

Effects of brooder machine rearing method in the first week on fattening performance, carcass characteristics, meat quality and some blood parameters of Pekin ducks

Evren ERDEM¹, Esin Ebru ONBAŞILAR², Afşin KOCAKAYA², Suzan YALÇIN³

¹Department Of Animal Science, Faculty of Veterinary Medicine, Kırıkkale Universty, Kırıkkale; ²Department Of Animal Science, Faculty of Veterinary Medicine Ankara Universty, Ankara; ³Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Selçuk University, Konya, Turkey.

Summary: The aim of this study is to determine effects of brooder machine rearing method in the first week on fattening performance, carcass characteristics, meat quality and some blood parameters of male and female Pekin ducks. A total of 120 (60 male and 60 female) ducklings were used in the research. Each sex group was randomly allocated into two rearing methods. In the first group (brooder machine), ducklings were arranged in the brooder machine from 1 to 7 d then reared on the deep litter floor until day 42. In the second group (litter/control), ducklings were reared on the deep litter floor from the day 1 to the day 42 of the fattening period. At the day 41 of the fattening period, 5 ducks from each sex and rearing groups were randomly selected and bled. At the day 42 of the fattening period all ducklings were slaughtered in a commercial slaughterhouse. Hot carcass yield, organ weights and carcass characteristics were determined. Also pH, ash, fat and crude protein were determined in the breast and thigh muscles. Total body weight gain, hot carcass yield and breast percentage of ducks reared on the litter group (control group) were significantly ($P<0.01$; $P<0.001$; $P<0.05$) higher than those of ducks reared in the brooder machine group. Thigh fat content and breast fat content were affected by first week rearing method and these traits were higher ($P<0.01$) in the litter group (control group) than the brooder machine group. Only creatinin kinase level in the examined blood parameters of ducks was higher in the group reared on the litter ($P<0.05$). Sex affected the hatching weight, body weight gain from 1 to 42 d, feed intake from 1 to 42 d, ash of thigh meat and also ash and crude protein of breast meat ($P<0.01$). In conclusion, the fattening performance, hot carcass yield and percentage of breast of the Pekin ducks were positively affected by the litter floor in the first week.

Key words: Blood parameters, brooder machine, carcass characteristics, meat quality, Pekin duck.

Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin karkas özellikleri, et kalitesi ve bazı kan parametrelerine etkileri

Özet: Bu çalışmanın amacı erkek ve dişi Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin besi performansı, karkas özellikleri, et kalitesi ve bazı kan parametreleri üzerine etkilerini belirlemektir. Çalışmada toplam 120 adet (60 erkek ve 60 dişi) Pekin ördeği palazı kullanılmıştır. Her cinsiyet grubu rastgele iki farklı yetiştirme grubuna ayrılmıştır. Birinci gruptaki (ana makinesi) palazlar besinin 1-7. günleri arasında ana makinesinde daha sonra altlıklı sistemde büyütülmüştür. İkinci gruptakiler (altlık/kontrol) ise besinin 1-42. günleri arasında altlıklı sistemde büyütülmüştür. Besinin 41. gününde her yetiştirme ve cinsiyet grubundan 5 ördek rastgele seçilerek kan örnekleri alınmıştır. Besinin 42. gününde ördekler özel bir kesimhanede kesilmiştir. Karkas randımanı, organ ağırlıkları ve karkas özellikleri belirlenmiştir. Göğüs ve but etlerinde pH, kül, yağ ve ham protein düzeyleri tespit edilmiştir. Altlıklı sistemde büyütülen ördeklerde toplam canlı ağırlık artışı, karkas randımanı ve göğüs eti yüzdesi ana makinesinde büyütülen ördeklere göre daha yüksek ($P<0.01$; $P<0.001$; $P<0.05$) olmuştur. Besi sonu but ve göğüs eti yağ oranı ilk hafta büyütme yönteminden etkilenmiştir ve bu değerler altlıklı yetiştirme sistemindeki ördeklerde daha yüksek ($P<0.01$) bulunmuştur. Kan değerlerinden sadece kreatin kinaz seviyesi, altlıklı yetiştirme sisteminde daha yüksek ($P<0.05$) olduğu tespit edilmiştir. Çıkım ağırlığı, toplam canlı ağırlık artışı, toplam yem tüketimi, but ve göğüs eti kül oranı ile göğüs eti protein oranı cinsiyetten etkilenmiştir ($P<0.01$). Sonuç olarak, Pekin palazlarında ilk hafta uygulanan altlıklı büyütme yönteminin besi performansı, karkas randımanı ve göğüs yüzdesini olumlu yönde etkilediği belirlenmiştir.

Anahtar sözcükler: Kan parametreleri, ana makinesi, karkas özellikleri, et kalitesi, Pekin ördeği.

Introduction

Pekin breed is the type of waterfowl most commonly raised for meat production. The importance of ducks as a source of animal protein has increased in

recent decades, because of their ability to adapt the wide range of environmental conditions (23, 31). Because of the ducklings have a remarkably rapid growth rate during the first week of life (30), this period is highly critical for

livability and fattening performance (28). Weight on day 7 correlated of body weight will be gained in subsequent weeks and contributed to average slaughter weight (13, 15, 18, 32). Ducklings are reared on litter system or in brooder machine during the first week of their life. Management is easier in brooder machine than the deep litter system. Although brooder machine provides optimal environmental conditions, litter system ensures more space for movement to ducklings (4, 5, 28). Furthermore, carcass quality and blood parameters of poultry can be greatly affected by the type of flooring (10, 12, 21, 22, 24, 27). Previous studies have examined patterns of growth, carcass and meat characteristics, blood chemistry parameters of Pekin ducks (7, 14, 16, 17, 26, 29, 31), however not any information could be obtained about effects of first rearing methods for ducklings.

The aim of this study is to determine effects of brooder machine rearing method in the first week on fattening performance, carcass characteristics, meat quality and some blood parameters of male and female Pekin ducks.

Materials and Methods

A total of one hundred and twenty (sixty male and sixty female) ducklings (Star 53 H.Y., Grimaud Freres) were obtained from a commercial hatchery (Köy-Tav, Ankara, Turkey). The ducklings were divided into homogeneous groups according to initial body weight and sex. The male and female ducklings were raised in separate pens under 2 different treatments, with 5 replicate pens of 6 ducklings in each treatment group. The two different treatments included, 1- Brooder machine group, in which ducklings were raised in the brooder machine from 1 to 7 d of age then on the deep litter floor from 8 to 42 d of age; 2- Litter group (control), in which ducklings were raised on the deep litter floor from 1 to 42 d of age. Size of brooder machine was 74x100x28.3 cm (widthxlengthxheight) and size of floor pen was 170x94x90 cm (widthxlengthxheight). Each brooder cage was equipped with one brooder drinker and two brooder feeder. The floor of the pens were covered with wood shavings as litter material and equipped with one of each bell drinker and one hanging suspended feeder until the end of the fattening period. Ducklings in all treatment systems were reared under the similar environmental conditions (Temperature was 32-34 °C in the first week then it was decreased to 20-22 °C; lighting period: 24 h) with naturally ventilated house. Fattening duration was 42 days. Food and water were provided *ad libitum* during the experiment. Ducklings were fed with starter diet from 1 to 21 day of age (2830 kcal/kg metabolizable energy and 18.2% crude protein) and with grower diet from 22 to 42 day of age (2720 kcal/kg metabolizable energy and 17.3% crude protein).

Body weight and feed intake were measured weekly for each pen. Feed conversion was calculated as the feed to gain ratio. At d 41, one duck from each pen were randomly selected and bled from the brachial vein. Blood samples were taken for estimating the cholesterol, triglyceride and creatinin kinase levels. These were determined using a Vitros 350 auto-analyzer (New York, USA; Product code 680-2153) and its accompanying commercial kits. At d 42, prior to slaughtering the ducks were weighed and deprived of feed for 6 h and then slaughtered in a commercial slaughterhouse. After defeathering process, all internal organs were carefully removed. Relative organ weights included heart, liver, gizzard were weighed and expressed as percentage of slaughter weight. The carcasses were stored 4°C for 24h by hanging. Cold carcass weights were recorded and expressed as percentage of slaughter weight as cold carcass yield. Each carcasses were dissected and break into parts including wings with skin, neck, legs (thighs+drumsticks) and breast without skin, subcutaneous fat with skin and abdominal fat (33). These parts were separately weighed and expressed as a percentage of cold carcass weight. The pH of the breast (*pectoralis superficialis*) and thigh (*biceps femoris*) were measured using a pH meter after the 24 hours slaughtering process. Breast and thigh meat were used for analyses of protein, fat and ash in one samples of each pen (five samples of each group). Samples were analyzed for protein, fat and ash according to the AOAC (1). Results were expressed as percentage over fresh matter basis.

Statistical analysis: Data were tested for normality of distribution using Kolmogorov-Smirnov and homogeneity of variance using Levene's test. Two-way ANOVA was used to identify the differences and interactions among rearing groups and sex. The model included main effects of group, sex and interaction, group differences for post-hoc multiple comparisons Duncan test was used. Statistical analyses were performed using the software package SPSS for Windows. A value of $P < 0.05$ was considered statically significant (6).

Results

Body weight at hatch, body weight gain, feed intake and feed intake to weight gain ratio were summarized in Table 1. Male ducklings were heavier (50.17) than the females (45.11) at hatch ($P < 0.001$). Body weight gain of male ducks from d (day) 22 to 42 and from d 1 to 42 were significantly ($P < 0.001$; $P < 0.01$) higher than those of female ducks. In our study, feed intake of male ducks 22 to 42d of age and 1 to 42d of age were significantly higher ($P < 0.05$) than those of females. However, feed intake to weight gain ratio between sex groups was not statistically different in all examined periods of fattening. Ducks reared in the litter group (control group) were markedly higher weight gain than that reared in brooder

Table 1. Effects of brooder machine rearing method in first week and sex on fattening performance of Pekin ducks.

Tablo 1. Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin ve cinsiyetin besi performansına etkileri.

First week rearing method	Sex	Body weight at hatch	Body weight gain (g/bird) d1 to 21	Body weight gain (g/bird) d22 to 42	Body weight gain (g/bird) d1 to 42	Feed intake (g/bird) d1 to 21	Feed intake (g/bird) d22 to 42	Feed intake (g/bird) d1 to 42	Feed intake to weight gain ratio (g/g) d1 to 21	Feed intake to weight gain ratio (g/g) d22 to 42	Feed intake to weight gain ratio (g/g) d1 to 42
Litter (control)	Male	50.72	1310	1852	3162	1887	4967	6854	1.44	2.69	2.17
	Female	45.13	1173	1769	2942	1837	4735	6572	1.57	2.68	2.23
Brooder	Male	49.62	1245	1677	2922	1643	5017	6660	1.33	3.00	2.28
	Female	45.09	1219	1550	2768	1631	4771	6402	1.35	3.09	2.32
Litter (control)		47.93	1242	1810	3052	1862	4851	6713	1.51	2.69	2.20
Brooder		47.36	1232	1613	2845	1637	4894	6531	1.34	3.05	2.30
Pool SEM	Male	50.17	1278	1765	3042	1765	4992	6757	1.39	2.85	2.23
	Female	45.11	1196	1659	2855	1734	4753	6487	1.46	2.89	2.28
First week rearing method		NS	NS	***	**	**	NS	NS	*	**	NS
Sex		**	NS	*	**	NS	*	*	NS	NS	NS
First week rearing method X Sex		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

n=5, NS; non significant, ***, P<0.001, **, P<0.01, *, P<0.05

n=5, NS; önemli değil, ***, P<0.001, **, P<0.01, *, P<0.05

Table 2. Effect of brooder machine rearing method in first week and sex on hot carcass yield and relative organ weights of Pekin ducks.

Tablo 2. Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin ve cinsiyetin karkas randımanı ve organ ağırlıklarına etkileri.

First week rearing methods	Sex	Hot carcass yield (%SW)	Liver (%SW)	Heart (%SW)	Gizzard (%SW)
Litter (control)	Male	71.94	1.58	0.68	2.92
	Female	71.44	1.70	0.73	3.07
Brooder	Male	70.41	1.73	0.68	3.07
	Female	69.88	1.75	0.68	3.15
Litter (control)		71.69	1.64	0.70	3.00
Brooder		70.15	1.74	0.68	3.11
	Male	71.18	1.65	0.68	2.99
	Female	70.66	1.72	0.70	3.11
Pool SEM		0.21	0.03	0.01	0.04
First week rearing method		***	NS	NS	NS
Sex		NS	NS	NS	NS
First week rearing method X Sex		NS	NS	NS	NS

n=30, NS; non-significant, ***, P<0.001

n=30, NS; önemli değil, ***, P<0.001

machine (P<0.001) after the d 21 and total body weight gain was affected by the first week rearing method (P<0.01). The feed intake was found to be different only from 1 to 21d of age between rearing methods (P<0.05). Feed intake to weight gain ratio was statistically different from d 1 to 21 and d 22 to 42 (P<0.01; P<0.05). The interactions between sex and type of rearing method were not statistically significant for body weight gains, feed intake and feed intake to weight gain ratio during fattening period. No any mortality was seen in trial groups during the experiment. In this study hot carcass

yield was affected by rearing method (P<0.001) but not by sex. And it significantly higher of ducks reared in the litter group (control group) than those reared in the brooder machine group. Percentages of liver, heart and gizzard were not affected by both rearing method and sex (Table 2). Sex didn't affect the examined carcass percentages (Table 3); however, rearing method affected only breast percentage in all examined carcass parts. Percentage of breast was higher in the litter group (control group) (P<0.05) than the brooder machine group during the first week. The interaction between sex and

Table 3. Effects of brooder machine rearing method in the first week and sex on carcass characteristics of Pekin ducks
Tablo 3. Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin ve cinsiyetin karkas özelliklerine etkileri.

First week rearing methods	Sex	Neck ¹ (% of cold carcass)	Breast ¹ (% of cold carcass)	Legs ¹ (% of cold carcass)	Wings ² (% of cold carcass)	Skin with subcutaneous fat (% of cold carcass)	Abdominal fat (% of cold carcass)
Litter (control)	Male	7.07	29.01	16.49	12.42	21.42	1.31
	Female	6.91	28.66	17.84	12.65	21.33	1.32
Brooder	Male	7.05	28.14	17.27	12.11	21.07	1.28
	Female	6.90	27.52	17.31	12.41	20.97	1.33
Litter (control)		6.99	28.84	17.16	12.54	21.38	1.31
Brooder		6.98	27.83	17.29	12.26	21.02	1.31
	Male	7.06	28.58	16.88	12.27	21.25	1.30
	Female	6.91	28.09	17.57	12.53	21.15	1.32
Pool SEM		0.06	0.21	0.18	0.07	0.19	0.03
First week rearing method		NS	*	NS	NS	NS	NS
Sex		NS	NS	NS	NS	NS	NS
First week rearing method X Sex		NS	NS	NS	NS	NS	NS

n=5, ¹: without skin and subcutaneous fat, ²: with skin, NS; non-significant, *, P<0.05
n=5, ¹: derisiz ve derialtı yağsız, ²: derili, NS; önemli değil, *, P<0.05

Table 4. Effects of brooder machine rearing method in the first week and sex on meat quality parameters.
Tablo4. Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin ve cinsiyetin et kalite özelliklerine etkileri.

First week rearing methods	Sex	Thigh meat (% on fresh matter)			Breast meat (% on fresh matter)			pH	
		Ash	Fat	Crude protein	Ash	Fat	Crude protein	Breast pH	Thigh pH
Litter (control)	Male	1.09	1.04	22.20	1.20	0.43	21.64	5.68	6.78
	Female	1.10	0.93	21.56	1.20	0.52	21.73	5.78	6.81
Brooder	Male	1.07	1.04	21.45	1.28	0.59	21.21	5.78	6.65
	Female	1.17	0.47	22.63	1.17	0.68	22.4	5.82	6.78
Litter (control)		1.10	0.99	21.88	1.20	0.64	21.68	5.73	6.80
Brooder		1.12	0.75	22.04	1.23	0.47	21.8	5.80	6.72
	Male	1.08	1.04	21.82	1.24	0.51	21.42	5.73	6.71
	Female	1.14	0.70	22.10	1.19	0.60	22.06	5.80	6.80
Pool SEM		0.01	0.03	0.18	0.01	0.03	0.10	0.02	0.06
First week rearing method		NS	**	NS	NS	**	NS	NS	NS
Sex		**	*	NS	**	NS	**	NS	NS
First week rearing method X Sex		*	*	*	**	NS	*	NS	NS

n=5, NS; non-significant, **, P<0.01, *, P<0.05
n=5, NS; önemli değil, **, P<0.01, *, P<0.05

Table 5. Effects of brooder machine rearing method in the first week and sex on some blood chemistry parameters.
Tablo 5. Pekin ördeklerinde ilk hafta ana makinesinde büyütmenin ve cinsiyetin bazı kan parametrelerine etkileri.

First week rearing method	Sex	Total Cholesterol (mg/dL)	Triglycerid (mg/dL)	Creatinin Kinase (IU/L)
Litter (control)	Male	86.20	87.20	617.00
	Female	105.40	84.40	715.00
Brooder	Male	97.40	80.80	496.60
	Female	93.00	81.40	530.40
Litter (control)		95.80	85.80	666.00
Brooder		95.20	81.10	513.50
	Male	91.80	84.00	556.80
	Female	99.20	82.90	622.70
Pool SEM		2.01	4.24	32.37
First week rearing method		NS	NS	*
Sex		NS	NS	NS
First week rearing method X Sex		*	NS	NS

n=5, NS; non-significant, *, P<0.05
n=5, NS; önemli değil, *, P<0.05

rearing method was not statically significant in all examined carcass characteristics. Fat contents of breast and thigh meats were affected by rearing method of first week. These data were higher in ducklings reared on the litter group (control group) than those of brooder group ($P<0.01$; $P<0.001$). Thigh and breast crude protein were not affected by first rearing method. The thigh and breast ash, thigh fat content and breast crude protein were significantly affected by sex ($P<0.01$; $P<0.001$) (Table 4). pH of breast and thigh meat were not affected by rearing method and sex (Table 4). Total cholesterol and triglycerid were not affected by rearing method and sex; however, creatinin kinase was affected by rearing method (Table 5). Creatinin kinase value of ducks was higher in litter group (control group) than the brooder group ($P<0.05$).

Discussion and Conclusion

Pekin ducks have prominent sexual dimorphism (20). Also our result demonstrates that body weight gain was affected by sexual dimorphism after the 21 d of age. However, Farhat and Chavez (7) reported that sexual dimorphism in Pekin ducks observed at 35 d of age. Body weight gains of ducks reared in different systems during the first week were found similar until 21d of age. The environmental conditions were easily controlled in the brooder machine for newly hatched ducklings; however this situation was not contributed to body weight gain. After this period, ducks reared in the litter group (control group) were markedly higher weight gain than that reared in brooder machine and total body weight gain was affected by the first week rearing method. This result could be explained by transferring the ducks from the brooder machine to the pens with litter. Stress owns as a result of transferring and environmental change may declined body weight gain for ducks in brooder machine group. Ducks reared in the litter group (control group) were consumed more feed than those reared in the brooder machine group from 1 to 21d of age. This might be due to the greater activity and energy consumption of ducks in the litter pens. Feed intake to weight gain ratio was found to be lower than the other groups from 1 to 21d of age in ducks reared in brooder machine. This might be due to more energy consumption of ducks reared on the litter group (control group). After this period of d 1 to 21, this situation was changed and feed intake to weight gain ratio of ducks reared in the brooder machine group was decline. This result also could be explained by transfer and changed environmental conditions. Hot carcass yields were found 71.69 and 70.15% in the litter and brooder machine groups, respectively. These results were the similar with reported by the other researchers (7, 24). In Pekin ducks after hatching, first growing part of the body is legs, which is followed by breast and wings. Leg muscles grow very quickly to the 2 wk of age and breast muscles to 7 wk of

age (3, 11). Maruyama et al. (25) reported that breast muscle grows faster than whole body during the fattening period, so this study showed that development of breast in Pekin ducks was sensitive to rearing method. Breast meat is built in carina sterni and the *pectoralis major* associated with wing beat (2, 35), therefore regularly movement of the wings in litter group (control group) might be contribute to development of the breast muscle. Breast ash value in present study was similar with result of Wawro et.al. (34), but protein values is higher and fat value is lower than the previous study that was reported the meat characteristics in Pekin ducks. These differences may be probably due to the genotype diversity. Generally, pH value is a direct reflection of muscle acid content (24). pH values of Pekin breast meat in litter and brooder machine groups were found 5.73 and 5.80, respectively. This result was agreement with the other researchers (8, 9, 19). Thigh pH values of litter (control) and brooder machine groups were 6.80 and 6.72, respectively. According to the data pH of breast muscle was lower than that of thigh muscle; this result was similar with those of reported by Kisiel and Książkiewicz (16). Lin et. al. (21) reported that plasma creatinin kinase was higher in rapidly growing broiler chicks. In the present study, total body weight gain from 1 to 42d of age and breast percentage of ducks reared on the litter group were significantly higher than those of the brooder machine group. This situation contributed to higher creatinin kinase level of ducks reared in the litter group.

In conclusion of the present study, litter rearing in the first week contributed to body weight gain of ducklings, positively affects the breast development and total body weight gain. Hot carcass yield and breast percentage of carcass were markedly increased in litter rearing method. Fat contents of thigh and breast and also creatinin kinase level were affected by the rearing method. Sex affected the hatching weight, body weight gain from 1 to 42 d, feed intake from 1 to 42 d, ash of thigh meat and ash and crude protein of breast meat. Pekin ducks were reared on the deep litter floor method in the first week, positively affected the fattening performance, hot carcass yield and percentage of breast.

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Address for correspondence:

Asst. Prof. E. Erdem,
Department Of Animal Science,
Faculty of Veterinary Medicine,
Kırıkkale University,
Kırıkkale, Turkey 71450.
e-mail: evrenerdem@kku.edu.tr