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Growth Performance, Hematological Characteristics and Carcass Merits in Four Different Duck Breeds

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Abstract

This work was conducted to investigate the growth performance, hematological characteristics, and carcass merits in four duck breeds (Pekin, Star 53, Muscovy and Mulard ducks). A total 80 ducklings one day old were used in this work till the age of 12 weeks. Each of the ducklings was allocated to 4 replicates (5 ducks/ replicate). The obtained results denoted that the Mulard had the heaviest body weight (4234 gm) followed by Muscovy, Star 53 and Pekin (4029, 3659 and 2938 g., respectively). Muscovy ducks had a highly significant dressing percentage (84.39 %) compared to that of Mulard, Pekin and Star 53 (83.23, 74 and 72.72 %, respectively). Mulard duck had the highest values in Hemoglobin and MCHC by (25 and 49 %) in Pekin and Star but (32 and 24 %) in Muscovy. Lymphocyte in Muscovy increased about two times of Pekin, Star 53. Conclusion, performance, carcass characteristics, and blood parameters were all generally better with Mulard ducks.

KEYWORDS
Duck breeds, Performance, Carcass merits, Blood measurements.

INTRODUCTION

Ducks (Anas platyrhynchos domestica) are more tolerant to hot and cold climates compared to chickens, making them easier to grow for both farmers and commercial producers and more durable (Holderread, 2011). Also, they are less exposed to most common poultry diseases like infectious bronchitis and Marek's disease (Oluyemi and Ologbobo, 1997). The demand for meat duck had visibly increased in the last decade. 2.1 billion ducks were raised in 2010, producing 4.0 million pounds of meat (FAO, 2010). From 2010 to 2021, a 3% yearly rise was estimated (Yahoo Finance, 2022). Duck meat is beneficial to human nutrition because of its high essential fatty acid content and abundant polyunsaturated fatty acids (Heo *et al*., 2015 and Qiao *et al*., 2017). Also, it has a higher protein-to-ash ratio, less fat and water, and more red muscle fibers than broiler (Ali *et al*., 2007).

In Egypt, the most common breeds raised for meat production are Pekin, Muscovy, and Mulard. Due to their rapid growth and diseases resistance, white Pekin ducks are utilized to improve strains (Tieshan *et al*., 2011). Muscovy ducks are very popular because of great different environmental adaptations, have a distinctive taste, a high breast meat and have a low-calorie level (Wu *et al*., 2014). The Mulard (a Muscovy and Pekin duck hybrid) is used to produce meat and fattened liver (Baeza *et al*., 2000; Wawro *et al*., 2001). The Mulard (a Muscovy and Pekin duck hybrid) is used to produce meat and fattened liver (Baeza *et al*., 2000; Wawro *et al*., 2001).

Understanding an animal's physiology, especially its hematological properties, is necessary for improving its productivity. Blood measurements are good indicators of an animal's nutritional and physiological health (Pascalonpekelniczky *et al*., 1996). To the best of the authors' knowledge there are few studies on Star 53 ducks. Consequently, this study was aimed to investigate the influence of breed variation of Star 53, Pekin, Muscovy and Mulard ducks on growth performance, blood measurements, carcass merits.

MATERIALS AND METHODS

Bird, housing and feeding program

This work was carried out at poultry farm, Faculty of Veterinary Medicine, Zagazig University, Egypt. The Institutional Animal Care and Use Committee at Zagazig University approved the protocol for the animal experiment.

A total of 80 one day old duckling of pekin, Star 53, Muscovy and Mulard was used in this work (20 each). Each of ducks were allocated to four replicates (5 ducks/ replicate). They were raised under the same environmental, managerial, and hygienic conditions from one day old till the end of experiment (12th week). They were kept in pens with similar floor area (5 ducks/ m^2) covered with 5 cm thickness of wood shaving. The environmental temperature was preserved at 34°C for the first three days, then decreased by about 2°C per week till it reached 25°C, and the light was continuous. The feed and water supplied ad libitum. From 1st to 4th week of age, the starter ration 22% (cp) offered. While, from 5th to 12th week of age, weeks of age, the grower / finisher ration 18% (cp) offered according to Dale (1994) (Table 1).

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Measurements and observations

Growth performance

The body weight (BW) and body weight gain (BWG) were calculated weekly. The feed withheld for 2 h before weighing the ducks. Feed consumption was also calculated for the total period and was divided by total body weight gain to estimate the feed conversion ratio (FCR).

Blood measurements

Blood samples were taken during slaughtering from six bird / breed at the end of the experiment (12th week of age) in labeled test tubes. These tubes with anticoagulant were used for hematological parameters to determine red blood cells, leukocytes, and platelets counts, packed cell volume, and differential leukocytic count (Natt and Herrich, 1952).

Carcass merits

At the 12th week of the study, ducks were fasted for 12 hours, weighed then slaughtered by a sharp knife according to Islamic method by cutting the carotid arteries, jugular veins and the blood drained under gravity. The ducks bled for 5 min and then scalded in warm water at about 63°C for 1 min, to facilitate plucking and birds were de feathered manually. The organs (liver, gizzard, spleen, kidney, heart), head, wing, breast, thigh muscles and eviscerated carcass were weighed and their percentages in relation to live body weight were recorded.

Statistical analysis

All the statistical procedures were presented using SPSS V.25.0. A one-way analysis of variance was used to analyze the data. (ANOVA). The post. hoc comparisons of means were equal variance assumed and carried out with Duncan's multiple range tests (DMRT). Results were performed as mean ± standard errors (SE), The values of ($p<.05$) was used to indicate statistical significance.

RESULTS

Body weight was significantly affected by breed. It was observed from Table 2 that the initial live weight of Star 53, Mulard, Muscovy and Pekin ducklings were 52.20, 52.4, 51.65 and 51.55g, respectively. Star 53 demonstrated a significant increase in live body weight till 7th week of age than other breeds ($p<.0001$). while, at 8th w Star 53 and same age Mulard did not differ significantly and was 3136 and 3062 g respectively. Mulard increased in weight from 9th to 12th w of age which recorded the heaviest final BW (4234g) followed by Muscovy, Star 53 and pekin (4029g, 3659g and 2961g, respectively).

The results of BWG through weeks of experiment from Table 3 showed that the Star 53 achieved the highest gain at the 2nd-3th w (600.47 g). While Muscovy acquired the highest gain at the 4th–5th weeks (595.79g). During the 6th-7th w of age, Mulard recorded the highest gain (569.51 g). At the 0-12th week of age, the highest gain (4182.36) observed in Mulard followed by Muscovy, Star 53 and pekin (3977.35, 3607.48 and 2886.86 g, respectively). The Star 53 duck consumed significantly more feed than other breeds followed by Mulard breed. AFI was significantly reduced in Muscovy breed in comparison to other breeds. In accordance to feed conversion ratio, the present results showed that no significant change between Muscovy and Mulard.

The comparison between different breeds of ducks showed that Mulard duck had the highest values in Hemoglobin and MCHC by (25 and 49 %) in pekin and Star but (32 and 24%) in Muscovy. Lymphocyte, platelets and WBCS% in Muscovy increased two times of pekin, Star 53. Heterophils increased in pekin and Star 53 compared with Mulard and Muscovy. There were no differences between blood parameters values in Star 53 and pekin. (Table 4).

Carcass merits of the different breeds are presented in table (5). The results revealed that the Carcass wt. decreased about Mulard by 38% in pekin, 24% in Star 53, 4% in Muscovy. the highest dressing percentage noticed in Muscovy ducks (84%) followed by Mulard, pekin and Star 53 (83.23, 74 and 72.72%, respectively). While Mulard ducks recorded the highest breast, liver and gizzard percentage.

Table 1. Chemical composition of experimental diets fed to ducks.

Ingredients (%)	Starter diet	Grower/Finisher
	One-day-old−4 wk. of age	5−12 wk. of age
yellow corn	54	65
Soybean meal	40.15	29.15
Soyabean oil	3	3
Limestone	1	1
Di- calcium phosphate	1	1
Methionine	0.1	0.1
NaCl	0.25	0.25
Premix[1]	0.5	0.5
Calculated analysis		
Crude protein%	22	18
Crude fiber%	3.72	4.44
Metabolizable energy, kcal ME /kg	2945	2985
Ash	7.69	6.17
Dry matter	92.5	93.07
Ether extract	3.77	3.36

1 The premix provided each kg of diet with: Vit. A: 12,000 IU, Vit. D3: 5,000 IU, Vit. E: 130 mg, Vit. K3: 3.6 mg, Vit. B1: 3 mg, Vit. B2: 8 mg, Vit. B6: 4.95 mg, Vit. B12: 0.17 mg, Niacin: 60 mg, Folic acid: 2.10 mg, dBiotin: 200 mg, calcium d-Pantothenate: 18.3 mg, Copper: 80 mg, Iodine: 2 mg, Selenium: 150 mg, Iron: 80 mg, Manganese: 100 mg, Zinc: 80 mg, Cobalt: 500 mg

DISCUSSION

This study investigated the influence of breeds on growth, carcass merits and hematological parameters to support good breed with superior property. It is significant to notice that the four breeds under research (Pekin, Star 53, Muscovy, and Mulard) differ considerably in terms of growth performance and the traits of valuable body parts. These results were maintained by the findings of other researchers on ducks (Steczny *et al*., 2015; El-Edel *et al*., 2015). The BW of Star 53 at the 8th week in this study was related to that reported by Kokoszyński *et al*. (2019), who indicated that the BW of Star was 2903 at 7th week. While, at the 12th week of age Mulard ducks yielded superior values for body weight which agree with (Omar *et al*., 2019; Nasr *et al*., 2022) who stated that Mulard was 4,021 g at the 10th w of age. But this study disagrees with Hassan *et al*. (2018) and Galal *et al*. (2011) who mentioned that the Muscovy showed the highest BW. However, Bhuiyan *et al*. (2005) reported that the Pekin breed is better than Muscovy and Deshi white ducks. These results may be attributed to genetic difference in slaughter age between breeds (Damaziak *et al*., 2014). Additionally, alterations to body weight gain in the present study of Star, Muscovy and Mulard was agree with the the findings of Steczny *et al*. (2015). While gain in pekin was related to that reported by Makram *et al*. (2021). Result of feed intake was in contrary with Galal *et al*. (2011) and Hassan *et al*. (2018) which reported that Muscovy consume large feed than pekin. The significant variations in body weight, average daily gain, and average feed intake could be attributed to differences in genetic makeup (Amao *et al*., 2011).

Result of blood hematological parameters of pekin agreed with Kavitha *et al*. (2016) and in contrary with Makram *et al*. (2017). Blood parameter values were related to that reported by Abdel–Rahman and Mosaad (2013) and contradictory with Okeudo *et al*. (2003) for Muscovy but results of Mulard was in line with Valchev *et al*. (2018) and in contrary with Ologbose *et al*. (2021). The white blood cells are responsible for protecting the body from infections (Adedibu *et al*., 2014). Higher WBCs value in Muscovy may indicate its higher immunity status against diseases where the lower WBCs value of the Star 53 and Pekin may indicate its lower status. Animals with lower WBC counts are more susceptible to disease infection, whereas those with higher counts are able to produce antibodies and have greater disease resistance (Soetan *et al*., 2013) and enhanced tolerance to local environmental and disease prevalence (Kabir *et al*., 2011). Blood

Table 2. Effects of breed on body weights (g) of ducks.

Body weight (g) at different weeks of age	Pekin	Star 53	Muscovy	Mulard	P-value
Day1	51.55±.67	52.20±.34	51.65±.85	52.4±.96	> 0.05
1st week	114.18±1.77^{d}	156.63±.53^{a}	140.80±1.90^{c}	147.05±1.1^{b}	< 0.0001***
2nd week	217.29±1.76^{d}	481.38±8.47^{a}	243.78±.80^{c}	336.30±1.16^{b}	< 0.0001***
3rd week	504.70±6.88^{c}	1085.6±7.23^{a}	358.15±.69^{d}	538.80±1.39^{b}	< 0.0001***
4th week	846.9±8.34^{d}	1657.22±5.42^{a}	937.75±8.97^{c}	1043.60±1.51^{b}	< 0.0001***
5th week	1222.96±10.61^{d}	2195.61±6.51^{a}	1530.82±15.40^{c}	1601.35±2.32^{b}	< 0.0001***
6th week	1734.38±30.14^{c}	2772.19±8.1^{a}	2056.98±12.9^{b}	2089.10±11.89^{b}	< 0.0001***
7th week	2040.63±32.3^{d}	2946.28±7.41^{a}	2561.60±11.9^{c}	2658.05±12.09^{b}	< 0.0001***
8th week	2292.03±28.41^{c}	3136.52±7.70^{a}	2961.90±9.93^{b}	3062.8±12.27^{a}	< 0.0001***
9th week	2475.20±26.57^{d}	3351.65±8.25^{b}	3288.55±9.65^{c}	3478.98±12.66^{a}	< 0.0001***
10th week	2619±25.14^{d}	3454.85±8.23^{c}	3610.80±9.79^{b}	3746.30±12.26^{a}	< 0.0001***
11th week	2800.38±23.85^{d}	3559.33±8.27^{c}	3828.20±9.83^{b}	4000.53±12.37^{a}	< 0.0001***
12th week	2938.41±25.43^{d}	3659.68±8.44^{c}	4029.90±8.31^{b}	4234.76±12.20^{a}	< 0.0001***

Data as presented as (Mean ± SE). S.E = Standard error., ^{abcd}Mean value with different superscript within same row are statistically significant. *** denotes highly statistical significance P< 0.0001.

Table 3. Effects of breed on body weight gain (BWG) (g), Average feed intake (AFI) and feed conversion ratio (FCR) of ducks.

BWG (g)	Pekin	Star 53	Muscovy	Mulard	P-value
0-1w	62.63±.2.25^{d}	104.43±.35^{a}	89.2±1.36^{c}	94.71±.24^{b}	< 0.0001***
1-2 w	103.36±.43^{c}	326.89±13.92^{a}	102.96±.74^{c}	189.26±.62^{b}	< 0.0001***
2-3w	287.14±8.82^{b}	600.47±15.12^{a}	113.92±.89^{d}	202.30±.45^{c}	< 0.0001***
3-4w	340.9±10.08^{c}	574.3±7.87^{a}	582.75±2.19^{a}	504.03±.35^{b}	< 0.0001***
4-5w	378.86±6.71^{c}	540.26±7.36^{b}	595.79±1.31^{a}	558.99±1.09^{b}	< 0.0001***
5-6w	484.01±22.40^{b}	581.06±9.08^{a}	524.79±1.82^{ab}	477.21±19.80^{b}	< 0.001**
6-7w	304.84±9.84^{c}	173.54±1.35^{d}	505.68±1.41^{b}	569.51±1.17^{a}	< 0.0001***
7-8w	250.05±7.33^{b}	190.17±2.66^{c}	400.10±.47^{a}	404.96±.72^{a}	< 0.0001***
8-9 w	199.25±11.23^{c}	203.65±1.66^{c}	340.87±18.8^{b}	416.10±3.5^{a}	< 0.0001***
9-10 w	146.3±4.46^{c}	103.2±.50^{d}	297.05±11.21^{a}	267.33±2.08^{b}	< 0.0001***
10-11w	181.38±5.82^{c}	104.48±.27^{d}	224.93±7.33^{b}	254.23±.31^{a}	< 0.0001***
11-12w	145.54±1.25^{c}	100.35±.27^{d}	208.13±6.53^{b}	234.24±.26^{a}	< 0.0001***
0-12w	2886.86±26.91^{d}	3607.48±6.23^{c}	3977.35±74.94^{b}	4182.36±23.78^{a}	< 0.0001***
AFI (g)	15445.5±61.19^{c}	16786±26.27^{a}	14316±28.93^{d}	15908.62±18.37^{b}	< 0.0001***
FCR (g feed: g gain)	5.33±.082^{a}	4.66±.01^{b}	3.75±.018^{c}	3.80±.022^{c}	< 0.0001***

Data as presented as (Mean ± SE). S.E = Standard error., ^{abcd}Mean value with different superscript within same row are statistically significant. *** denotes highly statistical significance P< 0.0001.

Table 4. Comparison blood parameters between four breeds

	Pekin	Star 53	Muscovy	Mulard	P value
RBCs count ($\times10^6$ /mm^3)	2.45±0.04^{bc}	2.52±0.04^{ab}	2.20±0.02^{c}	2.74±0.12^{a}	0.0003***
Hemoglobin con (g/dl)	10.25±0.05^{b}	10.48±0.05^{b}	9.50±0.3^{c}	13.93±0.3^{a}	< 0.0001***
Packed cell volume (%)	44.90±0.04^{a}	45.20±0.04^{a}	28.28±0.4^{c}	30.68±0.3^{b}	< 0.0001***
Mcv (fl)	18.48±0.36^{a}	18.48±0.36^{a}	14.02±0.26^{b}	10.42±0.09^{c}	< 0.0001***
MCH (pg)	4.29±0.08^{b}	4.29±0.08^{b}	4.60±0.11^{b}	5.29±0.36^{a}	< 0.0001***
MCHC (%)	23.19±0.12^{c}	23.19±0.12^{c}	34.47±0.38^{b}	45.25±0.21^{a}	< 0.0001***
Platelet count ($\times10^3$/mm^3)	37.16±1.07^{c}	37.16±1.07^{b}	75.00±5.62^{a}	83.16±0.16^{a}	<0.0001***
Total leukocytic count ($\times10^3$/mm^3)	12.59±0.02^{c}	12.65±0.02^{c}	27.86±0.45^{a}	22.18±.26^{b}	<0.0001***
Heterophils (%)	56.33±.49^{a}	55.95±.49^{a}	22.50±.2^{c}	31.33±.21^{b}	<0.0001***
Lymphocytes (%)	34.1±0.04^{c}	34.10±0.04^{c}	64.33±.21^{a}	61.17±.31^{b}	<0.0001***
Monocytes (%)	8.06±.04^{b}	8.06±.04^{b}	9.50±.2^{a}	3.84±.40^{c}	<0.0001***
Eosinophils (%)	1.65±0.06^{a}	1.65±0.06^{a}	2.33±.21^{b}	2.83±.17^{b}	<0.0001***

^{abcd} Mean value with different superscript within same row are statistically significant; *** denotes highly statistical significance.; (MCV): mean corpuscular volume; (MCH): mean corpuscular hemoglobin and (MCHC): mean corpuscular hemoglobin concentration.

Table 5. Comparison carcass merits between four breeds.

	Pekin	Star 53	Muscovy	Mulard	P-value
Carcass weight (g)	2175.41±25.43^{d}	2661±0.0^{c}	3400.9±8.31^{b}	3524.76±12.2^{a}	< 0.0001***
Dressing %	74.00±0.23^{c}	72.72±0.17^{d}	84.39±0.03^{a}	83.23±0.05^{b}	< 0.0001***
Head %	3.69±0.05^{c}	6.13±0.02^{a}	3.42±0.03^{d}	4.52±0.03^{b}	< 0.0001***
Wing%	5.21±0.04^{b}	12.39±0.04^{a}	3.69±0.09^{d}	4.17±0.05^{c}	< 0.0001***
Liver%	1.95±0.02^{d}	2.02±0.02^{c}	2.09±0.01^{b}	2.3±0.01^{a}	< 0.0001***
Heart%	0.54±0.01^{b}	0.75±0.01^{a}	0.74±0.01^{a}	0.76±01^{a}	< 0.0001***
Gizzard%	2.47±0.03^{b}	2.51±0.04^{b}	2.5±0.01^{b}	2.62±0.02^{a}	< 0.0001***
Spleen %	0.17±01^{a}	0.14±0.01^{b}	0.12±01^{c}	0.12±01^{c}	< 0.0001***
Kidney%	0.51±01^{a}	0.41±0.01^{b}	0.42±0.03^{b}	0.4±0.02^{b}	< 0.0001***
Thigh%	28.68±0.25^{c}	32.86±0.08^{b}	35.66±0.07^{a}	33.33±0.1^{b}	< 0.0001***
Breast %	39.95±0.35^{c}	39.05±0.12^{d}	41.31±0.11^{b}	42.62±0.12^{a}	< 0.0001***

^{abcd} Mean value with different superscript within same row are statistically significant. *** denotes highly statistical significance(P<0.05).

Hb levels have been shown to positively relationship with body mass (Minias, 2015). MCHC gives knowledge on the volume and character of Hb (Adedibu *et al*., 2014) and is exactly correlated to Hb and oppositely associated to PCV (Reece and Swenson 2004). The higher percentage of lymphocytes might be due to mild physiologic rise in epinephrine levels resulting from physical stress during restraining and handling of the birds to collect blood samples (Aengwanich *et al*., 2003).

Many studies have revealed that the carcass's traits varied by breed. In the present study dressing percentage of pekin (74) was disagree with Hassan *et al*. (2018) who stated that dressing percentage was (72%). while, in Star 53 dressing percentage was disagree with Kokoszyński *et al*. (2019) which demonstrated at 8th w was (68.1). the dressing percentage of Muscovy and Mulard were agree with Nasr *et al*. (2022). Within the breeds, Muscovy duck had the highest dressing percentage and thigh weight related to other breeds that in line with Hassan *et al*. (2018). The reason of high dressing percentage could be attributed to lower plumage and lesser internal organs in comparison to other breeds. In both ducks and geese, the proportion of breast muscles increases with age (Bochno *et al*., 2005). The variations in breast percentage among the four breeds may be due to variations in the quantity and size of breast muscle fibers. Similarly, several studies (Havenstein *et al*., 1994; Zuidhof *et al*., 2014) suggested a strong positive relationship between breast weight and body weight due to focus on genetic progress and body weight selection. This investigation accomplished that breed has favorable influence on ducks' growth and welfare. Mulard revealed the highest body weight, body weight gain, FCR, breast percentage, MCHC and Hb. For that reason, this study indicated that the best breed for performance, blood parameters was the Mulard.

CONCLUSION

During the twelve-week rearing period, the Mulard and Muscovy breeds yield better performance and carcass traits than Star 53 and pekin. Breeds have significant effects on PCV, Hb, lymphocyte, WBC and Heterophil suggest genetic dissimilarities. This will aid in planning breeding program for selection of economic traits.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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