Menoufia J. Animal, Poultry & Fish Prod., Vol. 5 Jan. (2021): 1 – 19 https://mjapfp.journals.ekb.eg/

INFLUENCE OF FEED FORM ON PERFORMANCE IN TWO STRAINS OF BROILER CHICKS

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Received: Sep. 15 , 2020 Accepted: Jan. 2 , 2021

ABSTRACT: The current study was conducted in private poultry farm (area of $120m^2$), Shibin El-Kom, Menoufia Governorate. The experiment was extended from April to May 2014. The great object of this study was to determine the effect of feed forms on productive and economical efficiency of two broiler strains (Cobb 500 and Ross 308) at ages 7, 14, 21, 28 and 35 days. Chicks were individually weighted and randomly assigned to 3 experimental groups nearly similar in average body weight (40g). The birds of the first, second and third groups were feed on crumble, mash and pellets, respectively. Chicks housed on floor with sawdust. Feed and water were available *ad libitun* during the experimental period which lasted for 35 days.

Body weights at different ages, growth rates, feed consumption (FC) (kg per bird/cycle), feed conversion ratio FCR, mortality and uniformity were studied. The main results were:

1. **For Cobb 500 strain, mash feed had a higher body weight at marketing age (35 days).**
2. **Ross 308 strain, pellet feed had a higher body weight at marketing age (35 days).**
3. **Ross 308 strain fed on crumble, and Cobb 500 strain fed on mash had lowest mortality %.**
4. **The best economic efficiency was obtained with pellet feed form for both Cobb 500 and Ross 308.**

Key words: Feed forms, Performance, Cobb 500, Ross 308 and Broilers.

INTRODUCTION

The world population is growing at a frightening level of 220,000 persons / day or 80 million per year. Asia and Africa are the regions likely to experience the fastest growth, therefore, poultry demand are increased from year to another year. (Fanout and Boekholt, 2018).

The review of the Egyptian broiler industry by the Food and Agriculture Organization of the United Nations (FAO, 2017), aims to inform policy makers and investors both about challenges and opportunities and promote a more efficient and inclusive poultry industry development.

In recent years, the Egyptian poultry production has become an industry rather than an agriculture activity. Growing consumer demand for affordable animal protein has prompted an increase of broiler chicken meat production in Arab Republic of Egypt.

Feed composition as the most important factor that determines the efficiency of feed utilization by animals. Feed structure (particle size) and feed form (mash, pellets) are also important for the optimal nutrient utilization (Ball *et al.* 2015). The success or failure of any poultry industry depends to a large extent on feeding. The cost of feeding ranges between 60-70% of the total cost of production (Willems *et al.* 2003).

Gracia *et al.* (2016) mentioned that broilers fed pelleted diets gained more weight than broilers fed mash diets (33.0 vs 44.8 g/d, 67.6 vs 87.6 g/d, and 49.4 vs

64.8 g/d for mash vs pelleted diets from 1–21 d, 22–42 d, and 1–42 d, respectively; P < 0.05). Nabi *et al.* (2017) showed that effect of different feed forms on live body weight of broiler was highly significant (P≤0.01) live body weight was higher in broiler of group C (2248.04 g/b) than group B (with crumble feed 1, 2, and 3 mm particle size to pre starter) and A (fed with mash as control). Feed conversion ratio was remarkably superior (1.72) in group C (fed with crumble feed 1.5, 2.5 and 3.5 mm particle size to pre starter), while being moderate (1.81) in broiler of group B, a relatively poor feed conversion ratio of 1.89 was recorded in broiler of group A fed mash feed.

Sogunle *et al.* (2017) obtained that feed intake of the birds on mash and pellet diets showed no significant (P≤0.05) difference with mean values of 97.30g/bird/day and 110.54g/bird/day for pellet and mash diets, respectively.

Farghly *et al.* (2014) found that mortality rate of the four studied groups (Mash, Pellets, Crumbles and Wet) were 10.0, 6.6, 13.3 and 6.6%, respectively.

Benyi *et al.* (2015) found significant superiority of Ross strain (7729 g) to Cobb (7349 g) at 21 days of age also the same trend was observed at 35 days where Ross weight was 1.809kg and 1.791kg for Cobb.

Rokonuzzaman *et al.* (2015), found that the weekly body weight gain of three broiler strains. The Arbor Acres was achieved the highest body weight 76.75g in first week followed by 75.75g and 73.60g in Cobb-500 and Hubbard Classic broiler strain, respectively. In second weeks Cobb-500 was gain167.03g body weight; it was the highest value in this week than other two strains. They were 407.88g body weight gains of Arbor Acres in third weeks, 342.83g of Hubbard Classic and 341.60g of Cobb-500. The arbor Acres had also highest body weight gain 502.71g in fourth weeks, besides 484.14g gain in Hubbard Classic and 461.72g gain in Cobb-500.

Singh *et al.* (2018) mentioned that the highest average live weight of 347.01g at 14th day was achieved in Vencobb-400 followed by 345.29g in Vencobb and 343.94g in Hubbard. Similarly at 28th day the average live weight of Vencobb-400 (980.80 g) was higher than the Vencobb and Hubbard strains (979.69g and 976.69g respectively). At 42nd day, the highest average live weight of 1673.77g was found in Vencobb followed by 1658.79g in Vencobb-400 and 1655.45g in Hubbard. The difference in the live weight of the three broiler strains was found significant (P≤0.05) at 14th, 28th and 42nd day. At 14th and 28th day, the live weight of the Vencobb-400 was found highest; whereas, at 42nd day the live weight was highest in Vencobb.

Kalia, *et al.* (2017) mentioned that mortalities in each broiler strain in experimental trial I., the mortality rate was recorded highest (30%) in Hubbard strain followed by Vencobb (22%) and RIR cross-bred (16%). Post-mortem examination of birds revealed 14%, 10%, and 6% mortality induced from ascites and 10%, 8%, and 4% mortality induced from coccidiosis in Hubbard, Vencobb, and RIR cross-bred, respectively.

MATERIALS AND METHODS

The present study was carried out at private poultry farm (area 120m^2), Shibin El-Kom, Menoufia Governorate. The experiment was extended from April to May 2014.

A total number of 1200, on day old, unsexed, commercial broiler chicks, Cobb 500 (600 birds) and Ross 308 (600 birds) were reared under similar managerial and hygienic conditions. Chicks were individually weight and randomly assigned to 3 experimental groups nearly similar in average body weight (40g) within each strain. The birds of first second and third groups were fed on crumble, mash and pellet, respectively. Chicks housed on floor with sawdust. Feed and water were available *ad libitum* during the experimental period which lasted for 35days. This study aimed to evaluate the effect of feed form on productive and economical efficiency of two broiler strains (Cobb 500 and Ross 308) at ages 7, 14, 21, 28 and 35 days. On density was applied in open system, 10 birds / m^2. The light program was 24 h (continuous).

All birds were fed the basal diets starter, (1-14 days of age, with 23% crude protein and 3030 kcal ME/kg diet), grower (14-28 days of age, with 21% crude protein and 3100 kcal ME/kg), and finisher (28 – 35 days), with 19% crude protein and 3200 kcal ME/kg), according to NRC (1994), as given Table (1).

The studied traits:

Body weights at different ages:

Weekly body weights were measured at one day old chicks, then were weighted weekly till 35 days. Each week sample of (10% of total number of birds) was taken randomly and were weighted to estimate average body weight of the dormitories and these samples were applied in all commercial broiler farms.

Table (1): Composition and calculated analysis of commercial diets.

Ingredients	Starter period (1-14 days)	Grower period (14-28 days)	Finisher period (28 – 35 days)
Ground yellow corn (8.5%).	541	592.0	656.7
Soybean meal, (44%).	320	260	190
Full fat soya.	29	29	30
Gluten, (60%).	71.5	78.0	84.9
Mono calcium phosphate.	16.6	17.5	15.3
Limestone.	13	13.4	11.8
L-lysine.	1	2	3
DL-methionine.	1.2	1.4	1.6
Salt (NaCl).	3.7	3.7	3.7
Premix (Minerals and Vitamins)[1].	3	3	3
Total.	1000	1000	1000
Calculated analysis[2]:			
Crude protein, %.	23	21	19
ME (kcal / kg).	3030	3100	3200
Calcium, %.	1	1.15	1.5
Available Phosphorus, %.	0.5	0.45	0.45

[1] Premix. at 0.30 % of the diet supplies the following/ kg of the diet: Vit. A, 12000 IU;Vit.E, 10 mg; Vit.K_3, 3 mg; Vit B_1, 1 mg; Vit. B_2, 4 mg; Pantothenic acid, 10 mg ;Vit. D_3 , 2500 IU; Nicotinic acid, 20 mg; Folic acid, 1 mg; Biotin, 0.05 mg; Niacin, 40 mg; Vit.B_6, 3 mg; Vit B_{12}, 0.02 mg; Choline chloride, 400 mg; Mn, 62 mg; Fe, 44 mg; Zn, 56 mg; I, 1 mg; Cu, 5 mg and Se, 0.01 mg.
[2]Calculated according to NRC (1994).

Growth Rate (GR):

Growth rates were estimated intervally at 1-7, 7-14, 14-21, 21-28 and 28-35 days of age, and cumulatively at 1-14, 1-21 and 1-28 days of age using the following formulas (Brody 1945):

$$\left[\text{Growth rate} = \frac{W_2 - W_1}{1/2(W_2 + W_1)} \times 100\right]$$

Where:
W_1 = First weight
W_2 = Second weight

Mortality (M):

$$\text{Mortality} = \frac{\text{number of died birds}}{\text{total number of the birds in the same week}} \times 100$$

Uniformity (UNI):

Uniformity of BW in broiler breeder flocks is usually determined by individually weighing a sample of birds, calculating the average BW, determining the limits 10% above and below the average.

Uniformity is a measure of the variability of bird size in a flock. This can be measured by various means, such as:
1. Visual and subjective evaluation
2. By weight +/- 10%
3. By coefficient of variation

Feed consumption (FC):

The amount of feed consumption per bird per cycle (35 days) was calculated by dividing the total feed consumption during the cycle on the receiving bird numbers in each dormitories.

Feed conversion ratio (FCR):

The feed conversion ratio was calculated as follow:

$$FCR = \frac{The \quad feed \quad consumption \quad (kg)/bird/cycle}{Body \quad weight \quad gain \quad /brid/cycle \quad (kg)}$$

while body weight gain was measured as deviation between the body weights (in grams) at 35 days of age.

Economic efficiency:

Economical efficiency for broiler production was calculated from the input - out put analysis (Heady and Jensen, 1954), according to the price of the experimental diets and broiler production. Values of economical efficiency were calculated as the net revenue per unit of total costs (Soliman and Abdo, 2005).

Statistical analysis:

Data were computerized and analyzed according to the following model by SPSS Program (2004). Also significant differences among means were detected by Duncan (1955).

The following fixed model was used:

$$Y_{ijkl} = \mu + S_i + F_j + A_k + (SF)_{ij} + (SA)_{ij} + (FA)_{jk} + (SFA)_{ijk} + e_{ijkl}$$

Where:

- **Y_{ijkl} : Observation of i strain, j feed form and k age;**
- **μ : General mean;**
- **S_i : Fixed effect of strain;**
- **F_j : Fixed effect of (F_j) feed form;**
- **A_k : Fixed effect of (A_k) age**
- **$(SF)_{ij}$: Effect of interaction $(SF)_{ij}$;**
- **$(SA)_{ik}$: Effect of interaction $(SA)_{ik}$;**
- **$(FA)_{jk}$: Effect of interaction $(FA)_{jk}$;**
- **$(SFA)_{ijk}$: Effect of interaction $(SFA)_{ijk}$;**
- **e_{ijkl} : Residual effect.**

RESULTS AND DISCUSSION

Performance traits:

Tables (2 a and b) showed analysis of variance of studied traits such as (body weight, growth rate, uniformity, daily mortality, cumulative mortality, daily feed consumption, cumulative feed consumption and feed efficiency) as affected by strains, feed forms and broiler ages.

Table (2a): Analysis of variance of (BW, GR, UNI, and WM) traits in broiler chicks.

Source of variation	Traits[1]							
	BW		GR		UNI		WM	
	df	Mean square	df	Mean square	df	Mean square	df	Mean square
Strain (S)	1	44253.8**	1	12.852*	1	9.503**	1	0.006**
Feed (F)	2	3356.6**	2	0.559N.S.	2	123.189**	2	0.322**
Age (A)	4	19799503.8**	4	32293.6**	4	30.648**	4	0.375**
S*F	2	2503.7**	2	0.057N.S.	2	54.654**	2	0.024**
S*A	4	13469.7**	4	280.9**	4	37.922**	4	0.493**
F*A	8	821.9**	8	14.733**	8	17.417**	8	0.480**
S*F*A	8	1011.5**	8	7.542**	8	40.291**	8	0.328**
Error	114	49.4	114	2.635	114	0.842	114	0.000

* Significant (P≤ 0.05), ** highly significant (P ≤ 0.01).

[1] BW= body weight, GR= growth rate, UNI= uniformity, and WM= weekly mortality

Table (2b): Analysis of variance of (CM, WFC, CFC, and FCR) traits in broiler chicks.

Source of variation	Traits[1]							
	CM		WFC		CFC		FCR	
	df	Mean square	df	Mean square	df	Mean square	df	Mean square
Strain (S)	1	0.608**	1	35973.0**	1	12558.7**	1	0.116**
Feed (F)	2	9.273**	2	25382.2**	2	109847.7**	2	0.128**
Age (A)	4	58.918**	4	7513441.5**	4	61226825.7**	4	2.175**
S*F	2	10.040**	2	371.3**	2	1593.1**	2	0.008**
S*A	4	0.168**	4	31652.8**	4	55946.7**	4	0.009**
F*A	8	0.253**	8	2985.9**	8	20619.3**	8	0.005**
S*F*A	8	0.246**	8	210.2**	8	321.6*	8	0.003**
Error	114	0.000	114	25.1	114	139.0	114	0.000

* Significant (P≤ 0.05), ** highly significant (P ≤ 0.01).

[1] CM= cumulative mortality, WFC= weekly feed consumption, CFC= cumulative feed consumption, and FCR= feed conversion ratio.

Analysis of variance:

Table (2a) showed analysis of variance of body weight at different ages (7, 14, 21, 28 and 35 days of age) as affected by strains, litters types, feed forms and broiler ages. It is clear that highly significant effect of strains, litters types, feed forms and broiler ages were noticed.

Correlations among some performance traits:

Table (3) showed correlations of studied traits. The Table illustrated that there were highly significant correlations and positive relationships among body weight and both weekly mortality, cumulative mortality, weekly feed consumption, cumulative feed consumption and feed conversion ratio. However, there were highly significant correlations and negative relationships between body weight and both growth rate and uniformity.

It was clear from the Table (3) that there were highly significant correlations and negative relationships between growth rate and both weekly mortality, cumulative mortality, weekly feed consumption, cumulative feed consumption and feed conversion ratio. But, there was no significant correlation with uniformity. There were highly significant correlations and positive relationships among weekly mortality and cumulative mortality, weekly feed consumption, cumulative feed consumption and feed conversion ratio. However, there were highly significant correlations and negative relationships between weekly mortality and uniformity. There were highly significant correlations and positive relationships among cumulative mortality and weekly feed consumption, cumulative feed consumption and feed conversion ratio. However, there were highly significant correlations and negative relationships between cumulative mortality and uniformity. There were highly significant correlations and negative relationships among uniformity and both weekly feed consumption, cumulative feed consumption and feed conversion ratio. Moreover, there were highly significant correlations and positive relationships between weekly feed consumption and cumulative feed consumption and feed conversion ratio.

Effect of the strains, feed forms and ages on body weight:

Effect of strains, feed form and age on body weight of 7, 14, 21, 28 and 35 days of age are displayed in Table (4). There were highly significant differences for three interactions between strains, feed form and age on body weight ($P \leq 0.01$).

Table (3): Correlations among some performance traits.

	Traits[1]						
	BW	GR	WM	CM	UNI	WFC	CFC
GR	-0.946**						
WM	0.370**	-0.254**					
CM	0.885**	-0.849**	0.532**				
UNI	-0.275**	0.026 N.S.	-0.179*	-0.210**			
WFC	0.987**	-0.968**	0.390**	0.896**	-0.312**		
CFC	0.996**	-0.928**	0.359**	0.881**	-0.258**	0.981**	
FCR	0.887**	-0.953**	0.420**	0.858**	-0.449**	0.936**	0.872**

* Significant ($p \leq 0.05$), ** highly significant ($P \leq 0.01$).

[1] BW= body weight, GR= growth rate, WM= weekly mortality, CM= cumulative mortality, UNI= uniformity, and WFC= weekly feed consumption, CFC= cumulative feed consumption, and FCR= feed conversion ratio.

Table (4): Body weight ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		g				
Cobb 500	Crumble	142.5±5.72^{a}	382.0±5.72^{b}	772.5±5.72^{b}	1313.0±5.72^{b}	2006.5±5.72^{b}
	Mash	137.0±5.72^{b}	379.0±8.10^{c}	786.5±5.72^{a}	1335.7±5.72^{a}	2072.5±5.72^{a}
	Pellet	136.0±5.72^{b}	384.0±5.72^{a}	778.5±5.72^{b}	1338.5±5.72^{a}	2056.5±5.72^{a}
Ross 308	Crumble	157.0±5.72^{b}	421.0±5.72^{b}	852.0±8.10^{b}	1393.5±5.72^{b}	2013.0±5.72^{b}
	Mash	157.0±5.72^{b}	422.0±5.72^{b}	832.5±5.72^{c}	1376.2±5.72^{c}	2009.5±5.72^{c}
	Pellet	160.5±5.72^{a}	442.0±8.10^{a}	860.5±5.72^{a}	1413.0±5.72^{a}	2027.0±5.72^{a}

a,b,c, Differences between values having the same high script in each strain within each column are not significant at P ≤ 0.05.

Table (4) illustrated that the highest value of body weight was recorded at 7 days of age for Ross 308 strain with pellet feed (160.5 ± 5.72 g), followed by Ross 308 strain with crumble feed, Ross 308 strain with mash feed (157.0 ± 5.72 g), Cobb 500 strain with crumble feed (142.5 ± 5.72 g), Cobb 500 strain with mash feed (137.0 ± 5.72 g), Cobb 500 strain with pellet feed (136.0 ± 5.72 g). The highest value was recorded at 14 days of age for Ross 308 strain with pellet feed (442.0 ± 8.10 g) followed by Ross 308 strain with mash feed (422.0 ± 5.72 g), Ross 308 strain with crumble feed (421.0 ± 5.72 g), Cobb 500 strain with pellet feed (384.0 ± 5.72 g), Cobb 500 strain with crumble feed (382.0 ± 5.72 g) and Cobb 500 strain with mash feed (379.0 ± 8.10 g).

The highest value was recorded at 21 days of age for Ross 308 strain with pellet feed (860.5 ± 5.72 g) followed by Ross 308 strain with crumble feed (852.0 ± 8.10 g), Ross 308 strain with mash feed (832.5 ± 5.72 g), Cobb 500 strain with mash feed (786.5 ± 5.72 g), Cobb 500 strain with pellet feed (778.5 ± 5.72 g) and Cobb 500 strain with crumble feed (772.5 ± 5.72 g). The highest value was recorded at 28 days of age for Ross 308 strain with pellet feed (1413.0 ± 5.72 g) followed by Ross 308 strain with crumble feed (1393.5 ± 5.72 g), Ross 308 strain with mash feed (1376.2 ± 5.72 g), Cobb 500 strain with pellet feed (1338.5 ± 5.72 g), Cobb 500 strain with mash feed (1335.7 ± 5.72 g) and Cobb 500 strain with crumble feed (1313.0 ± 5.72 g).

However, the highest value was recorded at 35 days of age for Cobb 500 strain with mash feed (2072.5 ± 5.72 g) followed by Cobb 500 strain with pellet feed (2056.5 ± 5.72 g), Ross 308 strain with pellet feed (2027.0 ± 5.72 g), Ross 308 strain with crumble feed (2013.0 ± 5.72 g), Ross 308 strain with mash feed (2009.5 ± 5.72 g) and Cobb 500 strain with crumble feed (2006.5 ± 5.72 g).

The obtained results were in similar with Cerrate *et al.* (2009) reported that feed form had a significant effect on BW at 13 d of age. At that time, birds that had been fed pelleted or crumbled diets were all significantly heavier than birds fed the mash diet. However, after all chicks had been placed on a common pelleted diet, BW at 34 or 41 d did not differ among birds fed any of the diets during the starter period of 0 to 13 d. Although a statistical difference in BW was not observed at 34 or 41 d, there were significant linear regressions between BW at 13 d and at 34 or 41 d. The slopes of regression lines indicated that a 1-g change in BW at 13 d resulted in a corresponding change of 1.5 or 1.8 g in BW at 34 d or at 41 d, respectively.

Effect of the interactions among strains, feed forms and ages as affected on growth rate:

Effect of strains, feed form and age on growth rate of 7, 14, 21, 28 and 35 days of age are displayed in Table (5). There were highly significant differences for three interactions between strains, feed form and age on growth rate (P≤0.01).

Table (5) illustrated that the highest value of growth rate was recorded at 7 days of age for Ross 308 strain with pellet feed (118.67 ± 0.82 %), followed by Ross 308 strain with crumble feed (118.50 ± 0.82 %), Ross 308 strain with mash feed (117.20 ± 0.82 %), Cobb 500 strain with crumble feed (112.07 ± 0.82 %), Cobb 500 strain with mash feed (108.74 ± 0.82 %), Cobb 500 strain with pellet feed (107.40 ± 0.82 %). The highest value was recorded at 14 days of age for Cobb 500 strain with mash feed (95.51 ± 1.16 %) followed by Cobb 500 strain with pellet feed (95.40 ± 0.82 %), Ross 308 strain with pellet feed (94.68 ± 1.16 %), Ross 308 strain with mash feed (91.46 ± 0.82 %), Ross 308 strain with crumble feed (91.36 ± 0.82 %) and Cobb 500 strain with crumble feed (91.31 ± 0.82 %).

The highest value was recorded at 21 days of age for Cobb 500 strain with mash feed (68.54 ± 0.82 %) followed by Cobb 500 strain with pellet feed (67.81 ± 0.82 %), Cobb 500 strain with crumble feed (67.58 ± 0.82 %), Ross 308 strain with pellet feed (64.83 ± 0.82 %), Ross 308 strain with crumble feed (65.55 ± 1.16 %) and Ross 308 strain with mash feed (65.37 ± 0.82 %). The highest value was recorded at 28 days of age for Cobb 500 strain with pellet feed (52.90 ± 0.82 %) followed by Cobb 500 strain with crumble feed (51.84 ± 0.82 %), Cobb 500 strain with mash feed (51.75 ± 0.82 %), Ross 308 strain with mash feed (49.23 ± 0.82 %), Ross 308 strain with crumble feed (48.72 ± 0.82 %) and Ross 308 strain with pellet feed (48.60 ± 0.82 %). However, the highest value was recorded at 35 days of age for Cobb 500 strain with mash feed (43.24 ± 0.82 %) followed by Cobb 500 strain with pellet feed (42.32 ± 0.82 %), Cobb 500 strain with crumble feed (41.77 ± 0.82 %), Ross 308 strain with mash feed (37.42 ± 0.82 %), Ross 308 strain with crumble feed (36.37 ± 0.82 %) and Ross 308 strain with pellet feed (35.70 ± 0.82 %).

Table (5): Growth rate ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		%				
Cobb 500	Crumble	112.07 ± 0.82^{a}	91.31 ± 0.82^{b}	67.58 ± 0.82^{b}	51.84 ± 0.82^{b}	41.77 ± 0.82^{b}
	Mash	108.74 ± 0.82^{b}	95.51 ± 1.16^{a}	68.54 ± 0.82^{a}	51.75 ± 0.82^{b}	43.24 ± 0.82^{a}
	Pellet	$107.40\pm0.82b^{b}$	95.40 ± 0.82^{a}	67.81 ± 0.82^{b}	52.90 ± 0.82^{a}	42.32 ± 0.82^{b}
Ross 308	Crumble	118.50 ± 0.82^{a}	91.36 ± 0.82^{a}	65.55 ± 1.16^{a}	48.72 ± 0.82^{b}	36.37 ± 0.82^{b}
	Mash	117.20 ± 0.82^{b}	91.46 ± 0.82^{a}	65.37 ± 0.82^{a}	49.23 ± 0.82^{a}	37.42 ± 0.82^{a}
	Pellet	118.67 ± 0.82^{a}	94.68 ± 1.16^{a}	64.83 ± 0.82^{b}	48.60 ± 0.82^{b}	35.70 ± 0.82^{b}

a,b,c, Differences between values having the same high script in each strain within each column are not significant at P ≤ 0.05.

Effect of the interactions among strains, feed forms and ages as affected on uniformity:

Effect of strains, feed form and age on uniformity of 7, 14, 21, 28 and 35 days of age are displayed in Table (6). There were highly significant differences for three interactions between strains, feed form and age on uniformity (P≤0.01).

Table (6) illustrated that the highest value of uniformity was recorded at 7 days of age for Ross 308 strain with pellet feed (90.50 ± 1.03 %), followed by Cobb 500 strain with crumble feed (86.50 ± 1.03 %), Cobb 500 strain with pellet feed (84.50 ± 1.03 %), Ross 308 strain with crumble feed (83.00 ± 1.03 %), Cobb 500 strain with mash feed and Ross 308 strain with mash feed (82.00 ± 1.03 %). The highest value was recorded at 14 days of age for Cobb 500 strain with mash feed (88.00 ± 1.45 %) followed by Ross 308 strain with crumble feed (87.50 ± 1.03 %), Ross 308 strain with mash feed (86.00 ± 1.03 %), Cobb 500 strain with crumble feed (84.50 ± 1.03 %), Cobb 500 strain with pellet feed (83.50 ± 1.03 %) and Ross 308 strain with pellet feed (82.00 ± 1.45 %).

The highest value was recorded at 21 days of age for Cobb 500 strain with crumble feed, and Ross 308 strain with pellet feed (86.00 ± 1.03 %) followed by Cobb 500 strain with mash feed (85.50 ± 1.03 %), Cobb 500 strain with pellet feed (84.50 ± 1.03 %), Ross 308 strain with crumble feed (80.00 ± 1.45 %) and Ross 308 strain with mash feed (76.00 ± 1.03 %). The highest value was recorded at 28 days of age for Cobb 500 strain with crumble feed, Ross 308 strain with pellet feed (88.00 ± 1.03 %) followed by, Cobb 500 strain with pellet feed, Ross 308 strain with mash feed (85.50 ± 1.03 %), Cobb 500 strain with mash feed and Ross 308 strain with crumble feed (83.50 ± 1.03%). However, the highest value was recorded at 35 days of age for Ross 308 strain with pellet feed (87.00 ± 1.03 %) followed by Cobb 500 strain with pellet feed (86.50 ± 1.03 %), Ross 308 strain with crumble feed (85.50 ± 1.03 %), Cobb 500 strain with mash feed (83.00 ± 1.03 %), Ross 308 strain with mash feed (82.50 ± 1.03 %) and Cobb 500 strain with crumble feed (82.00 ± 1.03 %).

Table (6): Uniformity ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		%				
Cobb 500	Crumble	$86.50{\pm}1.03^{a}$	$84.50{\pm}1.03^{b}$	$86.00{\pm}1.03^{a}$	$88.00{\pm}1.03^{a}$	$82.00{\pm}1.03^{c}$
	Mash	$82.00{\pm}1.03^{c}$	$88.00{\pm}1.45^{a}$	$85.50{\pm}1.03^{b}$	$83.50{\pm}1.03^{c}$	$83.00{\pm}1.03^{b}$
	Pellet	$84.50{\pm}1.03^{b}$	$83.50{\pm}1.03^{c}$	$84.50{\pm}1.03^{c}$	$85.50{\pm}1.03^{b}$	$86.50{\pm}1.03^{a}$
Ross 308	Crumble	$83.00{\pm}1.03^{b}$	$87.50{\pm}1.03^{a}$	$80.00{\pm}1.45^{b}$	$83.50{\pm}1.03^{c}$	$85.50{\pm}1.03^{b}$
	Mash	$82.00{\pm}1.03^{c}$	$86.00{\pm}1.03^{b}$	$76.00{\pm}1.03^{c}$	$85.50{\pm}1.03^{b}$	$82.50{\pm}1.03^{c}$
	Pellet	$90.50{\pm}1.03^{a}$	$82.00{\pm}1.45^{c}$	$86.00{\pm}1.03^{a}$	$88.00{\pm}1.03^{a}$	$87.00{\pm}1.03^{a}$

a,b,c, Differences between values having the same high script in each strain within each column are not significant at P ≤ 0.05.

The obtained results were in similar with some researchers such as Lippens *et al.* (2009) noticed that mash fed Ross 508-chickens in trial 1 only showed a lower uniformity after feed restriction (significant interaction). However, this response was not confirmed in trial 2 (Ross 308). Chehraghi *et al.* (2013) noticed that weight gain of birds of mash, pellet and crumble group in 1 and 2 weeks of age showed no significant differences. In 3-6 weeks most weight gain related to crumble groups and was significant difference between mash and crumble group. But between mash and pellet, crumble and pellet weight gain of the birds did not differ significantly (P<0.05).

Effect of strains, feed forms and ages as affected on both weekly and cumulative mortality:

Effect of the interaction among strains, feed form and age on both weekly and cumulative mortality of 7, 14, 21, 28 and 35 days of age are displayed in Tables (7 and 8). There were highly significant differences for three interactions between strains, feed form and age on both weekly and cumulative mortality (P≤0.01).

Table (7) illustrated that the highest value of weekly mortality was recorded at 7 days of age for Cobb 500 strain with crumble feed (1.13 ± 0.09 %), followed by Ross 308 strain with pellet feed (1.00 ± 0.09 %), Cobb 500 strain with pellet feed (0.87 ± 0.09 %), Ross 308 strain with mash feed (0.63 ± 0.09 %), Ross 308 strain with crumble feed (0.62 ± 0.09 %) and Cobb 500 strain with mash feed (0.50 ± 0.09 %). The highest value was recorded at 14 days of age for Cobb 500 strain with crumble feed and Ross 308 strain with mash feed (0.88 ± 0.09 %) followed by, Cobb 500 strain with mash feed (0.75 ± 0.09 %), Cobb 500 strain with pellet feed (0.63 ± 0.09 %), Ross 308 strain with crumble feed (0.50 ± 0.09 %) and Ross 308 strain with pellet feed (0.25 ± 0.13 %). The highest value was recorded at 21 days of age for Ross 308 strain with crumble feed (1.50 ± 0.13 %), followed by Ross 308 strain with pellet feed (1.38 ± 0.09 %), Cobb 500 strain with mash feed, Ross 308 strain with mash feed (0.75 ± 0.09 %), and Cobb 500 strain with pellet feed (0.63 ± 0.09 %). The highest value was recorded at 28 days of age for Cobb 500 strain with pellet feed (1.25 ± 0.09 %) followed by, Ross 308 strain with crumble feed, Ross 308 strain with pellet feed, Cobb 500 strain with crumble feed (1.00 ± 0.09 %), Ross 308 strain with mash feed (0.88 ± 0.09 %), and Cobb 500 strain with mash feed (0.50 ± 0.09 %). However, the highest value was recorded at 35 days of age for Ross 308 strain with crumble feed (1.13 ± 0.09 %) followed by Cobb 500 strain with crumble feed, Cobb 500 strain with mash feed, Ross 308 strain with mash feed (1.00 ± 0.09 %), Cobb 500 strain with pellet feed (0.88 ± 0.09 %), and Ross 308 strain with pellet feed (0.63 ± 0.09 %).

Table (8) illustrated that the highest value of cumulative mortality was recorded at 7 days of age for Cobb 500 strain with crumble feed (1.63 ± 0.17 %), followed by Cobb 500 strain with pellet feed, Ross 308 strain with pellet feed (1.25 ± 0.17 %), , Ross 308 strain with crumble feed, Ross 308 strain with mash feed (0.75 ± 0.17 %), and Cobb 500 strain with mash feed (0.50 ± 0.17 %). The highest value was recorded at 14 days of age for Cobb 500 strain with crumble feed (2.50 ± 0.17 %) followed by, Cobb 500 strain with pellet feed (1.88 ± 0.17 %), Ross 308 strain with mash feed (1.63 ± 0.17 %), Ross 308 strain with pellet feed, Ross 308 strain with crumble feed, and Cobb 500 strain with mash feed (1.25 ± 0.23 %). The highest value was recorded at 21 days of age for Cobb 500 strain with crumble feed (3.25 ± 0.17 %), followed by Ross 308 strain with pellet feed (2.75 ± 0.17 %),Cobb 500 strain with pellet feed, Ross 308 strain with crumble feed (2.50 ± 0.17 %), Ross 308 strain with mash feed (2.38 ± 0.17 %), and Cobb 500 strain with mash feed (1.63 ± 0.17 %).

The highest value was recorded at 28 days of age for Cobb 500 strain with crumble feed (4.25 ± 0.17 %) followed by, Cobb 500 strain with pellet feed, Ross 308 strain with pellet feed (3.75 ± 0.17 %), Ross 308 strain with mash feed (3.25 ± 0.17 %), Ross 308 strain with crumble feed (3.00 ± 0.17 %), and Cobb 500 strain with mash feed (2.13 ± 0.17 %). However, the highest value was recorded at 35 days of age for Cobb 500 strain with crumble feed (5.25 ± 0.17 %) followed by Cobb 500 strain with pellet feed (4.63 ± 0.17 %), Ross 308 strain with pellet feed (4.38 ± 0.17 %), Ross 308 strain with mash feed (4.25 ± 0.17 %), Ross 308 strain with crumble feed (4.13 ± 0.17 %), and Cobb 500 strain with mash feed (3.13 ± 0.17 %).

Table (7): Weekly mortality ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		%				
Cobb 500	Crumble	$1.13{\pm}0.09^{a}$	$0.88{\pm}0.09^{a}$	$0.75{\pm}0.09^{a}$	$1.00{\pm}0.09^{b}$	$1.00{\pm}0.09^{a}$
	Mash	$0.50{\pm}0.09^{c}$	$0.75{\pm}0.13^{b}$	$0.75{\pm}0.09^{a}$	$0.50{\pm}0.09^{c}$	$1.00{\pm}0.09^{a}$
	Pellet	$0.87{\pm}0.09^{b}$	$0.63{\pm}0.09^{c}$	$0.63{\pm}0.09^{b}$	$1.25{\pm}0.09^{a}$	$0.88{\pm}0.09^{b}$
Ross 308	Crumble	$0.62{\pm}0.09^{b}$	$0.50{\pm}0.09^{b}$	$1.50{\pm}0.13^{a}$	$1.00{\pm}0.09^{a}$	$1.13{\pm}0.09^{a}$
	Mash	$0.63{\pm}0.09^{b}$	$0.88{\pm}0.09^{a}$	$0.75{\pm}0.09^{c}$	$0.88{\pm}0.09^{b}$	$1.00{\pm}0.09^{b}$
	Pellet	$1.00{\pm}0.09^{a}$	$0.25{\pm}0.13^{c}$	$1.38{\pm}0.09^{b}$	$1.00{\pm}0.09^{a}$	$0.63{\pm}0.09^{c}$

a,b,c, Differences between values having the same high script in each strain within each column are not significant at $P \leq 0.05$.

Table (8): Cumulative mortality ($\overline{X}$ ± SE)as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		%				
Cobb 500	Crumble	$1.63{\pm}0.17^{a}$	$2.50{\pm}0.17^{a}$	$3.25{\pm}0.17^{a}$	$4.25{\pm}0.17^{a}$	$5.25{\pm}0.17^{a}$
	Mash	$0.50{\pm}0.17^{c}$	$1.25{\pm}0.23^{c}$	$1.63{\pm}0.17^{c}$	$2.13{\pm}0.17^{c}$	$3.13{\pm}0.17^{c}$
	Pellet	$1.25{\pm}0.17^{b}$	$1.88{\pm}0.17^{b}$	$2.50{\pm}0.17^{b}$	$3.75{\pm}0.17^{b}$	$4.63{\pm}0.17^{b}$
Ross 308	Crumble	$0.75{\pm}0.17^{b}$	$1.25{\pm}0.17^{b}$	$2.50{\pm}0.23^{b}$	$3.00{\pm}0.17^{c}$	$4.13{\pm}0.17^{c}$
	Mash	$0.75{\pm}0.17^{b}$	$1.63{\pm}0.17^{a}$	$2.38{\pm}0.17^{c}$	$3.25{\pm}0.17^{b}$	$4.25{\pm}0.17^{b}$
	Pellet	$1.25{\pm}0.17^{a}$	$1.25{\pm}0.23^{b}$	$2.75{\pm}0.17^{a}$	$3.75{\pm}0.17^{a}$	$4.38{\pm}0.17^{a}$

a,b,c, Differences between values having the same high script in each strain within each column are not significant at $P \leq 0.05$.

The obtained results were in similar with some researchers such as Cerrate *et al.* (2009) noticed that there was no significant effect of feed form on mortality. Farghly *et al.* (2014) found that mortality rate of the four studied groups (mash, pellets, crumbles and wet) were 10.0, 6.6, 13.3 and 6.6%, respectively. Namakparvar *et al.* (2014) studied that the importance of strain with sex and their interaction effect on broiler chickens performance and susceptibility to ascites. Chicks from three strains (Ross 308, Cobb 500 and Arian). They found that strain, sex and their interaction did not significantly effect ascites mortality from 1-14 d. Arian strain showed the highest incidence of ascites mortality ($P<0.01$) at 15-28, 28-49 d and the entire experimental period.

Effect of strains, feed forms and ages as affected on both weekly and cumulative feed consumption:

Effect of the interaction among strains, feed form and age on both weekly and cumulative feed consumption of 7, 14, 21, 28 and 35 days of age are displayed in Tables (9 and 10). There were highly significant differences for three interactions between strains, feed form and age on both weekly feed consumption ($P\leq0.01$) and cumulative feed consumption ($P\leq0.05$).

Table (9) illustrated that the highest value of weekly feed consumption was recorded at 7 days of age for Ross 308 strain with crumble feed (143.5 ± 3.94 g), followed by Ross 308 strain with mash feed (136.5 ± 3.94 g), Ross 308 strain with pellet feed (131.5 ± 3.94 g), Cobb 500 strain with crumble feed (126.0 ± 3.94 g), Cobb 500 strain with mash feed (121.0 ± 3.94 g) and Cobb 500 strain with pellet feed (117.0 ± 3.94 g). The highest value was recorded at 14 days of age for Ross 308 strain with crumble feed (389.5 ± 3.94 g), followed by Ross 308 strain with mash feed (373.5 ± 3.94 g), Ross 308 strain with pellet feed (366.0 ± 5.58 g), Cobb 500 strain with crumble feed (349.5 ± 3.94 g), Cobb 500 strain with mash feed (342.0 ± 5.58 g) and Cobb 500 strain with pellet feed (332.5 ± 3.94 g).

The highest value was recorded at 21 days of age for Cobb 500 strain with crumble feed (676.5 ± 3.94 g), followed by Ross 308 strain with crumble feed (673.0 ± 5.58 g), Cobb 500 strain with mash feed (656.0 ± 3.94 g), Ross 308 strain with mash feed (648.5 ± 3.94 g), Cobb 500 strain with pellet feed (641.5 ± 3.94 g) and Ross 308 strain with pellet feed (629.5 ± 3.94 g). The highest value was recorded at 28 days of age for Cobb 500 strain with crumble feed (1067.0 ± 3.94 g), followed by Cobb 500 strain with mash feed (1035.0 ± 3.94 g), Cobb 500 strain with pellet feed (1012.5 ± 3.94 g), Ross 308 strain with crumble feed (990.0 ± 3.94 g), Ross 308 strain with mash feed (948.2 ± 3.94 g) and Ross 308 strain with pellet feed (929.5 ± 3.94 g). However, the highest value was recorded at 35 days of age for Cobb 500 strain with crumble feed (1376.5 ± 3.94 g), followed by Cobb 500 strain with mash feed (1328.0 ± 3.94 g), Cobb 500 strain with pellet feed (1301.5 ± 3.94 g), Ross 308 strain with crumble feed (1273.5 ± 3.94 g), Ross 308 strain with mash feed (1230.0 ± 3.94 g) and Ross 308 strain with pellet feed (1167.5 ± 3.94 g).

Table (10) illustrated that the highest value of cumulative feed consumption was recorded at 7 days of age for Ross 308 strain with crumble feed (173.5 ± 7.08 g), followed by Ross 308 strain with mash feed (167.0 ± 7.08 g), Ross 308 strain with pellet feed (162.5 ± 7.08 g), Cobb 500 strain with crumble feed, Cobb 500 strain with mash feed (151.5 ± 7.08 g), and Cobb 500 strain with pellet feed (148.0 ± 7.08 g). The highest value was recorded at 14 days of age for Ross 308 strain with crumble feed (563.0 ± 7.08 g), followed by Ross 308 strain with mash feed (540.5 ± 7.08 g), Ross 308 strain with pellet feed (529.0 ± 10.01 g), Cobb 500 strain with crumble feed (505.0 ± 7.08 g), Cobb 500 strain with mash feed (494.7 ± 10.01 g) and Cobb 500 strain with pellet feed (480.5 ± 7.08 g).

The highest value was recorded at 21 days of age for Ross 308 strain with crumble feed (1234.0 ± 10.01 g), followed by Ross 308 strain with mash feed (1189.0 ± 7.08 g), Cobb 500 strain with crumble feed (1182.5 ± 7.08 g), Cobb 500 strain with crumble feed (1182.5 ± 7.08 g), Ross 308 strain with pellet feed (1154.5 ± 7.08 g), Cobb 500 strain with mash feed (1148.3 ± 7.08 g) and Cobb 500 strain with pellet feed (1122.0 ± 7.08 g). The highest value was recorded at 28 days of age for Cobb 500 strain with crumble feed (2249.5 ± 7.08 g), followed by Ross 308 strain with crumble feed (2223.0 ± 7.08 g), Cobb 500 strain with mash feed (2183.2 ± 7.08 g), Ross 308 strain with mash feed (2137.2 ± 7.08 g), Cobb 500 strain with pellet feed (2134.5 ± 7.08 g) and Ross 308 strain with pellet feed (2084.0 ± 7.08 g). However, the highest value was recorded at 35 days of age for Cobb 500 strain with crumble feed (3626.0 ± 7.08 g), followed by Cobb 500 strain with mash feed (3511.0 ± 7.08 g), Ross 308 strain with crumble feed (3496.5 ± 7.08 g), Cobb 500 strain with pellet feed (3436.0 ± 7.08 g), Ross 308 strain with mash feed (3367.0 ± 7.08 g) and Ross 308 strain with pellet feed (3251.5 ± 7.08 g).

Table (9): Weekly feed consumption ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		g				
Cobb 500	Crumble	126.0±3.94^{a}	349.5±3.94^{a}	676.5±3.94^{a}	1067.0±3.94^{a}	1376.5±3.94^{a}
	Mash	121.0±3.94^{b}	342.0±5.58^{b}	656.0±3.94^{b}	1035.0±3.94^{b}	1328.0±3.94^{b}
	Pellet	117.0±3.94^{c}	332.5±3.94^{c}	641.5±3.94^{c}	1012.5±3.94^{c}	1301.5±3.94^{c}
Ross 308	Crumble	143.5±3.94^{a}	389.5±3.94^{a}	673.0±5.58^{a}	990.0±3.94^{a}	1273.5±3.94^{a}
	Mash	136.5±3.94^{b}	373.5±3.94^{b}	648.5±3.94^{b}	948.2±3.94^{b}	1230.0±3.94^{b}
	Pellet	131.5±3.94^{c}	366.0±5.58^{c}	629.5±3.94^{c}	929.5±3.94^{c}	1167.5±3.94^{c}

a,b,c, Differences between values having the same high script in each strain within each column are not significant at P ≤ 0.05.

Table (10): Cumulative feed consumption ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		g				
Cobb 500	Crumble	151.5±7.08^{a}	505.0±7.08^{a}	1182.5±7.08^{a}	2249.5±7.08^{a}	3626.0±7.08^{a}
	Mash	151.5±7.08^{a}	494.7±10.01^{b}	1148.3±7.08^{b}	2183.2±7.08^{b}	3511.0±7.08^{b}
	Pellet	148.0±7.08^{b}	480.5±7.08^{c}	1122.0±7.08^{c}	2134.5±7.08^{c}	3436.0±7.08^{c}
Ross 308	Crumble	173.5±7.08^{a}	563.0±7.08^{a}	1234.0±10.01^{a}	2223.0±7.08^{a}	3496.5±7.08^{a}
	Mash	167.0±7.08^{b}	540.5±7.08^{b}	1189.0±7.08^{b}	2137.2±7.08^{b}	3367.0±7.08^{b}
	Pellet	162.5±7.08^{c}	529.0±10.01^{c}	1154.5±7.08^{c}	2084.0±7.08^{c}	3251.5±7.08^{c}

a,b,c, Differences between values having the same high script in each strain within each column are not significant at P ≤ 0.05.

The obtained results were in similar with some researchers such as Cerrate *et al.* (2009) reported that birds fed diets pelleted with 1.59- or 3.17-mm dies had higher feed consumption than birds fed mash, but the feed intake was similar when birds were fed either a crumble or mash diet. Significant linear regressions were observed between feed intake at 13 d and at 34 or 41 d. The slopes of regression lines indicated that a 1-g change in feed intake at 13 d resulted in a corresponding change of 4.2 or 5.9 g in feed intake at 34 or 41 d, respectively. Chehraghi *et al.* (2013) noticed that there were significant differences in 1and 2 week feed intake among the three dietary groups. In 3-6 weeks the highest and the lowest feed intake were observed in crumble and pellet group as well as mash group respectively that among crumble and mash group, pellet and mash group were significant differences ($p<0.05$). There were significant differences in 1and 2 week feed intake among the three dietary groups. In 3-6 weeks the highest feed intake were observed in pellet and the lowest feed intake were observed in crumble and mash group. Among all of the group were significant differences ($p<0.05$). Al-Nasrawi (2016) noticed that FI, of broiler chicks fed on crumble, pellet and mash diets. The results revealed that broilers fed crumble and pellet consumed more ($P \leq 0.05$) feed from 22 to 32 d, 33 to 42 d, and 1 to 42 d as compared with mash. Broiler chicks fed crumble had the highest FI (2085.28 g) in 22-32 d. The corresponding estimations for FI was 1369.97 in 33-42 d and 4300.07 g in 1-42 d.

Effect of strains, feed forms and ages as affected on feed conversion ratio:

Effect of the interaction among strains, feed form and age on feed conversion ratio of 7, 14, 21, 28 and 35 days of age are displayed in Table (13). There were highly significant differences for three interactions between strains, feed form and age on feed conversion ratio ($P \leq 0.01$).

Table (11) illustrated that the worst value of feed conversion ratio was recorded at 7 days of age for Ross 308 strain with crumble feed, Cobb 500 strain with mash feed (1.11 ± 0.011 g feed/ g gain), followed by Cobb 500 strain with pellet feed (1.09 ± 0.011 g feed/ g gain), Ross 308 strain with mash feed, Cobb 500 strain with crumble feed (1.06 ± 0.011 g feed/ g gain), and Ross 308 strain with pellet feed (1.01 ± 0.011 g feed/ g gain). The worst value was recorded at 14 days of age for Ross 308 strain with crumble feed (1.34 ± 0.011 g feed/ g gain), followed by Cobb 500 strain with crumble feed (1.32 ± 0.011 g feed/ g gain), Cobb 500 strain with mash feed (1.31 ± 0.016 %), Ross 308 strain with mash feed (1.28 ± 0.011 g feed/ g gain), Cobb 500 strain with pellet feed (1.25 ± 0.011 %) and Ross 308 strain with pellet feed (1.20 ± 0.016 g feed/ g gain).

The worst value was recorded at 21 days of age for Cobb 500 strain with crumble feed (1.53 ± 0.011 g feed/ g gain), followed by Cobb 500 strain with mash feed (1.46 ± 0.011 g feed/ g gain), Ross 308 strain with pellet feed (1.45 ± 0.016 g feed/ g gain), Cobb 500 strain with pellet feed (1.44 ± 0.011 g feed/ g gain), Ross 308 strain with mash feed (1.43 ± 0.011 g feed/ g gain) and Ross 308 strain with pellet feed (1.34 ± 0.011 g feed/ g gain). The worst value was recorded at 28 days of age for Cobb 500 strain with crumble feed (1.71 ± 0.011 g feed/ g gain), followed by Cobb 500 strain with mash feed (1.64 ± 0.011 g feed/ g gain), Cobb 500 strain with pellet feed, Ross 308 strain with crumble feed (1.60 ± 0.011 g feed/ g gain), Ross 308 strain with mash feed (1.55 ± 0.011 g feed/ g gain) and Ross 308 strain with pellet feed (1.48 ±

0.011 g feed/ g gain). However, the worst value was recorded at 35 days of age for Cobb 500 strain with crumble feed (1.81 ± 0.011 g feed/ g gain), followed by Ross 308 strain with crumble feed (1.74 ± 0.011 g feed/ g gain), Cobb 500 strain with mash feed (1.69 ± 0.011 g feed/ g gain), Ross 308 strain with mash feed (1.68 ± 0.011 g feed/ g gain), Cobb 500 strain with pellet feed (1.67 ± 0.011 %) , and Ross 308 strain with pellet feed (1.60 ± 0.011 g feed/ g gain).

From the obtained results, Ross 308 strain with pellet feed form had the best feed conversion ratio for all ages compared to the Cobb 500 strain with the other feed forms.

The obtained results were in similar with some researchers such as Pirzado *et al.* (2015), found that feed conversion ratio (FCR) was observed as 1.61 ± 0.01 (at 1st week), 1.76 ± 0.01 (at 2nd week), 1.69 ± 0.02 (at 3rd week) and 1.86 ± 1.00 (at 4th week) in broilers fed mash, while in broilers fed crumbles it was 1.64 ± 0.01, 1.81 ± 0.01, 1.73 ± 0.00 and 1.87 ± 1.00 at corresponding weeks. However FCR was improved in group of broilers fed crumbles at 5th week (1.93 ± 8.81) and 6th (2.03 ± 0.02) week as compared to broilers with mash at 5th and 6th week (2.15 ± 0.02 and 2.19 ± 5.78, respectively). FCR was recorded to be comparatively better ($P<0.05$) in broilers with crumble feeding (1.84 ± 3.33) than broilers with mash (1.88 ± 6.67). Al-Nasrawi (2016) noticed that FCR of broiler chicks fed on crumble, pellet and mash diets, broilers fed crumble and pellet diet grew faster ($P \leq 0.05$), consumed more ($P \leq 0.05$) feed and have lower FCR from 22 to 32 d, 33 to 42 d, and 1 to 42 d as compared with mash. Broiler chicks fed crumble had the best FCR (2.01) in 22-32 d. The corresponding estimations FCR was 2.38 in 33-42 d and 2.05 in 1-42 d.

Economic efficiency:

Results of feeding cost for chicks feed with different feed forms are presented in Tables (12 and 13). Best economic efficiency was obtained with pellet feed form for both Cobb 500 and Ross 308 (160.98 and 172.14 %, respectively) followed by mash feed form for both Cobb 500 and Ross 308 (156.96 and 159.81 %, respectively) and crumble feed form for both Cobb 500 and Ross 308 (141.13 and 150.16 %, respectively). However, this depends on feed form which improved of feed conversion ratio.

Table (11): Feed conversion ratio ($\overline{X}$ ± SE) as affected by interactions among strains, feed form and ages.

Strains	Feed form	Ages (days)				
		7	14	21	28	35
		g feed/ g gain				
Cobb 500	Crumble	1.06±0.011^a	1.32±0.011^a	1.53±0.011^a	1.71±0.011^a	1.81±0.011^a
	Mash	1.11±0.011^b	1.31±0.016^a	1.46±0.011^b	1.64±0.011^b	1.69±0.011^b
	Pellet	1.09±0.011^c	1.25±0.011^b	1.44±0.011^b	1.60±0.011^c	1.67±0.011^c
Ross 308	Crumble	1.11±0.011^a	1.34±0.011^a	1.45±0.016^a	1.60±0.011^a	1.74±0.011^a
	Mash	1.06±0.011^b	1.28±0.011^b	1.43±0.011^a	1.55±0.011^b	1.68±0.011^b
	Pellet	1.01±0.011^b	1.20±0.016^c	1.34±0.011^b	1.48±0.011^c	1.60±0.011^c

a,b,c, Differences between values having the same high script in each strain within each column are not significant at $P \leq 0.05$.

Table (12): Effect of feed forms on the economic efficiency of Cobb 500 at 35 days of age.

Items	Feed forms		
	Crumble	Mash	Pellet
Initial body weight, g.	40.0	40.0	40.0
Final body weight, kg.	2.01	2.07	2.06
Body weight gain, kg	1.97	2.03	2.02
Total revenue[1], L.E.	39.40	40.60	40.40
Feed intake, kg.	3.63	3.51	3.44
Price of one kg feed , L.E.	4.5	4.5	4.5
Feed cost[2], L.E.	16.34	15.80	15.48
Net revenue[3], L.E.	23.06	24.80	24.92
Economic efficiency[4], %.	141.13	156.96	160.98

Price of one kg live body weight 20L.E./ kg at time of experiment.
[1] Total revenue = live body weight × marketing price.
[2] Feed cost = feed intake × price of kg feed.
[3] Net revenue = Total revenue – Feed cost.
[4] Economical efficiency = (Net revenue / Feed cost) ×100.

Table (13): Effect of feed forms on the economic efficiency of Ross 308 at 35 days of age.

Items	Feed forms		
	Crumble	Mash	Pellet
Initial body weight, g.	40	40	40
Final body weight, kg.	2.01	2.01	2.03
Body weight gain, kg	1.97	1.97	1.99
Total revenue[1], L.E.	40.26	40.19	40.54
Feed intake, kg.	3.5	3.37	3.25
Price of one kg feed , L.E.	4.5	4.5	4.5
Feed cost[2], L.E.	15.75	15.17	14.63
Net revenue[3], L.E.	23.65	24.24	25.18
Economic efficiency[4], %.	150.16	159.81	172.14

Price of one kg live body weight 20L.E./ kg at time of experiment.
[1] Total revenue = live body weight × marketing price
[2] Feed cost = feed intake × price of kg feed.
[3] Net revenue = Total revenue – Feed cost.
[4] Economical efficiency = (Net revenue / Feed cost) ×100.

In general, the results showed that:

- For Cobb 500 strain, mash feed had a higher body weight at marketing age. But for Ross 308 strain, pellet feed had a higher body weight at marketing age.
- Ross 308 strain fed on crumble, and Cobb 500 strain fed on mash had lowest mortality %.
- The best economic efficiency was obtained with pellet feed form for both Cobb 500 and Ross 308 strains

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تأثير شكل العليقة علي أداء سلالتين من كتاكيت اللحم

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الملخص العربى

أجريت هذه التجربة في مزرعة دواجن خاصة (مساحتها 120 متر^2) في شبين الكوم – محافظة المنوفية، خلال الفترة من شهر إبريل حتي مايو 2014م. الهدف من هذه التجربة هو تقدير تأثير شكل العليقة علي الكفاءة الإنتاجية والاقتصادية لسلالتين من كتاكيت اللحم (كب 500 وروص 308) عند عمر 7، 14، 21، 28 و 35 يوم. أجريت التجربة في مزرعة مفتوحة علي كثافة تربية واحدة (10 طائر / متر^2). استخدم في هذه الدراسة 1200 كتكوت عمر يوم غير مجنسة (600 طائر من سلالة كب 500 و 600 طائر من سلالة روص 308). تم وزن الطيور بطريقة فردية ثم قسمت عشوائياً إلي ثلاث مجموعات تجريبية متماثلة تقريباً (متوسط وزن الكتكوت 40جم) داخل كل سلالة. غذيت طيور المجموعة الأولي والثانية والثالثة علي عليقة مفتتة (crumble)، ناعمة (mash) و محببة (pellet) علي التوالي. استخدم نظام الإضاءة المستمر (24 ساعة). ربيت الكتاكيت علي الأرض باستخدام نشارة الخشب كفرشة. تم تقديم العليقة والماء بصورة حرة أمام الطيور خلال فترة التجربة التي استمرت حتى 35 يوم من العمر.

تم دراسة الصفات التالية:

أوزان الجسم عند الأعمار المختلفة، معدلات النمو، الغذاء المستهلك، (كجم/ الطائر/ الدورة)، معدل تحويل الغذاء، % النفوق، % التجانس.

والنتائج المتحصل عليها أوضحت أن:

1- طيور سلالة كب التي غذيت علي عليقة ناعمة (mash) كانت أعلي وزن جسم عند التسويق (35 يوم من العمر).

2- طيور سلالة روص التي غذيت علي عليقة محببة (pellet) كانت أعلي وزن جسم عند التسويق (35 يوم من العمر).

3- أقل نسبة نفوق كانت في طيور سلالة روص 308 وسلالة كب 500 التي غذيت علي عليقة ناعمة (mash).

4- أفضل كفاءة اقتصادية تم الحصول عليها في الطيور التي غذيت علي عليقة محببة (pellet) في السلالتين (كب 500 وروص 308).

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