain the lower of tibia dyschondroplasia phenomenon occurred for quails stocked at 77 birds/m^2. In addition the present data suggest that adequate space was needed through the 6 weeks of growing period because of the continuous and rapid rate of bone growth. On the other hand females of Japanese quail exhibited significantly higher values of all former traits as compared with their males at 42nd days of age, this probably related to the differences ($P \leq 0.05$) in body weight between females and males. The results obtained by ***Kestin et al., (1994)*** found that high stocking density rates lead to reduce growth rate and increased incidence of diseases especially leg problems and various types of dermatitis. ***Martrenchar et al.,(2000)*** reported that high stocking density have been shown to induce poor leg condition ,a decrease in locomotion behavior, condition, frequent disturbances in growth rate and a high incidence of dermatitis attributable to deteriorating litter condition ***(Martrenchar et al., 1997). Kouichi et al., (2007)*** reported that there were no significant differences between males and females for the length, width and thickness of cortical bone in the central diaphysis. The same author found that the bone mineral density at the proximal epiphysis in the male tibia stopped increasing at 40th days of age, whereas that in the female tibia contained to increases until 100 days of age.

Carcass chemical composition.

Results of carcass composition of Japanese quails stocked at different stocking density and as affected by sex are outlined in Table (6). The analysis of variance indicated that there were an insignificant differences were observed for moisture, dry matter, crude protein, ether extract, ash and nitrogen free extract (NFE) percentages of breast, thigh and whole carcass, when quails stocked at different stocking density. Concerning the effect of sex the data also indicated that there were also insignificant differences were observed between sex for the same traits cited before. It can be observed that stocking density and sex have no significant effects on chemical carcass composition of Japanese quail at 42nd days of age.

In general, based on the former results it can be recommended that the keeping growing Japanese quail under 130 Cm^2 / birds (77 birds /m^2) give the better growth performance and physiological traits as compared with those kept at 100 Cm^2/birds (100 birds/m2) or those kept at 70 Cm^2/birds (143 birds /m^2)

Table (1): Formulation and diet composition of growing Japanese quail.

Ingredients	%
Ground yellow corn (8.5%).	55.65
Soybean meal (44.0%).	31.80
Wheat bran (15.7%).	01.20
Broiler concentrates (52.0%)*	10.00
Calcium carbonate ($CaCO_3$).	00.05
Sodium chloride (NaCl).	00.20
Sun flower oil.	00.60
Pre-mix**	00.50
Total (Kg)	100.00
Calculated diet composition:	
Crude protein %.	24.11
Metabolizable energy (Kcal ME/Kg).	2900.87
Lysine %.	001.22
Methinine %.	00.44
Methionine + Cystine%.	00.84
Calcium %.	00.95
Available phosphorus %.	00.44
Analyzed:	
Crude protein%.	23.95

*Broiler concentrate contains: CP 52%.CF 1.6%. Ca 8.30%. Available phosphorus 3.10%.Methionine 1.4%. Methionine +Cystine 2.3%.Lysine 2.3%. Sodium 1.76%. and ME 2580 Kcal/Kg .

**The premix (Vit& Min) was added at a rate of 3kg per ton of diet and supplied that following (as mg or I.U. per kg of diet): Vit A 12000 I.U.. Vit D3 2000 I.U.. Vit E 40 mg. Vit. K 34 mg. Vit. B 1 3 mg. Vit. B2 6 mg. Vit. B6 4 mg. Vit. B12 0.03 mg. Niacin 30 mg. Biotin 0.08. mg. Pantothenic acid 12 mg . Folic acid 1.5 mg. Choline chloride 700 mg. Mn 80 mg . Cu 10 mg. Se. 0.2 mg. Fe 40 mg. Zn 70 mg and Co . 0.25mg.

Table (2): Quail productive performance as affected by different stoking density and sex (Means ± SE)*.

Items	Effect of stocking density			Effect of sex	
	G_1** (N*** 143bird/m²) 70Cm²/bird	G_2 (N 100 bird/m²) 100Cm²/bird	G_3 (N 77 bird/m²) 130 Cm²/bird	Females	Males
Live body weight (g).					
7 days	30.76 ± 0.61	29.46 ± 0.43	30.36 ± 0.59	-	-
14 days	$62.55^{b}\pm0.21$	$65.53^{a}\pm0.25$	$66.54^{a}\pm0.26$	-	-
21 days	$84.30^{c}\pm0.23$	$91.98^{b}\pm0.29$	$93.05^{a}\pm0.28$	$96.0^{a}\pm0.21$	$83.54^{b}\pm0.27$
28 days	$132.76^{c}\pm0.48$	$145.23^{b}\pm0.51$	$149.67^{a}\pm0.61$	$148.10^{a}\pm0.53$	$137.00^{b}\pm0.51$
35 days	$138.19^{c}\pm0.75$	$157.52^{b}\pm0.65$	$166.46^{a}\pm0.62$	$168.0^{a}\pm0.72$	$140.09^{b}\pm0.63$
42 days	$157.33^{c}\pm0.79$	$184.71^{b}\pm0.74$	$199.60^{a}\pm0.71$	$190.80^{a}\pm0.73$	$170.30^{b}\pm0.70$
Body weight gain (g).					
7-14	$31.79^{b}\pm0.16$	$36.07^{a}\pm0.15$	$36.18^{a}\pm0.14$	-	-
15-21	$21.75^{b}\pm0.18$	$26.45^{a}\pm0.19$	$26.51^{a}\pm0.21$	-	-
22-28	$48.46^{c}\pm0.24$	$53.25^{b}\pm0.22$	$56.62^{a}\pm0.26$	$58.56^{a}\pm0.16$	$46.98^{b}\pm0.14$
29-35	$5.43^{c}\pm0.10$	$12.29^{b}\pm0.13$	$16.79^{a}\pm0.16$	$13.00^{a}\pm0.12$	$10.00^{b}\pm0.10$
36-42	$19.14^{c}\pm0.15$	$27.19^{b}\pm0.18$	$33.14^{a}\pm0.16$	$29.99^{a}\pm0.14$	$23.19^{b}\pm0.12$
7-42	$126.57^{c}\pm0.17$	$155.25^{b}\pm0.18$	$169.24^{a}\pm0.42$	-	-
Feed consumption (g/bird/period).					
7-14	$66.35^{c}\pm0.27$	$74.23^{b}\pm0.22$	$79.12^{a}\pm0.18$	-	-
15-21	$73.72^{c}\pm0.32$	$81.66^{b}\pm0.33$	$90.99^{a}\pm0.35$	-	-
22-28	$100.74^{c}\pm0.36$	$114.63^{b}\pm0.46$	$121.47^{a}\pm0.32$	$114.80^{a}\pm0.33$	$109.76^{b}\pm0.31$
29-35	$112.36^{c}\pm0.29$	$120.31^{b}\pm0.30$	$131.16^{a}\pm0.26$	$131.40^{a}\pm0.33$	$111.10^{b}\pm0.35$
36-42	$133.70^{c}\pm0.26$	$140.11^{b}\pm0.14$	$151.39^{a}\pm0.22$	$143.90^{a}\pm0.38$	$139.55^{b}\pm0.32$
7-42	$486.87^{c}\pm0.40$	$530.94^{b}\pm0.45$	$574.13^{a}\pm0.50$	-	-
Feed conversion ratio (FCR). (7-42 days).	$3.85^{a}\pm0.95$	$3.41^{b}\pm0.87$	$3.39^{c}\pm0.91$	-	-
Mortality rate (%). (7-42 days).	$9.50^{a}\pm0.26$	$7.00^{b}\pm0.18$	$3.89^{c}\pm0.19$	-	-

a.b.c…Means in the same row have the different superscript are significantly different($P \leq 0.05$).
*SE= stander error
**G_1. G_2. G_3=group 1. 2 and3.
***N=number of birds per replicate.

Table (3): Some physiological traits of Japanese quail as affected by different stoking density and sex during the whole experimental period (Means ± SE)*.

Items	Effect of stocking density			Effect of sex	
	G1** (N*** 143bird/m2) 70Cm2/bird	G2 (100 bird/m2) 100Cm2/bird	G3 (77 bird/m2) 130 Cm2/bird	Females	Males
Heart rate (per minute).	330.00 ^{a}±4.49	319.00 ^{b}±4.42	309.00 ^{c} ±3.48	328.00 ^{a}±4.65	310.00 ^{b}±3.75
Respiration rate (per minute).	48.00 ^{a}±1.80	35.00 ^{b}±1.42	32.00 ^{c}±1.42	40.00 ^{a}±1.45	36.00 ^{b}±1.40
Rectal body temperature (21 ^{0} C ambient)	42.40 ^{a}±1.91	42.00 ^{b}±1.89	41.30 ^{c}±1.84	42.40 ^{a}±1.88	41.40 ^{b}±1.93
Skin body temperature (21 ^{0}C ambient).	40.80 ^{a}±1.66	40.30 ^{b}±1.60	39.90 ^{c}±1.77	40.5 ^{a}±1.88	40.00 ^{b}±1.79

a.b.c…Means in the same row have the different superscript are significantly different($P \leq 0.05$).
*SE= stander error
**G_1, G_2, G_3=group 1. 2 and3.
***N=number of birds per replicate.

Table (4): Some hematological traits of Japanese quail as affected by different stoking density and sex at the end of growing period (Means ± SE)*.

Traits	Effect of stocking density			Effect of sex	
	G_1** (N*** 143bird/m^2) 70Cm^2/bird	G_2 (100 bird/m^2) 100Cm^2/bird	G_3 (77 bird/m^2) 130 Cm^2/bird	Females	Males
Total protein (g/ 100 ml).	5.24^a±0.82	5.34^a±0.92	5.30^a±0.71	5.22^a±0.54	5.36^a±0.44
Total albumin (g/ 100 ml).	2.20^a±0.13	2.24^a±0.15	2.20^a±0.12	2.20^a±0.20	2.23^a±0.23
Total globulin (g/ 100 ml).	3.04^a±0.47	3.10^a±0.43	3.10^a±0.37	3.02^a±0.45	3.13^a±0.48
A/G ratio.	0.72^a±0.042	0.72^a±0.073	0.71^a±0.087	0.72^a±0.076	0.71^a±0.077
Total lipids (mg/ 100 ml).	1015.75^a±3.6	1012.80^a±2.8	1014.10^a±4.6	1014.80^a±3.5	1013.61^a±4.03
Triglycerides (mg/ 100 ml).	163.64^a±2.23	165.69^a±2.30	164.70^a±2.14	164.55^a±2.29	164.80^a±2.26
AST (IU/L)[1]	61.30^c±1.28	65.30^b±1.19	69.30^a±1.12	68.20^a±1.22	62.30^b±1.33
ALT (IU/L)[2]	40.30^c±1.36	45.30^b±1.16	49.40^a±1.31	46.10^a±1.33	44.00^b±1.22
Calcium (mg/ 100 ml).	7.30^c±0.49	9.61^b±0.70	11.70^a±0.16	10.20^a±0.18	8.85^b±0.17
Alkaline phosphates (IU/L)[3]	711.00^c±0.31	743.00^b±0.30	931.00^a±0.44	803.00^a±0.45	787.00^b±0.48

a.b.c…Means in the same row have the different superscript are significantly different($P \leq 0.05$).
*SE= stander error
**G_1, G_2, G_3=group 1, 2 and3.
***N=number of birds per replicate
1-AST=Aspartate aminotransferase
2-ALT=Alanine aminotransferase
3-IU/L=International unit/litter

Table (5): Carcass characteristics of Japanese quail at the end of growing period as affected by different stokingdensity and sex (Means ± SE)* .

Traits	Effect of stocking density			Effect of sex	
	G_1** (N*** 143bird/m^2) 70Cm^2/bird	G_2 (N 100 bird/m^2) 100Cm^2/bird	G_3 (N 77 bird/m^2) 130 Cm^2/bird	Females	Males
Live body weight (g).	159.54^{c}±2.22	182.20^{b}±2.05	194.30^{a}±2.5	190.19^{a}±3.56	167.10^{b}±3.45
Feather weight(g).	10.02^{c}±0.55	11.0^{b}±0.56	11.13^{a}±0.53	10.53^{a}±0.48	9.89^{b}±0.45
Blood weight(g).	6.60^{b}±0.33	6.50^{b}±0. 30	7.44^{a}±0.35	6.88^{a}±0.36	6.70^{b}±0.38
Head weight (g).	6.95^{c}±0.39	7.71^{b}±0.40	7.93^{a}±0.36	7.85^{a}±0.38	6.84^{b}±0.36
Neck weight (g).	5.36^{c}±0.22	6.96^{b}±0.35	7.27^{a}±0.40	6.66^{a}±0.42	6.39^{b}±0.41
Wing weight (g).	4.90^{a}±0.19	4.89^{a}±0.17	4.83^{a}±0.23	4.88^{a}±0.20	4.89^{a}±0.22
Legs weight (g).	3.45^{c}±0.11	3.77^{b}±0.9	3.92^{a}±0.10	3.98^{a}±0.15	3.44^{b}±0.14
Liver weight(g).	4.48^{c}±0.45	5.21^{b}±0.43	6.85^{a}±0.40	5.88^{a}±0.44	4.94^{b}±0.42
Gizzard weight (g).	3.66^{a}±0.18	3.67^{a}±0.17	3.63^{a}±0.19	3.78^{a}±0.20	3.16^{b}±0.22
Heart weight(g).	1.01^{c}±0.02	1.10^{b}±0.05	1.77^{a}±0.04	1.62^{a}±0.02	1.02^{b}±0.03
Giblets weight(g).	9.15^{c}±1.02	9.98^{b}±1.08	12.25^{a}±1.12	11.28^{a}±1.18	9.12^{b}±1.19
Spleen weight (g).	0.11^{a}±0.002	0.11^{a}±0.005	0.12^{a}±0.003	0.12^{a}±0.008	0.11^{a}±0.006
Carcass weight(g).	101.15^{c}±2.15	118.31^{b}±2.18	126.05^{a}±2.22	118.82^{a}±2.11	113.12^{b}±2.01
Intestine weight (g).	11.91^{c}±1.05	12.97^{b}±1.08	13.36^{a}±1.05	13.62^{a}±1.02	11.90^{b}±1.0
Small intestine length (Cm).	67.60^{c}±2.10	67.30^{b}±2.0	69.50^{a}±1.99	73.20^{a}±2.4	69.30^{b}±2.5
Beast muscle thickness (mm)	16.00^{c}±1.23	17.60^{b}± 1.68	20.10^{a}±1.07	19.80^{a}±1.66	16.00^{b}±1.71

a.b.c…Means in the same row have the different superscript are significantly different ($P \leq 0.05$).

*SE= stander error

**G_1, G_2, G_3=group 1, 2 and3.

***N=number of birds per replicate.

Table (6): Tibia measurement and mineral contents of Japanese quail as affected by stoking density and sex at the end of growing period (Means ± SE)*.

Traits	Effect of stocking density			Effect of sex	
	G_1** (N*** 143bird/m^2) 70Cm^2/bird	G_2 (N100 bird/m2) 100$Cm^{2/}$bird	G_3 (N 77 bird/m^2) 130 Cm^2/bird	Females	Males
Tibia weight (g).	0.98^c±0.013	1.10^b±0.011	1.36^a±0.012	1.26^a±0.016	1.03^b±0.014
Tibia length (Cm).	4.20^c±0.15	5.00^b±0.16	5.28^a±0.15	5.18^a±0.20	4.46 ^{b}±0.22
Tibia width (mm).	0.21 ^{c}±0.001	0.26 ^{b}±0.003	0.30 ^{a}±0.005	0.30^a±0.006	0.22^b±0.004
Tibia ash (%).	38.0 ^{c}±2.44	43.0^b±2.89	46.0^a±3.12	44.45^a±2.89	40.20^b±2.18
Tibia calcium (% of ash).	9.0 ^{c}±1.08	11.50^b±1.11	13.90^a±1.52	12.83^a±2.15	10.10^b±2.16
Tibia phosphorous (% of ash).	2.0 ^{c}±0.09	2.60 ^{b}±0.05	3.56^a±0.04	3.03^a±0.03	2.42^b±0.04
Tibial dyschondroplasia (TD) (%).	29.37 ^{a}±2.40	25.0 ^{b}±2.30	19.48^c±2.0	28.90^a±2.12	20.33^b±2.15

a.b.c…Means in the same row have the different superscript are significantly different($P \le 0.05$).
*SE= stander error
**G_1, G_2, G_3=group 1, 2 and3.
***N=number of birds per replicate.

Table (7): Body chemical composition of Japanese quail at the end of growing period as affected by different stoking density and sex (Means ± SE) .

Items	Cut	Effect of stocking density			Effect of sex	
		G_1 (N 143bird/m^2) 70Cm^2/bird	G_2 (N 100 bird/m^2) 100Cm^2/bird	G_3 (N 77 bird/m^2) 130 Cm^2/bird	Females	Males
Moisture (%).	Breast	68.50±3.56	68.80±3.66	68.39±3.53	67.93±3.45	67.90±3.47
	Thigh	67.60±3.58	67.30±3.90	67.22±3.48	67.22±3.55	67.53±3.50
	Whole	68.05±3.16	68.05±3.20	67.80±3.46	67.78±3.70	67.86±3.40
Dry matter (%).	Breast	31.50±2.15	31.20±2.17	31.61±2.20	31.50±2.33	31.50±2.18
	Thigh	32.40±2.18	32.70±2.19	32.78±2.22	32.38±2.34	32.90±2.55
	Whole	31.95±2.48	31.95±2.50	32.20±2.78	31.98±2.89	31.80±2.65
Crude protein (%).	Breast	65.13±3.12	65.02±3.45	65.11±3.44	65.50±4.20	65.19±3.45
	Thigh	63.99±3.22	63.38±3.50	63.40±3.18	63.55±4.15	63.58±4.08
	Whole	64.60±3.15	64.40±3.46	64.44±3.26	64.31±3.99	64.37±3.26
Ether extract (%).	Breast	30.26±1.02	30.33±1.05	30.38±1.08	30.09±1.15	30.18±1.23
	Thigh	32.19±1.12	32.52±1.15	32.47±1.12	32.49±1.17	32.41±1.24
	Whole	31.09±1.22	31.52±1.33	31.50±1.22	31.47±1.25	31.49±1.17
Ash (%).	Breast	03.80±0.11	03.87±0.13	03.86±0.12	03.50±0.15	03.47±0.13
	Thigh	03.26±0.12	03.28±0.11	03.24±0.11	03.25±0.16	03.29±0.12
	Whole	03.56±0.10	03.40±0.15	03.43±0.13	03.37±0.14	03.35±0.14
NFE (%)[1].	Breast	0.81±0.002	0.51±0.005	0.65±0.007	0.91±0.008	0.96±0.006
	Thigh	0.56±0.004	0.78±0.003	0.89±0.001	0.71±0.006	0.78±0.005
	Whole	0.75±0.007	0.68±0.006	0.63±0.009	0.85±0.004	0.89±0.008

a.b.c…Means in the same row have the different superscript are significantly different($P < 0.05$).
1-NFE=nitrogen free extract (all components -100).
*SE= stander error
**G_1, G_2, G_3=group 1, 2 and3.
***N=number of birds per replicate.

.Fig (1); Effect of Stocking density on ash %

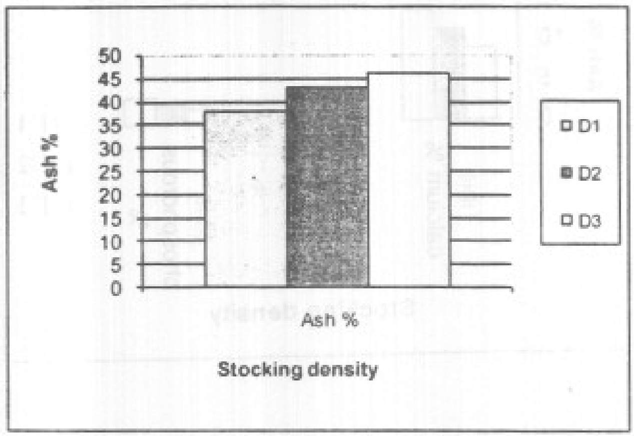


Fig. (2) :Effect of sex on ash %.

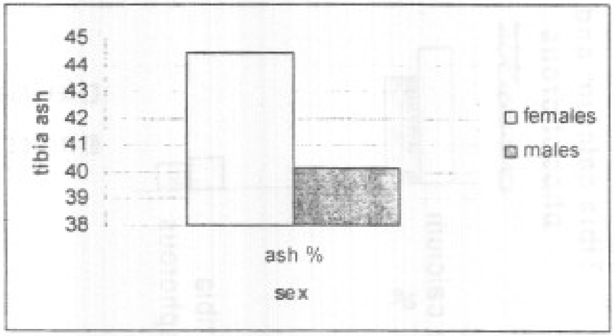


Fig.(3):Effect of stocking density on calcium and phosphorous %.

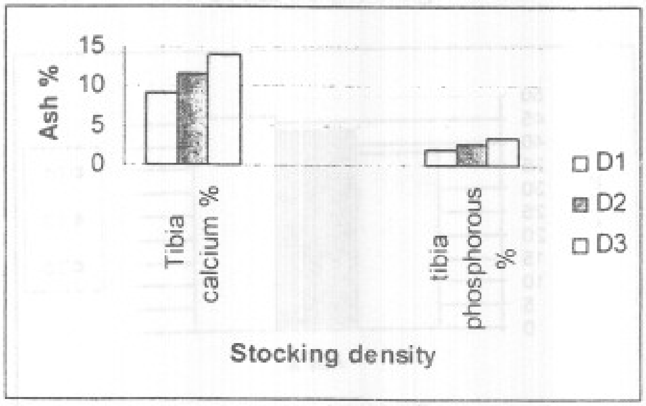


Fig.(4): Effect of sex on calcium and phosphorous %.

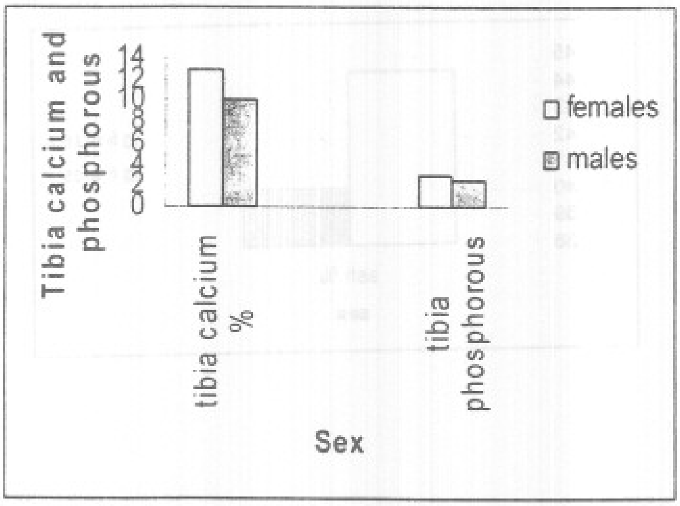


Fig.(5): Effect of stocking density on TD%

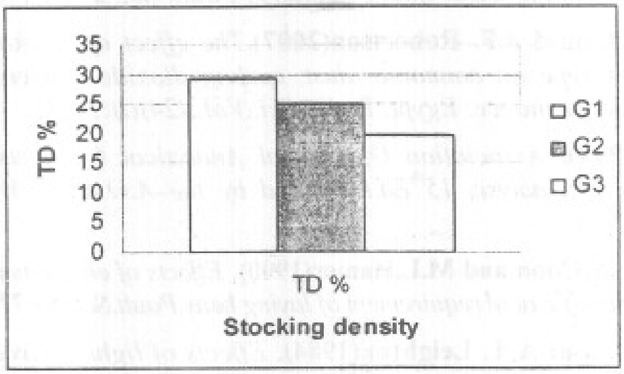
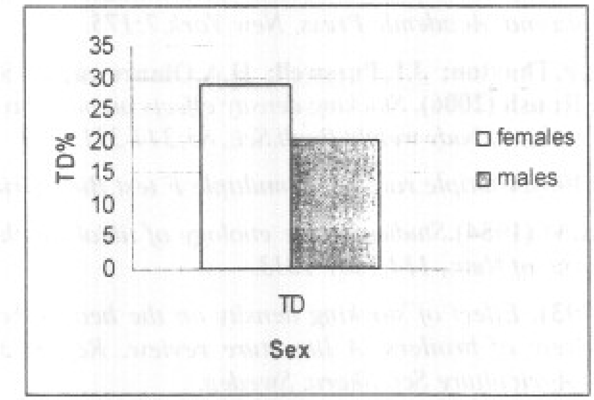


Fig.(6):Effect of sex on TD%.



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الملخص العربي

تأ ثير الكثافة والجنس على الاداء الانتاجي وبعض الصفات الفسيولوجية في السمان الياباني

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جامعة الازهر –كلية الزراعة- مدينة نصر –القاهرة-مصر

اجريت هذة الدراسة بهدف دراسة تأثير الكثافة والجنس على الاداء الانتاجي وبعض الصفات الفسيولوجية والتي ترتبط بدرجة كبيرة بالانتاج ،وكذلك دراسة مقاييس عظام التبيا ومحتوى الاملاح المعدنية في عظام التبيا وصفات اخرى في السمان الياباني خلال مرحلة التسمين والممتدة من ٧-٤٢ يوم من العمر. استخدم في هذة الدراسة عدد ٩٦٠ سمانة وتم تسكين هذا العدد في بطاريات تحت كثافات مختلفة بمعدل ٧٠ سم ٢ /للطائر (١٤٣ طائر /م ٢)، ١٠٠ سم ٢ /طائر (١٠٠ طائر/م ٢)، ١٣٠ سم٢/للطائر (٧٧ طائر/م ٢) واحتوت كل مجموعة على ثلاث مكررات. وفي اثناء فترة التجربة تم تسجيل اوزان الجسم وكذلك الزيادة في وزن الجسم كما تم تسجيل الغذاء المستهلك والوفيات.

واشارت النتائج المتحصل عليها من التجربة ان وزن الجسم وكذلك الزيادة المكتسبة في الوزن والغذاء المستهلك زادت معنويا في السمان والذى تم تسكينة عند مستوى كثافة (٧٧ طائر/م٢) تلي ذلك المجموعة التي سكنت عند ١٠٠ طائر/م٢ ثم المجموعة التي تم تسكينها عند ١٤٣ طائر/م٢ .كما اشارت النتائج ايضا الى ان احسن تحويل غذائي ظهر في المجموعة المسكنة بمعدل (٧٧ طائر/م٢) تلي ذلك السمان الموجود تحت مستوى كثافة (١٠٠ طائر/م٢) ثم المجموعة الموجودة تحت مستوى كثافة (١٤٣ طائر/م٢) . بالنسبة لمعدل الوفيات كان اقل معنويا في السمان المربى عند مستوى كثافة (٧٧ طائر/م٢) بالمقارنة بالمجموعات الاخرى والتي تم تسكينها عند مستوى١٠٠ طائر/م٢ أو تلك المسكنة (١٤٣ طائر /م٢). كما سجلت الاناث زيادة معنوية في وزن الجسم وكذلك الزيادة في وزن الجسم المكتسب بالمقارنة بالذكور. كما لوحظ ان هناك تاثير معنوى لكل من الكثافة والجنس على كل الصفات الفسيولوجية المدروسة (معدل ضربات القلب،عدد مرات التنفس، درجة حرارة الجسم ، ودرجة حرارة الجسم الخارجية حيث ان هذة القياسات انخفضت معنويا عندما تم تسكين السمان عند مستوى كثافة (٧٧طائر/ م ٢) بالمقارنة بباقي الكثافات الاخرى.

فيما يتعلق بمقاييس الدم فلقد اشارت النتائج الى عدم حدوث اختلافات معنوية في كل من مستوى البروتين الكلي في الدم، الالبيومين، الجلوبيولين، نسبة الالبيومين الى الجلوبيولين، الدهون الكلية ونسبة الجليسريدات الثلاثية بين الكثافات الثلاثة، .بينما لوحظ ان هناك زيادة معنوية في كل من انزيمات الكبد والكالسيوم وانزيم الفوسفاتيز القاعدى في الدم للسمان المربى تحت مستوى كثافة (٧٧ طائر /م٢) بالمقارنة بباقي الكثافات الاخرى. كذلك لم تلاحظ هناك اختلافات معنوية بين الذكور والاناث في مستوى البروتين الكلي والالبيومين والجلوبيولين ونسبة الالبيومين الى الجلوبيولين والدهون والجليسريدات الثلاثية في الدم بينما سجلت الاناث زيادة معنوية اكبر في نسبة الكالسيوم والفوسفاتيز القاعدى بالمقارنة بالذكور. ايضا لوحظ ان هناك اختلافات معنوية في معظم صفات الذبيحة بين السمان المربى تحت مستوى كثافات مختلفة. و فيما يتعلق بوزن عظام التبيا وكذلك الطول والعرض ونسبة الرماد ونسبة الكالسيوم والفوسفور(كنسبة مئوية من الرماد) فلقد اظهرت النتائج الى ان السمان المربى تحت مستوى كثافة (٧٧ طائر /م٢) اظهر تفوق ملحوظ في هذة الصفات تلي ذلك السمان المربى تحت مستوى كثافة (١٠٠ طائر /م٢) ثم السمان الموجود تحت مستوى كثافة (١٤٣ طائر /م٢)، كما سجلت الاناث تفوق ملحوظ في هذة الصفات بالمقارنة بالذكور. كما اشارت النتائج ايضا الى عدم فروق معنوية في تركيب الجسم الكيماوى نتيجة لاختلافات الكثافة او الجنس . وعموما نستخلص من هذة الدراسة الى ان تربية السمان عند مستوى كثافة (٧٧/طائر /م٢) اعطى نتائج افضل فيما يتعلق بالاداء الانتاجي او الصفا ت الفسيولوجية المدروسة بالمقارنة بالكثافات الاخرى.