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# Effect of Flock Age, Air Pressure and Litter Types on Carcass Traits and Meat Quality of Broiler Chicks

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**Abstract**

The present study was aimed to investigate the effect of flock age (younger breeder flock 33 WKS and older breeder flock 43 WKS), air pressure during incubation period (low, 100719 (LAP) and high, 101000 (HAP) Pascal) and the type of litter on carcass characteristics and meat quality of broiler chicks. A total number of 600 one day old chicks (Ross 308) hatched from eggs of two flocks in different age (each of 300 chicks)were randomly chosen divided into two sub experimental groups according the air pressure of incubation conditions (each of 150 chicks), each sub-group divided into three sub-sub experimental groups were raised on floor house provided with litters of wood shaving, plastic and sand, respectively. This study was design as 2×2×3 factorial arrangement experiment. The results obtained showed that, broiler chicks produced from older breeder flock recorded the higher significant ($p>0.05$) absolute and relative weights of eviscerated carcass, giblets, total edible parts, protein, ash percentages, odor, color, elasticity and overall score of meat quality compared with younger ones. However broiler chicks produced from eggs incubated at HAP shoed the higher absolute and relative weights of eviscerated carcass, giblets, total edible parts, percentages of protein, fat pH, TVN, TPA and odor of meat. Broilers chicks raised on plastic (PL) litter type showed the higher values of absolute and relative weights of eviscerated carcass total edible parts, percentages of protein and ash, meat sensory evaluation and recorded the lowest microbial count of APC bacteria in meat and cecal . According to the interaction between the studied factors, it could be concluded that the broiler chicks hatched from eggs of the flock at age of 43 WK, incubated at HAP and raised on plastic litter type (43 WKS × HAP ×PL) seemed to be adequate to achieve the favorable results.

**Key words:** flock age, air pressure, litter type, carcass characteristics and meat quality.

## Introduction

The production of broiler chickens is the most dynamically developing part of the poultry farming sector because of the short chicken rearing time, while maintaining good quality meat and low costs associated with the production **(Vissers et al., 2021)**. The quality of production is influenced by numerous factors that may affect production results, the proper functioning of the digestive system of chickens, the general health status of birds, and the quality of meat**(Banaszak et al., 2020)**. All these factors are related to bird well-being **(Avcılar et al., 2019, Kers et al., 2019).** Poultry meat quality results from complex interactions between the genotype of the animal and its raising environment **(Bihan-Duval 2004)** also he reported that carcass composition varies during the fattening period in addition, **(Avcılar et al., 2019)** reported that the environmental conditions and genotype are the key factors affecting carcass and meat quality of broilers. Their skeletal muscles, particularly the pectoralis major and minor, are one of the main body components of broiler. In food industry, these body cuts have great importance. Their external characteristics, dietary profiles, and chemical properties are essential characteristics of these muscles **(Zhao et al., 2018).**

Nowadays, consumers are also more interested in the nutritional value of the foods they eat **(Mir et al., 2017)** the pH and cooking losses, along with the nutritional composition, are also some of the essential parameters of meat quality assessment that can help ensure exceptional quality and profitability of the final product. In the assessment of meat quality, the ultimate pH is of particular importance with regard to meat physical characteristics since it can directly influence other quality characteristics, such as parameters of meat colour and shear force **(Kirmizibayrak et al., 2011).** Good rearing conditions including the type of bedding material, its quality, and composition can provide greater comfort thus improving the welfare conditions of broilers **(Avcılar et al., 2019).** Birds are reared on floors using various forms of litter material in intensive commercial broiler production. As poultry production increases, there is also an increase in the amount of litter required by the system. Consequently, both litter control and disposal pose serious challenges to the poultry industry, and its economy is a significant factor **(Taherparvar et al., 2016).** The consistency of litter can be the root of environmental and management issues in the commercial poultry industry **(Karamanlis et al., 2008, Garcia et al., 2010)** if not properly selected or managed. In chicken industry, the quality of litter is not only a major concern because it affects the health and productivity of the flock **(Garcês et al., 2013).** However, for pathogens and potential pathogens, it can be serve as a potential reservoir and transmission vehicle. The industry is also concerned with consumer trust in the food supply chain, in addition to pursuing improved efficiency, thus supporting several studies on the benefits of various bedding materials and litter chemical treatments/amendments to reduce the existence of pathogenic bacteria and improve the production characteristics of broilers **(Taherparvar et al., 2016)**.

Because the environmental and rearing factors significantly affect of the broiler carcass traits, meat quality and therefore microbial count, these study aimed to investigate the effect of flock age, air pressure and litter types on carcass characteristics, chemical, sensory, bacteriological examinations of meat and cecum microbiota in broilers.

**Materials and methods:**

The present study was carried out at the Association of Al-tanmia hatching and poultry production at El-Khanka, Qalyubia Governorate, Egypt to conduct the eggs incubation period of 21st days, starting from 12th July 2019. The hatched chicks were brooding and reared at Poultry Research Farm belonging to the Department of Animal Production, Faculty of Agriculture, Benha University, Egypt, during the period from 1st August to 15th September 2019. The chemical analysis and microbiological studies were conducted at the laboratory of Food Analysis Center, Faculty of Veterinary Medicine belonging to Benha University. This study was aimed to evaluate the effect of flock age, air pressure during incubation period and the different litter types on carcass traits and meat quality of hatched broiler chikens.

**Incubation:**

Eggs of a common commercial breeder flocks (Ross 308)of broiler chicken at 33 and 43 WKS of age were collect. Then, eggs were held for approximately 72 h under standard conditions before being set. A total number of 19200 eggs incubated by single-stage incubation program were taken randomly and equally divided into main two groups according to the flocks age (9600 per each flock). Eggs of each flock were then subdivided into two sub groups each of 4800 according to ventilation by air pressures. Eggs of the 1st sub group were incubated by ventilation of the normal air pressure (100719 Pascal) and considered as a control group, the 2nd sub group was incubated by ventilation with higher air pressure (101000 Pascal). Eggs were randomly set in vertical position with the large end up on each of the 4th middle tray levels in calibrated Pas Reform incubator (Model V6.0 SmartSet TM, SmartHatch TM); the incubator was adjusted at 99.7°f dry bulb with relative humidity at 55% during the first 18 days of incubation, then adjusted to 97.8°f of dry bulb with relative humidity at 50 % during the last three days in hatcher.

**Birds and their management:**

A total number of 600 one day old chicks (Ross 308) hatched from eggs of two flocks in different age (each of 300 chicks) were randomly chosen divided into two sub experimental groups according the air pressure of incubation conditions (each of 150 chicks), each sub-group divided into three sub-sub experimental groups were raised on floor house provided with litters of wood shaving, plastic and sand, respectively. This study was design as 2×2×3 factorial arrangement experiment. Chicks were kept under similar, standard hygienic and environmental conditions. Chicks were vaccinated against Newcastle and Gumboro diseases, Pullorum free and avian influenza according to vaccination program under the supervision of a licensed veterinarian. Wood shaving and sand litters were used at 10cm depth the same as the high of plastic one. The wetting litter of wood shaving and sand were continually removed and supplied with a fresh one. Floor brooders with gas heaters were used for brooding chicks. The brooding temperature was maintained at 35° C during the first five days of chick's age, then decreased by 2° C degree weekly until the end of the 4th week. The lighting program was 24 h light at the first five days of age, then decreased from 6 to 35 days of age (the end of the experimental) to 23 hours light and a 1-hour dark was applied. Feed and water were offered ad-libitum. Chicks were fed starter and grower diets. The basal diet was formulated according to the recommended requirements of NRC (1994) as shown in table (1).

**Parameters estimated and data collection:**
**Slaughtering and carcass characteristics:**

Carcass characteristics for random sample of 4 birds from each treatment were performed at the end of the experimental period (5 weeks). Birds chosen randomly were deprived from feed for 16 hours before slaughtering after which they were individually weighed to the nearest gram then sloughtering by cutting the throat and the jugular veins with a sharp knife near the first neck vertebra. Birds were individually reweighed after complete bleeding. Shank and head were separated, the birds were then eviscerated and intestine, gizzard, lungs, spleen, liver, heart and all internal organs were removed. The carcass and giblets (empty gizzard, liver and heart) were separately weighed. The proportional weights to live weight of giblets, carcass and total edible parts were calculated as follows: giblets weight (%) = (GW/LW) ×100, edible parts (%) = ((EW+GW)/LW) ×100, whereas: **LW** = live weigh, **EW**= eviscerated weigh and **GW**= giblets weight.

**Meat quality traits:**

**Chemical composition:**

The examined samples of chicken fillets and sheish were analyzed for determination of their contents of moisture, protein, fat and ash by using the standard method recommended by **Horwitz (2000) "AOAC"**. Keeping quality tests by determination of pH **(Pearson 2006)**, total volatile nitrogen (TVN) was recommended by **Food and Agriculture Organization FAO (1980)** as follows: TVN/l00g = 26.88 x (2-$T_1$). Where, $T_1$ = volume of NaOH consumed in the titration. Thiobarbituric acid number (TBA) by **Pikul et al., (1989)** was applied as follow: TBA value= R x 7.8 (mg malonaldehyde /Kg).Where, R = Reading of sample against blank.

**Sensory evaluation:**

Sensory evaluation, the examined samples of chicken meat were analyzed for the quantification of the final sensory profile according to procedures of the World's Poultry Science Association by **Mead (1987)**. Five trained panelists applied the proposed organoleptical method of raw chicken meat analysis. The different attributes were quantified on a rating scale from 1 to 3. The sensorial analyzed attributes were: visual look (skin and meat color), meat consistency and elasticity and the odor.

**Bacteriological examination:**

Bacteriological examination preparation of samples by method of **Hunt et al., (2001)**, Aerobic Plate according to procedures of **ISO (2002)** and Coliform count "MPN/g **Hunt et al., (2001).**

**Statistical analysis:**

Analysis of variance was calculated using **SAS** procedure guide **(SAS 2004)** using the following linear model:

$$X_{ijhk} = \mu + F_i + P_j + L_h + FP_{ij} + FL_{ih} + PL_{jh} + FPL_{ijk} + e_{ijhk}$$

**Whereas:**

**μ** = the overall mean.

$F_i$ = the effect of the i[th] flock age. (i, 1-2)

**Pj** = the effect of the j[th] air pressure. (j, 1-2)

$L_h$= the effect of h[th] litter types. (h, 1-3)

$FP_{ij}$ = the interaction between i[th] flock age and j[th] air pressure. (2×2)

$FL_{ih}$ = the interaction between i[th] flock age and h[th] litter types. (2×3)

$PL_{jh}$= the interaction between j[th] air pressure and h[th] litter types. (2×3)

$FPL_{ijh}$ = the interaction between i[th] flock age, j[th] air pressure, and h[th] litter types. (2×2×3)

$e_{ijhk}$ = the experimental error, accordingly zero mean and variance = $\sigma^2 e$.

Significant differences among groups means were tested using Duncan multiple range test **(Duncan 1955).**

**Results and Discussions**

**Carcass characteristics:**

Data presented in Table.2 showed the absolute and proportional weights of carcass, giblets and total edible parts of carcass for broilers chickens as affected by flock age (FA), air pressure (AP), litter type (LT) and the interaction between them. Broiler chicks produced from older breeder flock recorded significant (p>0.05) the higher absolute and relative weights of eviscerated carcass, giblets and total edible parts compared with those produced from younger one. There is no significant variations were found in relative weights of eviscerated carcass and total edible parts due to FA. These results agree with those reported by **(Horsted et al., 2005)** who found that with slow-growing chickens from New Hampshire, I 657 and Light Sussex, the yield of eviscerated carcasses in these birds has changed with age. Also **Kokoszynski et al., (2016)** stated that significant differences (P <0.05) were found for the absolute and relative weights of carcass weights due to flock age. However, there were no significant effects of air pressure and litter type on absolute and relative weights of eviscerated carcass, giblets and total edible parts. These results agree with those reported by **(Vizzier-Thaxton et al., 2010)** who found that low atmosphere pressure significantly affected broiler carcass quality by reducing carcass weights and caused exsanguinated carcasses after the slaughtering. **Xu et al., (2015)** who found that litter type did not affected on absolute weights of giblets. **Połtowicz and Doktor (2011)** demonstrated that Ross 308 broiler chicken recorded only a 0.64% higher dressing percentage when it has reared on wood shaving litter type.

**Chemical examination of meat:**

Data obtained tabulated in Table .3 revealed that highly significant (p<0.001) effect was found due to FA on fat % only, while, no significant variations were found in moisture, protein and ash %, respectively due to FA. The chemical composition of meat varies during the fattening period have been reported by **(Uhlířová et al., 2018).** In addition **(Chang et al., 2010)** found that the proportion of fat in meat was increased with age increased, there was substantially lower in the breast muscles of slow-growing chickens than in fast-growing chickens. The results obtained disagree with those reported by **Díaz et al., (2010)** stated that chemical compositions of the meat were significantly influenced by the age of the Sasso T-44 and X-44 (commercial strains), they added that ash contents decreased and fat was not affected with age in T-44 and X-44 pullets. Concerning to the effect of AP on meat chemical composition, it is clearly found that there was highly significant (p<0.001) effect on fat % of meat only due to AP. These results disagree with those reported by **(Vizzier-Thaxton et al., 2010)** who found that low-atmosphere pressure has been utilized successfully to rearing broilers without any detrimental effect on meat quality. It was found that litter type applied had significant ($p<0.001$) effect on protein percentage in meat contents, only. These results agree with those reported by **(Simsek et al., 2009)** who found that the litter types affecting significantly ($p<0.01$ and $p<0.05$) on meat composition including protein and fat content, respectively.**Tablante et al., (2003)** stated that bone and meat ash was not affected by the litter types in broiler chicken.

Concerning the effect of flock age applied on the average of chemical parameter applied in meat (pH, TVN and TPA), it was found that the FA showed highly significant ($p<0.0001$) effect on averages of TVN and TPA of meat content (table, 4). Broiler chicks produced from younger breeder flock recorded the higher values pH, TVN and TPA (5.78, 6.22 and 0.090 mg/Kg meat, respectively). The ultimate pH has great importance in the evaluation of meat quality, because it may directly affect other quality characteristics; such as meat colour parameters and shear force have been reported by **(Kirmizibayrak et al., 2011)**. These results agreed with those reported by **(Połtowicz 2012)** stated that chickens age had significant effect on physico-chemical properties of meat, also added that pH tend to be significantly higher in older chicks.**Pudyszak et al., (2005)** observed that a tendency towards a decrease in muscle pH with the age of chickens and guinea fowl, respectively.

Highly significant ($p<0.0001$) variations were found in TVN and TPA only of different experimental groups due to the air pressure, it was found that broiler chicks produced from eggs incubated at HAP had the higher values of pH, TVN and TPA (5.74, 5.54 and 0.081 mg/Kg meat, respectively). These results disagree with those reported **(Dadgar et al., 2010)** who found that birds were subjected to conditions of hypoxia before slaughter resulted had higher pH value in meat. **Battula et al., (2008)** stated that the effect of LAP on broiler breast meat quality including pH was ranged from (5.99- 5.95).

Concerning to the effect of litter type highly significant ($p<0.0001$) effect was found on TVN and TPA. Broiler chicks reared on sand litter type recorded the highest values of pH (5.78), TVN (6.33 mg/Kg) and TPA (0.110 mg/Kg meat) These results obtained disagree with those reported by **(Meluzzi et al., 2008)** who found that litter type did not exert any important effect on meat quality of broilers.

**Meat sensory evaluation:**

Data presented in Table. 5 shows highly significant ($p<0.0001$) effect on averages of odor, color, elasticity and overall score values in sensory examination of broiler meat the higher values of odor (2.50), color (2.33), elasticity (2.50) and overall score (9.83) were found to be highly significant increase in broilers chicks produced from older breeder flocks than the younger ones. As a general rule, birds age may play a key role because myoglobin increases with age, shifting the meat color toward darker and redder tonalities have been reported by **(Bianchi et al., 2006)** also showed that the age of chickens influences the color of meat. **Boni et al., (2010)** who found that quail meat of varying ages varied significantly in colour and acidity.

Highly significant ($p>0.001$) effects on averages of aspect, odor, color, elasticity and overall score values in meat sensory examination were found due to the effect of AP (table, 5). These results agree with those reported by **Dadgar et al., (2010)** who found that birds subjected to conditions of hypoxia before slaughter resulted in darker-colored breast meat. And disagree with those reported by **Rossaint et al., (2015)** who stated that no significant difference in sensory parameters were observed for poultry samples under a high-oxygen atmosphere.

Broilers chicks raised on plastic litter type recorded the highest values of aspect (2.91), odor (3.00), color (2.33), elasticity (2.75) and overall score (11.00) for meat sensory examination. These results agreed with those reported by **(Saleeva et al., 2018)** who stated that litter types had significantly ($p>0.05$) affected on broiler meat quality, they added that the meat of the broiler chickens grown on the various bedding materials was better that of the broilers grown in cages.**Gandi et al., (2020)** found that the results of sensory parameters revealed that aroma, taste, colour, tenderness, juiciness and acceptability were significantly ($p<0.05$) affected by broiler litter types.

**Meat bacteriological examination**

Data presented in Table.6 showed that broiler chicks produced form old breeder flock which recorded the lowest APC ($3.70\times10^4$ cfu/g) and coliform count bacteria ($2.56\times10^3$ cfu/g) meat samples produced from different flock age were found to be free from salmonella. These results agreed with those reported by **(Northcutt et al., 2003)** who found that coliforms, Campylobacter, E.coli and Salmonella. $Log_{10}$ counts for coliforms, Campylobacter, and E. coli were significantly ($P<0.05$) affected by bird age. And disagree with those reported by **Williams and Macklin (2013)** who stated that as birds aged, bacteria increased in number, as much as 5 log in the case of E. coli.

No significant variations were found in (APC) bacteria and coliform count bacteria due to AP. These results may be due to that the high pressure (HP) is a non-thermal technology capable of inactivating vegetative cells of pathogenic and spoilage microorganisms, modifying enzymatic activity, reducing losses of desirable compounds, thus preserving freshness and nutritional values of foods have been reported by **(Huang et al., 2014).**

Litter type showed highly significant ($p<0.0001$) effect on meat bacteriological examination, broilers chicks reared on PL and WSH showed the lowest count of APC and coliform count bacteria ($2.95\times10^3$ and $3.30\times10^2$ cfu/g, respectively). These results agreed with those reported **by (Li et al., 2017)** who found that built- up litter like wood shaving and sand litter types increasing APC and coliform count bacteria in meat of chickens.**Torok et al., (2009)** indicated that the welfare, performance and carcass meat quality of poultry are affected directly by litter types and quality.

**Cecal bacteriological examination:**

Data presented in Table.6 showed highly significant ($P<0.0001$) differences were found in (APC) bacteria had positive E.coli and negative salmonella content, cecal microbial count due to FA. Broiler chicks produced from younger breeder flock had higher APC ($5.66\times10^{10}$ cfu/g) and coliform count bacteria ($3.83\times10^{10}$ cfu/g). These results agree with those reported by **(Torok et al., 2009)** who stated that birds age had a significant influence on cecal microbiota composition regardless of litter material.

Significant ($p>0.01$) variations were found in APC bacteria and coliform count bacteria due to AP. However, the higher ($4.88\times10^{10}$ cfu/g) count of APC bacteria was found in cecal of broiler chicks produced from eggs incubated at HAP. These results may be attributed to the bacterial count the intestine that was captured by feeding or from the litter these agreed with **(Mead 2000)** hypothesized that any beneficial dietary modulation of the intestinal environment should reflect in composition and activities of the cecal microflora.

Concerning to the effect of litter type on cecal bacterial count, it was clearly observed that litter type showed highly significant ($p<0.0001$) effects on cecal microbial content of APC and coliform bacteria. broilers chicks raised on PL and S litter type showed the lowest count of APC and coliform count bacteria ($2.40\times10^{10}$ and $2.40\times10^{10}$ cfu/g, respectively). These results agree with those reported by **(Torok et al., 2009)** who found that the cecal microbiota of chickens raised on reused litter was significantly ($P< 0.05$) different from that of chickens raised on any of the other litter materials, except softwood shavings at d 28.

According to the interaction between the studied factors, it could be concluded that the interaction between 43 WKS × HAP ×PL seemed to be adequate to achieve the favorable results.

**Table 1**. Ingredients and calculated analysis of the experimental diets:

| Ingredients (%) | Starting, (0-3 wks) | Growing, (3-5 wks) |
|---|---|---|
| Yellow corn, ground | 56.80 | 60.00 |
| Soybean meal (44% CP) | 31.00 | 29.00 |
| Corn gluten meal (60% CP) | 6.75 | 4.60 |
| Vit & Min. premix* | 0.30 | 0.30 |
| Sunflower oil | 1.7 | 3.00 |
| Dicalcium phosphate | 2 | 1.80 |
| Limestone | 1.00 | 1.00 |
| Salt | 0.30 | 0.30 |
| DL-methionine | 0.05 | - |
| L- lysine | 0.10 | - |
| Total | **100** | **100** |
| Calculated analysis** | | |
| Crude Protein (%) 23.00 21.00 | 23.00 | 21.00 |
| ME (KCal/Kg diet) | 3000 | 3100 |
| Crude fiber (%) | 3.26 | 3.51 |
| Crude fat (%) | 4.28 | 5.64 |
| Calcium (%) | 0.98 | 0.93 |
| Available phosphorus (%) | 0.46 | 0.41 |

*Each diet was supplied with2.5 kg/ton Vit. & Min. Mix (commercial source B. p. Max) Each 3 kg contains, Vit. A 10,000,000 MIU, Vit. D 2000,000 MIU, Vit. E 10,000 mg, Vit, K3 1000 mg, Vit, B1 1000 mg, Vit, B2 5000 mg, Vit, B6 1500 mg, Biotin 50 mg, BHT 10,000 mg, Pantothenic 10,000 mg, folic acid 1000 mg, Nicotinic acid 30,000 mg, Mn 60 gm, Zinc 50 gm, Fe 30 gm, Cu 4 gm, I 3 gm, Selenium 0.1 gm, Co 0.1 gm ** Calculated according to NRC" (1994).

**Table 2.** least_ square means and standard error ($\overline{X} \pm S.E$) for carcass characteristics of different experimental groups as affected by studied factors

| Items | | Absolute and relative weights of carcass traits | | | | | |
|---|---|---|---|---|---|---|---|
| | | Eviscerated carcass | | Giblets | | Total edible parts | |
| | | g | % | g | % | g | % |
| FA | 33WKS | 1780.41±21.61[b] | 73.54±1.24 | 107.96±3.36[b] | 4.45±0.12[b] | 1888.38±23.08[b] | 78.00±1.30 |
| | 55WKS | 2001.40±21.61[a] | 73.60±1.24 | 143.40±3.36[a] | 5.26±0.12[a] | 2144.81±23.08[a] | 78.86±1.30 |
| AP | LAP | 1862.95±21.61 | 72.90±1.24 | 125.40±3.36 | 4.88±0.12 | 1988.36±23.08 | 77.79±1.30 |
| | HAP | 1918.86±21.61 | 74.24±1.24 | 125.96±3.36 | 4.83±0.12 | 2044.83±23.08 | 79.07±1.30 |
| LT | WSH | 1875.00±26.46 | 73.41±1.52 | 123.63±4.12 | 4.81±0.15 | 1998.63±28.27 | 78.22±1.59 |
| | PL | 1927.25±26.46 | 74.44±1.52 | 126.61±4.12 | 4.85±0.15 | 2053.86±28.27 | 79.30±1.59 |
| | S | 1870.48±26.46 | 72.86±1.52 | 126.80±4.12 | 4.91±0.15 | 1997.28±28.27 | 77.78±1.59 |
| FA×AP×LT | 33WKS×LAP×WSH | 1703.75±52.93[e] | 70.88±3.05 | 110.97±8.25[cd] | 4.62±0.31[ab] | 1814.72±56.54[f] | 75.50±3.18 |
| | 33WKS×LAP×PL | 1713.75±52.93[e] | 73.98±3.05 | 110.23±8.25[cd] | 4.74±0.31[ab] | 1823.98±56.54[f] | 78.72±3.18 |
| | 33WKS×LAP×S | 1783.75±52.93[de] | 73.23±3.05 | 115.25±8.25[bcd] | 4.72±0.31[ab] | 1899.00±56.54[ef] | 77.95±3.18 |
| | 33WKS×HAP×WSH | 1860.00±52.93[cde] | 73.88±3.05 | 100.10±8.25[d] | 3.96±0.31[b] | 1960.10±56.54[cdef] | 77.84±3.18 |
| | 33WKS×HAP×PL | 1797.50±52.93[de] | 73.74±3.05 | 99.21±8.25[d] | 4.05±0.31[b] | 1896.71±56.54[ef] | 77.79±3.18 |
| | 33WKS×HAP×S | 1823.75±52.93[cde] | 75.56±3.05 | 112.01±8.25[cd] | 4.63±0.31[ab] | 1935.76±56.54[def] | 80.20±3.18 |
| | 43WKS×LAP×WSH | 1990.00±52.93[bc] | 75.99±3.05 | 134.87±8.25[abc] | 5.12±0.31[a] | 2124.87±56.54[bc] | 81.12±3.18 |
| | 43WKS×LAP×PL | 2039.00±52.93[ab] | 72.37±3.05 | 139.96±8.25[ab] | 4.96±0.31[ab] | 2178.96±56.54[ab] | 77.33±3.18 |
| | 43WKS×LAP×S | 1947.50±52.93[bcd] | 70.96±3.05 | 141.13±8.25[ab] | 5.15±0.31[a] | 2088.63±56.54[bcd] | 76.11±3.18 |
| | 43WKS×HAP×WSH | 1946.25±52.93[bcd] | 72.88±3.05 | 148.58±8.25[a] | 5.53±0.31[a] | 2094.83±56.54[bcd] | 78.42±3.18 |
| | 43WKS×HAP×PL | 2158.75±52.93[a] | 77.69±3.05 | 157.06±8.25[a] | 5.65±0.31[a] | 2315.81±56.54[a] | 83.34±3.18 |
| | 43WKS×HAP×S | 1926.93±52.93[bcd] | 71.70±3.05 | 138.81±8.25[ab] | 5.16±0.31[a] | 2065.75±56.54[bcde] | 76.86±3.18 |

Mean having similar letters in each column within each factor are not significantly different.
Where; FA= flock age, AP = Air pressure and LT = litter types

**Table 3.** least – square means and standard error ($\overline{X} \pm S.E$) for meet chemical examination (moisture, protein, fat and ash) of different experimental groups as affected by studied factors

| Items | | Moisture (%) | Protein (%) | Fat (%) | Ash (%) |
|---|---|---|---|---|---|
| FA | 33WKS | 73.73±0.48 | 19.51±0.23 | 21.50±0.23[a] | 1.61±0.23 |
| | 43WKS | 73.10±0.48 | 20.20±0.23 | 11.50±0.23[b] | 1.93±0.23 |
| AP | LAP | 73.56±0.48 | 19.85±0.23 | 16.00±0.23[b] | 1.80±0.23 |
| | HAP | 73.26±0.48 | 19.86±0.23 | 17.00±0.23[a] | 1.75±0.23 |
| LT | WSH | 73.47±0.59 | 19.90±0.28[ab] | 16.50±0.28 | 1.67±0.28 |
| | PL | 72.97±0.59 | 20.47±0.28[a] | 16.50±0.28 | 2.02±0.28 |
| | S | 73.80±0.59 | 19.20±0.28[b] | 16.50±0.28 | 1.62±0.28 |
| FA×AP×LT | 33WKS×LAP×WSH | 74.50±1.19 | 19.40±0.57[ab] | 21.00±0.57[b] | 1.60±0.57 |
| | 33WKS×LAP×PL | 73.30±1.19 | 20.10±0.57[ab] | 21.00±0.57[b] | 1.90±0.57 |
| | 33WKS×LAP×S | 73.70±1.19 | 19.10±0.57[ab] | 21.00±0.57[b] | 1.70±0.57 |
| | 33WKS×HAP×WSH | 73.10±1.19 | 19.70±0.57[ab] | 22.00±0.57[a] | 1.30±0.57 |
| | 33WKS×HAP×PL | 72.90±1.19 | 20.00±0.57[ab] | 22.00±0.57[a] | 1.80±0.57 |
| | 33WKS×HAP×S | 74.90±1.19 | 18.80±0.57[b] | 22.00±0.57[a] | 1.40±0.57 |
| | 43WKS×LAP×WSH | 73.40±1.19 | 20.10±0.57[ab] | 11.00±0.57[d] | 1.70±0.57 |
| | 43WKS×LAP×PL | 73.00±1.19 | 20.80±0.57[a] | 11.00±0.57[d] | 2.00±0.57 |
| | 43WKS×LAP×S | 73.50±1.19 | 19.60±0.57[ab] | 11.00±0.57[d] | 1.90±0.57 |
| | 43WKS×HAP×WSH | 72.90±1.19 | 20.40±0.57[ab] | 12.00±0.57[c] | 2.10±0.57 |
| | 43WKS×HAP×PL | 72.70±1.19 | 21.00±0.57[a] | 12.00±0.57[c] | 2.40±0.57 |
| | 43WKS×HAP×S | 73.10±1.19 | 19.30±0.57[ab] | 12.00±0.57[c] | 1.50±0.57 |

Where; FA= flock age, AP = Air pressure and LT = litter types

**Table 4**. least – square means and standard error ($\bar{X} \pm S.E$) for meet chemical examination of meat (pH, TVN, and TPA (mg/Kg)) of different experimental groups as affected by studied factors

| | Items | pH | TVN (mg /Kg) | TPA (mg/Kg) |
|---|---|---|---|---|
| FA | 33WKS | 5.78±0.23 | 6.22±0.23[a] | 0.090±0.00[a] |
| | 43WKS | 5.66±0.23 | 3.86±0.23[b] | 0.066±0.00[b] |
| AP | LAP | 5.69±0.23 | 4.55±0.23[b] | 0.075±0.00[b] |
| | HAP | 5.74±0.23 | 5.54±0.23[a] | 0.081±0.00[a] |
| LT | WSH | 5.73±0.28 | 5.44±0.28[b] | 0.082±0.00[b] |
| | PL | 5.64±0.28 | 3.37±0.28[c] | 0.042±0.00[c] |
| | S | 5.78±0.28 | 6.33±0.28[a] | 0.110±0.00[a] |
| FA×AP×LT | 33WKS×LAP×WSH | 5.77±0.57 | 6.01±0.57[cd] | 0.090±0.00[d] |
| | 33WKS×LAP×PL | 5.67±0.57 | 3.70±0.57[ef] | 0.060±0.00[g] |
| | 33WKS×LAP×S | 5.81±0.57 | 6.34±0.57[bc] | 0.110±0.00[b] |
| | 33WKS×HAP×WSH | 5.83±0.57 | 7.86±0.57[b] | 0.080±0.00[e] |
| | 33WKS×HAP×PL | 5.69±0.57 | 3.88±0.57[ef] | 0.060±0.00[g] |
| | 33WKS×HAP×S | 5.92±0.57 | 9.57±0.57[f] | 0.140±0.00[a] |
| | 43WKS×LAP×WSH | 5.63±0.57 | 3.85±0.57[ef] | 0.070±0.00[f] |
| | 43WKS×LAP×PL | 5.62±0.57 | 3.13±0.57[f] | 0.030±0.00[h] |
| | 43WKS×LAP×S | 5.68±0.57 | 4.29±0.57[def] | 0.090±0.00[d] |
| | 43WKS×HAP×WSH | 5.71±0.57 | 4.04±0.57[ef] | 0.090±0.00[d] |
| | 43WKS×HAP×PL | 5.59±0.57 | 2.78±0.57[a] | 0.020±0.00[i] |
| | 43WKS×HAP×S | 5.74±0.57 | 5.12±0.57[cde] | 0.100±0.00[c] |

Where; FA= flock age, AP = Air pressure and LT = litter types

**Table 5.** least – square means and standard error ($\bar{X} \pm S.E$) for meat sensory evaluation (aspect, odor, color and elasticity) of different experimental groups as affected by studied factors

| | Items | Aspect (3) | Odor (3) | Color (3) | Elasticity (3) | Overall (12) |
|---|---|---|---|---|---|---|
| FA | 33WKS | 2.61±0.039[a] | 2.33±0.00[b] | 1.88±0.039[b] | 2.33±0.00[b] | 9.16±0.00[b] |
| | 43WKS | 2.50±0.039[a] | 2.50±0.00[a] | 2.33±0.039[a] | 2.50±0.00[a] | 9.83±0.00[a] |
| AP | LAP | 2.66±0.039[a] | 2.33±0.00[b] | 2.16±0.039 | 2.50±0.00[a] | 9.66±0.00[a] |
| | HAP | 2.44±0.039[b] | 2.50±0.00[a] | 2.05±0.039 | 2.33±0.00[b] | 9.33±0.00[b] |
| LT | WSH | 2.25±0.048[c] | 2.00±0.00[c] | 1.75±0.048[b] | 2.50±0.00[b] | 8.50±0.00[c] |
| | PL | 2.91±0.048[a] | 3.00±0.00[a] | 2.33±0.048[a] | 2.75±0.00[a] | 11.00±0.00[a] |
| | S | 2.50±0.048[b] | 2.25±0.00[b] | 2.25±0.048[a] | 2.00±0.00[c] | 9.00±0.00[b] |
| FA×AP×LT | 33WKS×LAP×WSH | 3.00±0.096[a] | 2.00±0.00[b] | 2.00±0.096[c] | 2.00±0.00[b] | 9.00±0.00[d] |
| | 33WKS×LAP×PL | 3.00±0.096[a] | 3.00±0.00[a] | 2.00±0.096[c] | 2.00±0.00[b] | 10.00±0.00[c] |
| | 33WKS×LAP×S | 2.00±0.096[c] | 2.00±0.00[b] | 2.00±0.096[c] | 3.00±0.00[a] | 9.00±0.00[d] |
| | 33WKS×HAP×WSH | 2.00±0.096[c] | 2.00±0.00[b] | 2.00±0.096[c] | 2.00±0.00[b] | 8.00±0.00[e] |
| | 33WKS×HAP×PL | 2.66±0.096[b] | 3.00±0.00[a] | 2.33±0.096[b] | 3.00±0.00[a] | 11.00±0.00[b] |
| | 33WKS×HAP×S | 3.00±0.096[a] | 2.00±0.00[b] | 1.00±0.096[d] | 2.00±0.00[b] | 8.00±0.00[e] |
| | 43WKS×LAP×WSH | 3.00±0.096[a] | 2.00±0.00[b] | 3.00±0.096[a] | 2.00±0.00[b] | 10.00±0.00[c] |
| | 43WKS×LAP×PL | 3.00±0.096[a] | 3.00±0.00[a] | 2.00±0.096[c] | 3.00±0.00[a] | 11.00±0.00[b] |
| | 43WKS×LAP×S | 2.00±0.096[c] | 2.00±0.00[b] | 2.00±0.096[c] | 3.00±0.00[a] | 9.00±0.00[d] |
| | 43WKS×HAP×WSH | 2.00±0.096[c] | 3.00±0.00[a] | 2.00±0.096[c] | 2.00±0.00[b] | 9.00±0.00[d] |
| | 43WKS×HAP×PL | 3.00±0.096[a] | 3.00±0.00[a] | 3.00±0.096[a] | 3.00±0.00[a] | 12.00±0.00[a] |
| | 43WKS×HAP×S | 2.00±0.096[c] | 2.00±0.00[b] | 2.00±0.096[c] | 2.00±0.00[b] | 8.00±0.00[e] |

Where; FA= flock age, AP = Air pressure and LT = litter types

**Table 6.** least _ square means and standard error ($\bar{X} \pm S.E$) for cecal bacterial count (APC, Coliform count, E. coli and Salmonellae) of different experimental groups as affected by studied factors

| Items | | APC (cfu/g) | Coliform count(cfu/g) | E. coli | Salmonellae |
|---|---|---|---|---|---|
| FA | 33WKS | $5.66\times10^{10}\pm0.20^{a}$ | $3.38\times10^{10}\pm0.21^{a}$ | +ve | -ve |
| | 43WKS | $3.15\times10^{10}\pm0.20^{b}$ | $3.01\times10^{10}\pm0.21^{a}$ | +ve | -ve |
| AP | LAP | $3.93\times10^{10}\pm0.21^{b}$ | $3.56\times10^{10}\pm0.20^{a}$ | +ve | -ve |
| | HAP | $4.88\times10^{10}\pm0.21^{a}$ | $2.83\times10^{10}\pm0.20^{b}$ | +ve | -ve |
| LT | WSH | $6.22\times10^{10}\pm0.26^{a}$ | $3.80\times10^{10}\pm0.24^{a}$ | +ve | -ve |
| | PL | $2.40\times10^{10}\pm0.26^{c}$ | $3.40\times10^{10}\pm0.24^{a}$ | -ve | -ve |
| | S | $4.60\times10^{10}\pm0.26^{b}$ | $2.40\times10^{10}\pm0.24^{b}$ | +ve | -ve |
| FA×AP×LT | 33WKS×LAP×WSH | $5.40\times10^{10}\pm0.53^{cd}$ | $2.90\times10^{10}\pm0.49^{c}$ | -ve | -ve |
| | 33WKS×LAP×PL | $3.20\times10^{10}\pm0.53^{ef}$ | $1.30\times10^{10}\pm0.49^{f}$ | +ve | -ve |
| | 33WKS×LAP×S | $7.10\times10^{10}\pm0.53^{ab}$ | $4.50\times10^{10}\pm0.49^{b}$ | +ve | -ve |
| | 33WKS×HAP×WSH | $610\times10^{10}\pm0.53^{bc}$ | $3.40\times10^{10}\pm0.49^{bc}$ | -ve | -ve |
| | 33WKS×HAP×PL | $3.70\times10^{10}\pm0.53^{e}$ | $2.00\times10^{10}\pm0.49^{de}$ | +ve | -ve |
| | 33WKS×HAP×S | $8.50\times10^{10}\pm0.53^{a}$ | $6.20\times10^{10}\pm0.49^{a}$ | +ve | +ve |
| | 43WKS×LAP×WSH | $2.90\times10^{10}\pm0.53^{ef}$ | $1.50\times10^{10}\pm0.49^{ef}$ | -ve | -ve |
| | 43WKS×LAP×PL | $1.60\times10^{10}\pm0.53^{fg}$ | $1.30\times10^{10}\pm0.49^{f}$ | -ve | -ve |
| | 43WKS×LAP×S | $3.40\times10^{10}\pm0.53^{e}$ | $1.90\times10^{10}\pm0.49^{def}$ | +ve | -ve |
| | 43WKS×HAP×WSH | $4.00\times10^{10}\pm0.53^{de}$ | $1.80\times10^{10}\pm0.49^{ef}$ | -ve | -ve |
| | 43WKS×HAP×PL | $1.10\times10^{10}\pm0.53^{g}$ | $1.00\times10^{9}\pm0.49^{g}$ | -ve | -ve |
| | 43WKS×HAP×S | $5.90\times10^{10}\pm0.53^{bc}$ | $2.60\times10^{10}\pm0.49^{de}$ | +ve | -ve |

Where; FA= flock age, AP = Air pressure and LT = litter types

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## تأثير عمر القطيع, ضغط الهواء و أنواع الفرشة على خصائص الذبيحة و جودة اللحم فى دجاج كتاكيت التسمين

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هدفت هذه الدراسة إلى تقييم تأثير عمر القطيع ( القطيع الأصغر عمراً 33 أسبوع و القطيع الأكبر عمراً 43 أسبوع), ضغط الهواء خلال فترة التفريخ (منخفض, 100719 و مرتفع 101000 باسكال) و نوع الفرشة (نشارة الخشب, البلاستيك و الرمل ) على خصائص الذبيحة و جودة اللحم فى كتاكيت التسمين. وإستخدم فى هذه الدراسة عدد 600 كتكوت(روص 308 ) عمر يوم فاقسة من بيض قطيعين مختلفين فى العمر (300 كتكوت بكل قطيع) إختيرت وقسمت عشوائياً إلى إثنين تحت مجموعة تجريبية حسب ضغط الهواء ( بواقع 150 كتكوت), كل تحت مجموعة قسمت إلى ثلاثة تحت – تحت مجاميع تجريبية تم رعايتها فى مساكن أرضية مزودة بأنواع فرشة من نشارة الخشب, البلاستيك و الرمل على الترتيب. صممت هذه الدراسة فى تجربة عاملية 2×2×3 . أظهرت النتائج المتحصل عليها أن كتاكيت التسمين المنتجة من القطيع الأكبر عمراً سجلت إرتفاعاً معنوياً فى الأوزان النسبية و المطلقة للذبيحة , الأحشاء المأكولة , مجموع الأجزاء المأكولة, نسبة البروتين والرماد, الرائحة, اللون , النعومة , التقدير العام فى جودة اللحم مقارنة بالقطيع الأصغر عمراً. بينما أظهرت كتاكيت التسمين المنتجة من البيض المفرخ عند ضغط الهواء المرتفع إرتفاع فى الأوزان النسبية والمطلقة للذبيحة , الأحشاء المأكولة , مجموع الأجزاء المأكولة, نسبة البروتين ,الدهن , الأس الهيدروجينى,إجمالى النيتروجين المتطاير, الرائحة فى اللحم. أظهرت كتاكيت التسمين المرباة على الفرشة البلاستيك إرتفاعاً فى قيم الأوزان النسبية والمطلقة فى الذبيحة , مجموع الأجزاء المأكولة, نسبة البروتين والرماد, التقيم الحسى للحم و سجلت أقل عدد بكتيرى من أطباق العد البكتيرى فى اللحم والأعورين. بالنسبة للتداخل بين العوامل المدروسة يمكن أن نوصى بأن كتاكيت التسمين الفاقسة من بيض قطيع عند عمر 43 أسبوع و مفرخة عند ضغط الهواء المرتفع و المرباة على نوع الأرضية البلاستيك يمكن أن تحقق نتائج مرضية وإيجابية.

**الكلمات المفتاحية:** عمر القطيع , ضغط الهواء , نوع الفرشة , خصائص الذبيحة – جودة اللحم.