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Carcass Traits of Geese (*Anser anser*) as Affected by Age, Gender and Their Interactions

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ABSTRACT

Background: The geese have several advantages over chickens. These birds are highly valued for its meat, also used to get rid of weeds as it was released in the fields, which the cost of raising it was low. In recent years, despite of interest in geese production, it is important to take cognisance of the fact that there is a dearth of information on carcass traits and the different effects of age, gender and their interactions on carcass characteristics of geese. Therefore, the objective of the current study aimed to investigate effect of age, gender and their interactions on the carcass traits of geese (*Anser anser*).

Methods: A number of geese parents at the end of the third season and their gosling hatched reared until 10 weeks of age and each stock contain equal number of sexes for assessing carcass traits. All geese were reared under equal managerial, environmental and hygienic conditions.

Result: Parent stock was significantly ($p \leq 0.0001$) higher body weight, dressing percentage and edible meat parts compared to the young geese. Males' geese had approximately a 17% significantly higher live weight, a 4.6% higher dressed carcass percentage and 5.2% higher edible meat parts percentage than females. The intestine and neck percentages were significantly affected only by age, whereas blood and feather percentages were significantly affected only by gender. Moreover, abdominal fat and gizzard fat percentages were affected by all observed factors. The young geese had approximately a 24.7% higher non-edible meat percentage than the parent's geese. Females' geese had approximately 8.7% higher non-edible meat percentage than males. Abdominal and gizzard fat (%) were significantly affected by interaction between age and gender. A significant positive correlation coefficient was detected between live body weight and all edible parts of carcass characteristics weights for goose males. In conclusion, the increase of age had a positive effect on the carcass traits of geese (*Anser anser*). Males' geese had a better carcass characteristics compared to females; in addition, the females were significantly higher than males for the abdominal fat and gizzard fat percentages.

Key words: Age, Carcass, Geese, Gender, Parents.

INTRODUCTION

The goose one of the oldest birds that were domesticated in the world due to its economic importance, as it was raised to produce meat, feathers, also used to get rid of weeds as it was released in the fields, which the cost of raising it was low. Also, geese have some characteristics that make them a suitable bird for grazing, as they have a serrated beak in order to be able to cut grass and have a strong memory, as they can graze for a distance of 5 km and return to their home again (Buckland and Gérard, 2002; Makram, 2018). The production of geese carcass depends on the fattening period, which is from 10 to 12 weeks and in parents after the end of their productive season, the broiler goose in Egypt is depend on Native geese which descended from Grey lag goose (*Anser anser*), (Makram, 2018; Makram, 2016). Carcass traits and quality related to age and sex (Ziolecki, 1980; Szabone Willin and Bögre, 1992). Tilki *et al*. (2004) reported that slaughtered at around 10-12 weeks of age in order to have more meat and less fat than 16 weeks of age in the native Turkish goose. Pingel (1999) stated that the skin increased and the breast muscle decreased in Muscovy, Pekin and Mulard before marketing age.

The goose carcass characteristics are affected by a lot of various factors including rearing system (Liu *et al*., 2011), genotype (Kapkowska *et al*., 2011; Tůmová and Uhlířová, 2013; Uhlířová and Tùmová, 2014; Uhlířová *et al*., 2018; Uhlířová *et al*., 2019). In addition, depending on goose breed, values of some physicochemical parameters of leg and breast muscles change differently through postmortem aging (Tůmová and Uhlířová, 2013; Okruszek, 2012; Okruszek *et al*., 2008) and variety (Boz *et al*., 2019). The aim of this study was to investigate effect of age (parents

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and young geese), gender (males and females) and their interactions on the carcass traits of geese (*Anser anser*).

MATERIALS AND METHODS

Housing and management

A sample of 32 birds (sixteen parents of geese at the end of the third season and sixteen of their gosling hatched were reared until 10 weeks of age) for assessing carcass traits. All geese were reared under equal managerial, environmental and hygienic conditions. A diet containing 16% protein and 2800 Kcal/ME/kg of diet were offered plus a daily feeding on grass like alfalfa for the parents during the season. However, the goslings were feed on 23% protein and 2900 Kcal/ME/kg until 4 weeks of age with a daily feeding on grass like alfalfa from the second week of age, from 4-8 weeks of age, the gosling was feed on 18% protein and 2900 Kcal/ME/kg with a daily feeding on grass. From 8-10 weeks, the gosling and the parents were feed together in the same dies, 21% protein and 3000 Kcal/ME/kg without feeding on grass. Composition, chemical analysis and distribution of experimental diets, in addition, types of the grasses in pasture are shown in (Table 1 and 2). A normal natural daylight was provided during the whole experimental.

Carcass traits

Sixteen birds from each age, were randomly taken weighed and slaughtered for carcass evaluation to calculate edible meat parts (dressed carcass, gizzard, liver, heart, giblets) and non-edible meat parts (blood+feathers, head, leg and inner viscera) in addition, abdominal fat and gizzard fat. The neck were removed and weighed.

Statistical analysis

Data subjected to statistical analysis using two-way analysis of variance with age effect and the gender with interaction using General Linear Model (GLM) procedure of (SAS, 2003) as following model;

$$Y_{ij} = \mu + A_i + G_j + [A \times G]_{ij} + e_{ijk}$$

Where,

Y_{ij} = Trait measured.
μ = Overall mean.
A_i = Age effect.
G_j = Gender effect (j=1 and2).
$[A \times G]_{ij}$ = Interaction between age and gender.
e_{ijk} = Experimental error.

Means were separated using Duncan's multiple range tests, when significant differences among means were found.

RESULTS AND DISCUSSION

Edible meat parts

The results of edible meat parts of Native geese (*Anser anser*) as affected by age, gender and their interactions are presented in Table 3. The present results indicate that live body weight was significantly affected by age and gender. The parent's geese (3 years) were significantly heavier body weight compared to the young geese (10 wks); whereas body weight of the young geese represented only 81.4% of their parent's geese. Males recorded a heavier body weight compared to females.

Age and gender had an impact on dressing percentage, we showed significantly ($p \leq 0.0001$) higher dressing percentage for parent stock (68.51%) compared to the young geese (62.5%). Regarding gender effect, males had higher significant dressed carcass percentage compared with females; No significant difference ($P \geq 0.05$) of interaction between age and gender of geese for dressed carcass percentage were found. However, No significant difference ($P \geq 0.05$) between age, gender and their interactions for liver, gizzard, heart and giblets percentages were found.

Concerning percentage of edible meat parts, the parents were significantly higher (76.69%) than the young geese (71.23%), also, the males was significantly higher percentage of edible meat parts compared to the females. Males' geese had approximately 5.2% significantly higher percentage of edible meat parts than females.

Tilki *et al*. (2004) found that geese have actually achieved only 70% to 80% of their adult weight at the age of 9 wk. In our study, males' geese had approximately a 17% significantly higher live weight than females. These findings are similar with a previous study with geese (Saatci *et al*., 2009; Kırmızıbayrak and Önk, 2011; Kırmızıbayrak and Boğa, 2018) they reported that slaughter and Carcass weight statistical differences between male and female. Our results confirm those of Muth and Valle Zárate, (2017) and Hussein *et al*., (2019) who found that age at slaughter significantly affected ($P<0.0001$) slaughter weight and dressing percentage and they found that dressing percentage was significantly higher in older birds than smaller/ younger ones.

Males' geese had approximately a 4.6% significantly higher dressed carcass percentage than females. Uhlířová *et al*. (2018) observed the same trend. However, Saatci *et al*., (2009) and Buzała *et al*., (2014) found a higher dressing percentage in females.

In our study, No significant difference ($P \geq 0.05$) of interaction between age and gender of geese for dressed carcass percentage were found. However, Uhlířová *et al*., (2018) revealed a significant interaction effect of age and sex in the dressing percentage.

The gender effect on some carcass characteristics (liver, heart and gizzard) determined in the present study are contrary to results those reported by Tilki *et al*., (2004) on heart and liver, by Kirmızıbayrak and Önk, (2011) on gizzard, and by Sarica *et al*., (2015) on heart when comparing male and female geese. In addition, Kirmizibayrak and Boğa, (2018) find a significant effect of goose gender on liver, heart and gizzard; whereas male's geese were statistically higher compared to those of females. These differences among studies may be attributed to age at slaughter, genotype, and feeding practices.

Table 1: Composition, chemical analysis and distribution of experimental diets.

Ingredient	Diets			
	Starter	Grower	Finisher 18%	Production
Yellow corn	58.74	55	67.00	60
Soybean meal 44%	30.40	10	24.00	21.25
Corn gluten meal 60%	7.50	-	6.04	-
Wheat bran	0.00	33.00	0.00	10.54
Limestone	0.65	0.49	0.55	6
Die calcium phosphate	1.50	0.5	1.20	1
Salt	0.3	0.3	0.30	0.30
Vit.-Min. Mex*	0.5	0.3	0.50	0.50
Methionine	0.01	0.01	0.01	0.01
Dry Yeast	0.1	0.1	0.10	0.10
Dry mulases	0.1	0.1	0.10	0.10
Trigonella	0.1	0.1	0.10	0.10
Chamomile	0.1	0.1	0.10	0.10
Total	100	100	100	100
Calculated chemical analysis				
Crude protein, %	23.07	14.89	20.04	18.07
ME, kcal/kg	2972.50	2642.25	3006.60	2923.16
Calcium, %	0.75	0.82	0.62	2.96
Avail. Phosphorus, %	0.41	0.42	0.34	0.46
Methionine, %	0.42	0.18	0.37	0.14
Lysine, %	1.05	0.48	0. 88	0.78
Fiber, %	3.53	5.57	3.23	3.97
Diets distribution				
Goslings	0-4	4-8	8-10	
Parents	-	-	Before slaughtering	During season lying

Table 2: Types of the grasses in pasture.

Type of grasses	
Common name	Binomial name
Alfalfa	*Medicago sativa*
Cabbage	*Brassica oleracea var. capitata*
Lettuce	*Lactuca sativa*
Nutsedge	*Cyperus longus* L.
Annual sowthistle	*Sonchus oleraceus* L.
Chicory	*Cichorium pamilum* L.

Non-edible meat parts

Data presented in Table 4 show non-edible parts of native geese (*Anser anser*) as affected by age, gender and their interactions. In the present study observed that the intestine and neck percentages were significantly affected only by age, whereas blood and feather percentages were significantly affected only by gender. Moreover, for leg percentage the interaction only between the age and gender ($p=0.001$) was significant. While, abdominal fat and gizzard fat percentages were affected by all observed factors.

Females were significantly higher blood and feather percentages in comparison with males. On the contrary, males were significantly higher head percentage compared to the females. Significant interaction effect were noted between the age and gender ($p<0.05$) in head percentage. The intestine and neck percentages significantly increased with age. No significant difference ($P\geq0.05$) between genders for intestine percentage.

The non-edible meat percentage was influenced significantly by the age and gender. The young geese had approximately a 24.7% higher non-edible meat percentage than the parent's geese. Females' geese had approximately 8.7% higher non-edible meat percentage than males.

The young geese were significantly higher neck, abdominal fat and gizzard fat percentages than parent's geese. The females were significantly higher than males for the abdominal fat and gizzard fat. Concerning interaction effect, abdominal fat and gizzard fat percentages were significantly ($p<0.05$) affected by interaction between age and gender of geese.

No significant difference ($P\geq0.05$) between genders for intestine percentage. These findings are consistent with the results of Kırmızıbayrak and Boğa, (2018).

In this study, the young geese were significantly higher neck, abdominal fat and gizzard fat percentages than parent's geese. Similar trend was noticed by Uhlířová *et al*., (2018) who stated that percentage of abdominal fat was significantly affected by the age and genotype, with higher values in the 8-wk-old ES birds. Compared to the results of Saatci *et al*., (2009) and Hamadani *et al*., (2013) who detected a

Table 3: Edible meat parts of native geese (Anseranser) as affected by age, gender and their interactions.

Traits	Gender	Age (A)		Overall	Level of significant		
	(G)	3 years (Parents)	10 weeks (young)		A	G	A*G
LBW, g	Males	3580.0±115.04	3040±136.34	3310.0[a]			
	Females	3097.50±101.30	2397.50±35.31	2747.5[b]			
	Overall	3338.8[a]	2718.8[b]		0.0001	0.0001	NS
Dressed carcass, %	Male	69.79±1.27	64.28±1.55	67.04[a]			
	Female	67.23±0.90	60.72±1.57	63.97[b]			
	Overall	68.51[a]	62.50[b]		0.0001	0.03	NS
Liver, %	Males	3.03±0.06	3.08±0.20	3.05			
	Females	2.70±0.20	2.95±0.13	2.82			
	Overall	2.87	3.01		NS	NS	NS
Gizzard, %	Males	4.36±0.07	4.37±0.26	4.37			
	Females	4.61±0.18	4.18±0.34	4.40			
	Overall	4.49	4.27		NS	NS	NS
Heart, %	Males	0.84±0.01	0.92±0.04	0.88			
	Females	0.81±0.03	0.79±0.12	0.80			
	Overall	0.83	0.86		NS	NS	NS
Giblets, %	Males	8.23±0.13	8.37±0.47	8.30			
	Females	8.12±0.21	7.92±0.51	8.02			
	Overall	8.18	8.14		NS	NS	NS
Edible meat parts, %	Males	78.02±1.17	73.83±1.04	75.92[a]			
	Females	75.35±0.76	68.64±1.24	71.99[b]			
	Overall	76.69[a]	71.23[b]		0.0001	0.001	NS

[a,] and [b] Means within the same row with different letters are significantly differed.

Table 4: Non-edible parts of native geese (Anseranser) as affected by age, gender and their interactions.

Traits	Gender	Age (A)		Overall	Level of significant		
	(G)	3 years (Parents)	10 weeks (young)		A	G	A*G
Blood + feather, %	Males	6.61±0.20	7.49±1.69	7.05[b]			
	Females	9.61±0.64	9.25±0.83	9.43[a]			
	Overall	8.11	8.37		NS	0.02	NS
Head, %	Males	4.41±0.07	4.08±0.16	4.25[a]			
	Females	3.83±0.10	4.07±0.10	3.95[b]			
	Overall	4.12	4.08		NS	0.01	0.02
Leg, %	Males	3.35±0.10	3.01±0.09	3.18			
	Females	2.88±0.08	3.24±0.12	3.06			
	Overall	3.11	3.12		NS	NS	0.001
Intestine, %	Males	7.62±0.92	15.26±1.65	11.44			
	Females	8.34±0.73	15.57±0.97	11.96			
	Overall	7.98[b]	15.42[a]		0.0001	NS	NS
Non-edible meat, %	Males	21.98±1.17	29.84±1.60	25.91[b]			
	Females	24.65±0.77	32.12±0.91	28.39[a]			
	Overall	23.32[b]	30.98[a]		0.0001	0.04	NS
Neck, %	Males	4.24±0.23	4.68±0.21	4.46			
	Females	4.17±0.27	4.99±0.29	4.58			
	Overall	4.21[b]	4.84[a]		0.01	NS	NS
Abdominal fat, %	Males	0.25±0.09	1.15±0.13	0.70[b]			
	Females	2.33±0.18	2.28±0.34	2.31[a]			
	Overall	1.29[b]	1.72[a]		0.05	0.0001	0.03
Gizzard fat, %	Males	0.09±0.035	0.06±0.02	0.08[b]			
	Females	0.29±0.04	0.74±0.22	0.52[a]			
	Overall	0.19[b]	0.40[a]		0.05	0.0006	0.04

[a] and [b] Means within the same row with different letters are significantly differed.

higher abdominal fat percentage in females; the same result was obtained in the present experiment. Contrary to our results, Uhlířová *et al*., (2018) not find a significant effect of interaction between age and gender (p=0.07) for abdominal fat percentage trait.

Correlation coefficients

Pearson correlation coefficients and probabilities between edible parts of carcass characteristics weights for goose males (Upper part) and females (Lower part) at 3 years of age are presented in Table 5. It could be observed that a significant positive correlation coefficient was detected between live body weight and all edible parts of carcass characteristics weights for goose males; we can observe that all studied traits in males had a significant positive correlation coefficient, except the correlation between giblets and heart were not statistically significant. On the other hand, this trend was not observed for goose females. Almost, live body weight was positively correlated with both gizzard and heart, dressed was positively correlated with both heart and giblets, gizzard was positively correlated with both liver and giblets, liver correlated with heart, and edible parts was positively correlated with heart and giblets, but these coefficients were not statistically significant. A significant negative correlation coefficient was detected between dressed and gizzard, also, edible parts and gizzard.

Table 6 clarifies pearson correlation coefficients and probabilities between edible parts of carcass characteristics weights for goose males (Upper part) and females (Lower part) at 10 weeks of age. In goose males, a significant positive correlation coefficient was detected between all studied traits. While, in goose females, a significant positive

Table 5: Pearson correlation coefficients and probabilities between edible parts of carcass characteristics weights for goose males (Upper part) and females (Lower part) at 3 years of age.

Traits	LBW	Dressed	Gizzard	Liver	Heart	Giblets	Edible parts
LBW	1	0.99134***	0.93267**	0.93492**	0.94462**	0.95024**	0.99129***
		<.0001	0.0007	0.0007	0.0004	0.0003	<.0001
Dressed	0.9129**	1	0.94055**	0.94182**	0.95211**	0.95791**	0.99992***
	0.0015		0.0005	0.0005	0.0003	0.0002	<.0001
Gizzard	0.19913	-0.14798	1	0.99923***	0.88707**	0.99690***	0.94463**
	0.6364	0.7266		<.0001	0.0033	<.0001	0.0004
Liver	0.91936**	0.75216*	0.41652	1	0.88736**	0.99674***	0.94584**
	0.0012	0.0313	0.3047		0.0033	<.0001	0.0004
Heart	0.59697	0.41743	0.7163*	0.64071	1	0.92025	0.95240**
	0.1182	0.3035	0.0456	0.0870		0.0012	0.0003
Giblets	0.82128*	0.57695	0.67725	0.9482***	0.80049*	1	0.96140**
	0.0124	0.1343	0.0650	0.0003	0.0170		0.0001
Edible parts	0.95157***	0.99178***	-0.02727	0.82655*	0.50169	0.67673	1
	0.0003	<.0001	0.9489	0.0114	0.2053	0.0653	

LBW = Live body weight, * p<0.05, ** p<0.01, *** p<0.001.

Table 6: Pearson correlation coefficients and probabilities between edible parts of carcass characteristics weights for goose males (Upper part) and females (Lower part) at 10 weeks of age.

Traits	LBW	Dressed	Gizzard	Liver	Heart	Giblets	Edible parts
LBW	1	0.91611**	0.85831**	0.90045**	0.79631*	0.88981**	0.96561***
		0.0014	0.0064	0.0023	0.0180	0.0031	<.0001
Dressed	0.65978	1	0.71084*	0.75426*	0.71410*	0.74480*	0.79836*
	0.0750		0.0481	0.0306	0.0466	0.0340	0.0175
Gizzard	-0.03154	-0.59744	1	0.96796***	0.75815*	0.98976***	0.90731**
	0.9409	0.1178		<.0001	0.0293	<.0001	0.0019
Liver	0.38515	-0.24332	0.76859*	1	0.84008**	0.99247***	0.91052**
	0.3461	0.5615	0.0259		0.0090	<.0001	0.0017
Heart	0.00526	-0.16040	0.39762	0.55728	1	0.82809*	0.76588*
	0.9901	0.7044	0.3293	0.1513		0.0111	0.0267
Giblets	0.08430	-0.48880	0.94525**	0.89498**	0.63923	1	0.91754**
	0.8427	0.2190	0.0004	0.0027	0.0879		0.0013
Edible parts	0.75341*	0.96995***	-0.39731	-0.01958	0.00084	-0.26186	1
	0.0309	<.0001	0.3297	0.9633	0.9984	0.5310	

LBW = Live body weight, * p<0.05, ** p<0.01, *** p<0.001.

correlation coefficient was observed between edible parts with both live body weight and dressed. The same trend was observed between giblets with both gizzard and liver. Negative correlation coefficient detected between dressed and whoever gizzard, liver, heart and giblets, but these coefficients were not statistically significant. The same trend was observed between edible parts gizzard, liver and giblets.

CONCLUSION

It could be concluded that the increase of age had a positive effect on the carcass traits of geese (*Anser anser*). Males' geese had a better carcass characteristics compared to females; in addition, the females were significantly higher than males for the abdominal fat and gizzard fat percentages.

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Conflict of interest

There is no conflict of interests among authors and organizations.

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