



# Effects of Chick Quality and Pre-Starter Feed on Fattening Performance and Carcass Characteristics of Broilers

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## ABSTRACT

The present study was conducted to investigate the effects of chicks quality and pre-starter feeding during the first five days of the feeding period on performance and carcass characteristics. After hatching, experimental chicks were divided into sex by employing 2 by 2 factorial design chick quality (low and high) and two feeding regimes as the main effects in each sex. Thus, four treatment groups (low quality on starter feed, low quality on pre-starter+starter feed, high quality on starter feed, high quality on pre-starter+starter feed) were arranged in the study. Total of 800 chicks was used in four treatment groups including five replicates each, using 40 chicks (20 males and 20 females) per replicates. At the beginning of the experiment, initial live weight was seen to be affected by chick quality, as the mean body weights of the high-quality chick groups were 1.3 g heavier than those of the low-quality chick groups ( $P < 0.001$ ). However, at the end of the experiment, the use of pre-starter feeding and chick quality did not affect body weight gain, feed consumption, feed conversion rate or mortality rate significantly ( $P > 0.05$ ). With regard to the fatness of the carcass, a higher amount and proportion of abdominal fat were found in low-quality female chicks ( $P < 0.05$ ).

### Article Information

Received 18 June 2021

Revised 05 April 2022

Accepted 23 April 2022

Available online 08 September 2022  
(early access)

### Authors' Contribution

MD conducted the experiments. MD and HRK contributed to the design and interpretation of the current study and wrote the article.

### Key words

Broiler, Carcass characteristics, Chick quality, Growth performance, Pre-starter feed

## INTRODUCTION

As the human population continues to increase, it has become necessary to increase food production and quality to meet the demand for quality food and to ensure the availability of a balanced diet for human nutrition. It is well known that poultry meat is one of the main sources of good quality protein. In fact, the economy, quantity and quality of poultry meat production are significantly affected by chick quality (CQ), which is known to be affected by many factors. Besides genotype and age of breeder flock, CQ is affected by three stages including pre-hatching (feeding breeder, egg quality, collection and storage conditions etc.), hatching (incubation temperature, humidity, ventilation and turning of eggs) and post-hatching (the first 7 days feeding) (Durmuş and Kutlu, 2019). It is well known that these factors cover a long process

from the feeding of breeder flock to slaughter of broilers. Depending on the effects of all these factors, chicks are produced of different quality and meat yield from broiler production could vary according to the quality of chicks (Durmuş *et al.*, 2021). Therefore, CQ is the combination of many parameters and it is essential for the enhancement of production and slaughter performance. Quality of chicks are defined as those that have developed optimally during the incubation period and have a high growth rate, high breast meat ratio and high survival rate after hatching (Kamanli and Durmuş, 2014). It is difficult to identify chicks that would have a better performance after incubation, as there have been no quality classification systems established in most of the broilers producing countries. Activity, general appearance, the color of feathers, condition of eyes, structure of legs, open or closed navel, etc. at hatching could be the main criteria taken into account in determining CQ (Tona *et al.*, 2003). According to the studies conducted on chicks' quality, one of the most important features of healthy chicks after hatching is the ability of standing upright on the feet and clear and bright eyes. Moreover, it is well known that egg yolk provides necessary nutrients for the development of the embryo and the color pigments of the feathers at hatching. Absorption at a high rate of the yolk sac by the chicks at the end of the incubation could sign dark yellow feathers at hatching (Meijerhof, 2005). For this reason, the feathers' color of the chick is desired to

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0030-9923/2022/0001-0001 \$ 9.00/0



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be yellow as dark as possible. Also, it is speculated that the weight of the heart, liver and spleen and the length of the digestive system increase in parallel with the length of the chick and the intestinal system develops better (Reijrink and Molenaar, 2006). Since qualitative characteristics of chicks at hatching cannot be measured or converted into quantitative scores, to make subjective interpretation is really difficult to achieve repeatable success. In the present literature, few studies have examined the effects of qualitative characteristics on post-incubation performance and compiled industry-oriented knowledge on this issue that has not been provided (Tona *et al.*, 2003, 2005). In fact, not only CQ, care and feeding during the first week of life post-incubation are very important for high yield, with the form, digestibility and nutrient content of feed being particularly important (Garcia *et al.*, 2006; Leeson, 2008). It is well known that a chick's digestive system at hatching is not yet well developed; enzyme activities are extremely low (Çelik and Açıkgöz, 2006). Therefore, it is thought that the nutrition provided to chicks during the first 5-7 days affects the growth performance and immune system and the feed given during this period should be highly nutritious and digestible to meet the nutrient demands of the animals and to promote the development of the gastrointestinal tract (Maiorka *et al.*, 2006; Ebling *et al.*, 2015).

The present study was aimed to determine whether CQ (high and low) and providing pre-starter feeding during the first five days after incubation would affect fattening performance and carcass characteristics of broilers.

## MATERIALS AND METHODS

### *Ethical statement*

This study was approved by the Çukurova University Animal Experiments Local Ethics Committee (Approval no: 2018/7).

### *Animals, diets and experimental design*

One-day-old chicks (Ross 308) were obtained from a private hatchery following the standard incubation process for broilers according to Mcquoid (2000). Eggs used for hatching were obtained from the breeding flock at 62 weeks of age and the eggs were placed in the incubator after stored for 24 h. For the quality classification of the chicks at hatching, 1200 chicks were randomly chosen from the hatchery. After sexing based on wing feathers according to the Ross Recommendation (2018), a total of 800 chicks (400 male and 400 female) were selected according to the quality parameters (Table III) adopted in the study. The male and female chicks were divided into two treatment groups defined as high quality and low

quality. Each quality group was divided into two feeding groups that received control feeding (CF) throughout the experiment or a pre-starter diet (PSF) for the first five days with control diets given for the remainder of the experiment. Thus, the birds were assigned to four treatment groups (2x2 factorial design feed and quality as main effects) including five replicates (20 males and 20 females in each) for each treatment. Since the nutrient requirements for the chicks changed according to age, the chicks were fed with three or four different feeds (pre-starter and/or starter-grower-finisher) that had different pellet forms and nutrient content. Half of the chicks were fed with a PSF (Neochicc™ by Cargill, a commercial PSF designed with highly digestible foodstuffs (maize-soya-animal plasma) to aid the transition from yellow sac to solid feed after hatching). Approximately 100 g of Neochicc were provided to each bird for the first 120 h of life. Nutrient specification of Neochicc contains 23% crude protein, 9% crude fat, 2.65% crude cellulose, 6.3% crude ash, 0.95% calcium, 0.72% phosphorus, 0.20% sodium, 1.42% lysine and 0.66% methionine and it is specially designed in dust-free pellets with a diameter of 2 mm. The other feeds (starter, grower and finisher feeds, based on maize and soya) used in the trial were obtained from a commercial feed mill in pelleted forms with 3-4 diameters. The nutrient and ingredient composition of the feeds used in the experiment are given in Supplementary Tables I and II.

The birds were reared in an environmentally controlled house containing a total of 20 pens (3 × 1 m) with a 24-h daily lighting schedule. Feed and water were provided *ad libitum* throughout the experiment. Animal density in each pen was adjusted to 17 chicks/m<sup>2</sup>, similar to that applied in commercial conditions. During the experiment, the environmental temperature and humidity were maintained within the animal comfort zone using a curtain and tunnel ventilation systems according to the Ross Recommendation (2018).

### *Measurements and analytical methods*

The quality of chicks were measured according to the criteria given in Table I and the quality score of the chicks was calculated by summing the scores of each parameter. Accordingly, chicks with a total score of 80-100 were considered to be high quality, chicks with a total score of 60-79 were considered to be low quality and chicks with a total score below 60 were classified as off-trail chicks. The weighted scores (30% for legs, 30% for eyes, 20% for feather color, and 20% for chick length) of these criteria were determined by evaluating leg structure, eye condition, feather color, and chick length. The importance level of each criterion for a healthy chick was taken into account in

determining the weighted scores of the criteria used in the evaluation of CQ. The effects of the determining criteria on CQ were not individual and/or their relationships with each other, but the total effect of these criteria determined the CQ.

**Table I. Scoring of parameters used for the determination of chick quality.**

Quality parameters	Criteria	Scores
Legs	Excellent	30
	Joint swelling and upright posture	15
	Shape and/or discoloration of the legs and/or fingers	15
Eyes	Excellent	30
	Clear but dull or choked eye	15
	Closed eye	0
Feather colour	Dark yellow (DSM-S 4 ≤)	20
	Medium yellow (DSM-S 2-3)	15
	Light yellow (RS 1 ≥)	10
Length	Long (19.6 cm <)	20
	Medium (19.2-19.6 cm)	10
	Short (< 19.2 cm)	0
Total scores		100
High quality chick		80-100
Low quality chick		60-79
Off-trial chick		<60

The leg structure and eye condition of the chicks were evaluated by eye inspection, the feather color of the neck area was scored using the DSM-S yolk scale and the chick length was measured as the distance between the beak and the middle fingernail using a ruler (Supplementary Figs. 1 and 2).

The standard value ranges taken into account in the evaluation of chick length were determined by a preliminary study on a total of 200 eggs obtained from the breeding flock at 62 weeks of age.

#### Calculation and statistical analysis

Feed consumption was recorded weekly at the sub-group level, body weight (male and female birds separately) was measured each week by weighing on a digital scale. The feed conversion ratio (FCR) was calculated by dividing feed intake by body weight gains at the sub-group level.

Feed conversion ratio = (cumulative feed intake (g)/

cumulative body weight gain (g)) × 100

The number of dead birds was recorded daily by sex and assigned treatment groups. At the end of the experiment when the birds were 35-days old, all of the chicks were prepared for slaughter. Five male and five female birds having the average live weight of each replicate were used for the carcass analyses. Immediately after slaughter, the carcasses of the sample birds were weighed to obtain hot carcass values. The carcasses were then held in cold storage at 4°C for 24 h before the measurement of the cold carcass weight. The carcass yield was calculated using the following formula. At the same time, the abdominal fat weight was weighed and the relative abdominal fat weights were calculated using the following formula.

Carcass yield = (cold carcass weight (g)/slaughter weight (g)) × 100

Relative abdominal fat weight = abdominal fat weight (g)/cold carcass weight (g) × 100

The data were analyzed using Statistical Analysis System (SAS) by 2x2 factorial design. Duncan's new multiple range test in SAS was used to identify significant differences among treatment means. The data related to liveability were calculated using Chi-square analysis with the help of SAS. The results obtained in this study are presented as means per bird with standard errors of the difference between means (SED). In addition, the significance level was taken as 0.05 in all tests.

## RESULTS

Quality scoring for chick was applied to 1200 chicks and the rates of high, low and off-trial chicks were found to be 49.67%, 39.33% and 11.00%, respectively. The results obtained in the present study revealed that although the initial body weight was not taken as a parameter for CQ, the differences between the initial live weights of the quality groups were found to be significant ( $P < 0.05$ ; Table II). According to this result, the mean initial body weights of the high-quality groups were found to be 1.33 g heavier than those of the low-quality groups and thus, the chicks having higher live weight classified as higher quality. Also, at the end of the experiment, the high-quality chicks were found to have 37.59 g more body weight gain than low-quality chicks ( $P > 0.05$ ). It is thought that such as low as 1.33 g higher body weight at the beginning of the fattening period may create almost 37 g difference at the end of the fattening period. This may lead to more profitable production. But the differences in body weight gains of high and low-quality birds were not significant ( $P > 0.05$ ). It has been reported in many studies that chicks with a high live weight at the beginning of the fattening period

**Table II. The effect of chick quality and pre-starter feed on performance in broiler.**

	Low quality chickens		High quality chickens		P-value			
	CF	PSF	CF	PSF	SED	CQ	PSF	CQxPSF
ILW	47.43a	47.70a	48.98b	48.80b	0.30	<0.001	-	-
<b>Body weight gain (g/chick)</b>								
7 <sup>th</sup> day	134.22	135.72	141.09	133.89	2.40	0.61	0.56	0.38
14 <sup>th</sup> day	483.94	481.13	492.43	480.38	3.96	0.63	0.36	0.57
21 <sup>th</sup> day	1022.10	1035.42	1029.81	1067.98	11.46	0.40	0.28	0.60
28 <sup>th</sup> day	1713.09	1731.88	1785.84	1789.59	16.89	0.74	0.83	0.58
35 <sup>th</sup> day	2460.22	2458.53	2505.60	2488.33	20.05	0.36	0.82	0.85
<b>Feed intake (g/chick)</b>								
7 <sup>th</sup> day	172.60	171.28	172.16	167.37	2.24	0.63	0.50	0.70
14 <sup>th</sup> day	580.54	570.58	574.59	575.23	4.21	0.94	0.59	0.54
21 <sup>th</sup> day	1334.43	1303.72	1330.74	1310.31	14.83	0.96	0.40	0.87
28 <sup>th</sup> day	2366.65	2340.42	2383.18	2378.05	23.72	0.58	0.75	0.83
35 <sup>th</sup> day	3595.57	3540.64	3618.93	3593.09	33.59	0.58	0.56	0.83
<b>Feed conversion ratio (gain/feed)</b>								
7 <sup>th</sup> day	1.29	1.27	1.22	1.26	0.02	0.32	0.85	0.44
14 <sup>th</sup> day	1.20	1.19	1.17	1.20	0.01	0.61	0.70	0.29
21 <sup>th</sup> day	1.31 <sup>b</sup>	1.26 <sup>ab</sup>	1.29 <sup>ab</sup>	1.23 <sup>a</sup>	0.01	0.32	0.03	0.64
28 <sup>th</sup> day	1.38 <sup>b</sup>	1.35 <sup>ab</sup>	1.33 <sup>a</sup>	1.33 <sup>a</sup>	0.01	0.02	0.19	0.37
35 <sup>th</sup> day	1.46	1.44	1.44	1.44	0.01	0.56	0.38	0.36

ILW, Initial live weight; CQ, Chick quality; CF, Control feed; PSF, Pre-starter feed. <sup>a, b</sup>, Significant of interaction effect on group averages indicated by different letters ( $P < 0.05$ ).

attained higher performance. When the groups fed with PSF for the first five days and the control groups were compared, it was observed that the groups fed with PSF had numerically higher live weights on the 7, 21 and 28 days. This result shows an increase in body weight gain and an improvement in the feed conversion rate in broilers fed with PSF at the weeks indicated. As shown in Table II, in terms of feed consumption, there was not a significant difference between the groups ( $P > 0.05$ ). However, when the quality groups were evaluated individually, it was observed that the groups fed with PSF in the first 5 days consumed less feed during the experiment.

The results concerning FCRs showed that there were no significant differences between treatment groups during the first two weeks of the experiment. However, FCRs calculated on the 3<sup>rd</sup> and 4<sup>th</sup> weeks of the experiment were found to be significant between the groups ( $P < 0.05$ ; Table II). As the birds were getting older, the effects of CQ and PSF on the FCR were disappeared and become insignificant ( $P > 0.05$ ). On the 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup>, 28<sup>th</sup> and 35<sup>th</sup> days of the experiment, it was found that the mortality rate

between the groups was not significant, as shown in Table III ( $P > 0.05$ ).

**Table III. The effect of chick quality and pre-starter feed on mortality in broiler.**

	CQ				P value
	Low quality chick		High quality chick		
	CF	PSF	CF	PSF	
7 <sup>th</sup> day	1.50	1.00	0.00	0.00	0.07
14 <sup>th</sup> day	1.50	2.00	0.00	0.00	0.14
21 <sup>th</sup> day	2.00	2.50	0.50	0.00	0.63
28 <sup>th</sup> day	2.50	3.00	0.50	0.50	0.63
35 <sup>th</sup> day	2.50	4.00	2.00	1.00	0.21

For abbreviations and statistical details see Table II.

However, it was observed that the mortality rate was lower in high-quality chicks for all weeks. Although the effect of PSF on mortality was not statistically ( $P > 0.05$ ) significant, the group with the lowest mortality

**Table IV. The effect of chick quality and pre-starter feed on carcass parameters in male and female broiler.**

Parameter	Low quality chicks		High quality chicks		P-value			
	CF	PSF	CF	PSF	SED	CQ	PSF	CQxPSF
<b>Male</b>								
Slaughter weight 35 <sup>th</sup> day (g/chicken)	2737.60	2667.40	2768.00	2693.20	21.27	0.52	0.11	0.96
Hot carcass weight (g/chicken)	2113.16	2066.36	2137.48	2083.84	17.63	0.56	0.17	0.92
Cold carcass weight (g/chicken)	2077.88	2019.32	2095.88	2041.48	17.11	0.57	0.12	0.95
Abdominal fat weight (g/chicken)	22.08	22.56	24.20	22.76	0.58	0.33	0.68	0.42
Carcass yield (%)	75.91	75.71	75.71	75.80	0.23	0.90	0.90	0.76
Abdominal fat rate (%)	1.06	1.12	1.16	1.12	0.03	0.47	0.93	0.44
<b>Female</b>								
Slaughter weight 35 <sup>th</sup> day (g/chicken)	2300.80	2372.40	2367.40	2364.60	23.98	0.55	0.48	0.45
Hot carcass weight (g/chicken)	1791.60	1853.40	1842.64	1878.56	16.32	0.26	0.15	0.70
Cold carcass weight (g/chicken)	1762.06	1813.04	1807.20	1803.48	18.96	0.65	0.54	0.48
Abdominal fat weight (g/chicken)	23.91 <sup>a</sup>	24.32 <sup>a</sup>	19.88 <sup>b</sup>	20.12 <sup>b</sup>	0.70	0.04	0.36	0.52
Carcass yield (%)	76.60	76.42	76.33	76.26	0.15	0.49	0.67	0.86
Abdominal fat rate (%)	1.35 <sup>a</sup>	1.34 <sup>a</sup>	1.10 <sup>b</sup>	1.20 <sup>b</sup>	0.03	0.01	0.43	0.30

For abbreviations and statistical details see [Table II](#).

rate was observed to be high-quality chicks receiving the PSF. In general, mortality was observed to be lower in high-quality chicks, as it was expected. At the end of the trial, CQ and PSF application were found to have no significant effects on slaughter and carcass characteristics in male chicks ( $P > 0.05$ ; [Table IV](#)). However, CQ was found to have significant effects on abdominal fat weight and abdominal fat ratio in female chicks ( $P < 0.05$ ).

## DISCUSSION

The results of the present experiment suggest that good quality chicks with a higher body weight after hatching may perform better than their low-quality counterparts. However, the relationship between the hatching weight of the chick and the slaughtering weight remains still unclear. However, [Powell and Bowman \(1964\)](#) speculated on a positive relationship between these two parameters; [McLoughlin and Gous \(1999\)](#), [Wolanski et al. \(2003\)](#) and [Tona et al. \(2004\)](#) reported no relationship between these two parameters. Contrary to our [Vieira and Moran \(1999\)](#) reported a negative relationship between the same parameters. [McLoughlin and Gous \(1999\)](#) found that there was no relationship between hatching weight and slaughter performance; however, they stated that chick weight at 7-10 days of age is closely related to slaughter weight. The beginning of the production period (especially for the first 5 days) is important for adaptation of the digestive system to exogenous feed-origin nutrients; chicks need

highly digestible nutrients for growth, development of the immune system and thermoregulation ([Maiorka et al., 2006](#); [Ebling et al., 2015](#)). Therefore, feeding chicks with PSFs that have a high nutrient content and/or digestibility during this transition period enables more efficient use of nutrients ([Garcia et al. 2006](#); [Leeson, 2008](#)).

In a study conducted by [Leeson \(2008\)](#), it was reported that the average live weights of chicks fed highly digestible PSFs instead of commercial corn and soy-based feeds increased from 160-170 g to 200 g. [Tabeidian et al. \(2015\)](#) reported that the addition of 0.3 L/kg water to PSFs prepared using casein-dextrose, casein-starch, gluten-dextrose and gluten-starch increased body weight gain of chicks. [Nabizadeh et al. \(2017\)](#) were investigated the effects on broiler performance of PSF prepared using four different levels of isolated soy protein (ISP; 0, 1.5, 3.0, 4.5%) and four different levels of broken rice (0, 6, 12, 18%). They reported that the bodyweight gains of the groups fed with PSFs were higher than the control group and that the body weight gain increased linearly with the increase of broken rice in the ration. The use of broken rice in pre-starter diets of broilers also had positive effects on body weight gains ([Kita and Okuten, 2013](#); [Ebling et al., 2015](#)). [Ivanovich et al. \(2017\)](#) investigated the effects on broiler performance of PSFs having different metabolic energy (ME; 3,000 or 2,900 kcal/kg) and different digestible amino acids (DAA; 100%, 107%, and 114%) contents given during the first ten days. At the end of the study, they found that ME levels did not have a significant

effect on body weight gain; however, they reported an increased body weight gain in all periods of production parallel to the increase in DAA level. For optimal development of the chick digestive system after hatching, chicks should be stimulated to consume feed with the size of appropriate (pelleted) form, nutrients, and digestibility, as these factors significantly affect performance. In a study by [Tabeidian \*et al.\* \(2015\)](#), it was observed that feed consumption was increased in chicks fed with a PSF supplemented with gluten-dextrose. Another study on broilers by [Bidar \*et al.\* \(2007\)](#) examined the effects of PSF containing three different sodium levels (0.15%, 0.30%, and 0.45%) fed over different lengths of time (the first 4, 7 and 10 days) on broiler performance. Groups given PSF for 7 and 10 days during the first 2-weeks period consumed a higher amount of feed than those given the PSF for 4 days and control feed. In a similar study, [Omede and Iji \(2017\)](#) examined the effects of a pre-starter diet prepared in mash and crumble form using processed soy protein products (PSP) instead of soybean meal in the diet on broiler performance. They reported that during the first 24 days the birds received crumble feed consumed more than those of birds on mash, however, this effect was eliminated at the end of the experiment. It was also noted that PSP levels (0, 50 and 100 g/kg) used in the diet did not have a significant effect on feed consumption. [Mahdavi \*et al.\* \(2017\)](#) reported that the use of PSF during the first 10 days of feeding in broilers did not affect feed consumption. In another study, the difference in feed consumption between groups fed with alternative-doped (control+cassava starch, control+sucrose, control+corn gluten, control+blood plasma and control+corn gluten flour+sucrose) PSF and a control feed were not significant ([Longo \*et al.\*, 2007](#)).

Our results suggest that the use of PSF during the first five days had no significant effects on feed consumption, supporting the findings of [Mahdavi \*et al.\* \(2017\)](#) and [Longo \*et al.\* \(2007\)](#). However, the results obtained in the present trial were also showed that the chicks on PSF consumed less amount than those of birds on control feed during all weeks. The reason for the low feed intake in the groups fed with PSF for the first 5 days is could be attributed to that birds could have reached the satiety with less amount of feed with the diet containing high nutrient digestibility. [Pretorius \(2011\)](#) suggested the use of highly digestible energy sources with high-quality protein sources in PSFs. [Tabeidian \*et al.\* \(2015\)](#) found that wetting of PSFs prepared using casein-dextrose, casein-starch, gluten-dextrose and gluten-starch with 0.3 L/kg water positively affected the FCR in all production periods. Besides, it was determined that feeding of wetted PSF containing casein-starch improved the FCR.

[Ivanovich \*et al.\* \(2017\)](#) investigated effects on broilers

performance of the PSFs with two different metabolic energy (ME; 3,000 or 2,900 kcal/kg) and three different digestible amino acids (DAA; 100%, 107% and 114%) levels during the first ten days. They reported that at the end of the study, ME had no significant effect on feed conversion rate; however, the FCR in the first ten days was improved with the increase in the DAA level of ration. [Mahdavi \*et al.\* \(2017\)](#) examined the changes in the performance of broiler chickens fed with PSF in the first ten days. They reported that the use of PSF improved FCR but this positive effect disappeared by the end of the production period. The results of the studies examining the effects of PSF on the performance in broilers conducted by [Lilburn \(1998\)](#), [Saleh \*et al.\* \(1997\)](#) and [Stringhini \*et al.\* \(2003\)](#) are in agreement with those reported by [Ivanovich \*et al.\* \(2017\)](#) and [Mahdavi \*et al.\* \(2017\)](#). In contrast, [Longo \*et al.\* \(2007\)](#) found that the performance of chicks fed with PSFs prepared using highly digestible carbohydrates (cassava starch and sucrose) and proteins (corn gluten and blood plasma) did not significantly change. In similar studies conducted by [Bidar \*et al.\* \(2007\)](#), [Ali and Latshawe \(1994\)](#) and [Junqueira \*et al.\* \(2003\)](#) observed no significant effects of pre-starter diet on feed efficiency. The results concerning feed conversion efficiency suggest that high-quality chicks had better FCRs than their low-quality counterparts. This finding could be attributed to better digestive capacity in high-quality chicks. The results also suggest that feeding with a pre-starter diet had more pronounced positive in low-quality chicks. This effect may relate to the higher digestibility of PSF. Therefore, especially in low-quality chicks, PSF led to numerically better FCRs throughout the experiment.

[Lamot \*et al.\* \(2016\)](#) reported that deaths occurring before the 28<sup>th</sup> day were related to the nutritional composition of the PSF and particularly, the delay in the time of the first feed consumption. In another study conducted in broiler, [Cerrate \*et al.\* \(2008\)](#) investigated the effects of PSFs with different pellet diameters (1.59mm, 2.38mm, 3.17mm and 4.76mm) on broiler performance and it was found that pellet diameters did not affect mortality. However, the optimum performance of the chicks in the first week was seen feeding by feeds with pellet diameters of 1.59 and 2.38mm because of the small size of the chick beaks. Mortality in the present study was seen to be lower in high-quality chicks, as expected. However, when the feeding groups of the low-quality chicks were compared, it was found that the mortality rate of chicks fed with the PSF was numerically higher than chicks fed with the control feed. Our results concerning mortality depending on pellet diameters of pre-starter and starter feeds seem to be compatible for high-quality chicks with the results of [Cerrate \*et al.\* \(2008\)](#). [Ivanovich \*et al.\*](#)

(2017) reported from their studies investigating effects of PSFs having two different metabolizable energy (ME; 3,000 or 2,900 kcal/kg) and three different digestible amino acids (DAA; 100%, 107% and 114%) levels given during the first 10 days, found that total carcass weight, breast muscle weight and thigh weight in the first ten-day period increased with the increment of digestible amino acids levels in PSFs given for the first ten days. However, at the end of the experiment, they found that metabolizable energy, digestible amino acids and their interaction had no significant effects on the carcass characteristics such as carcass yield, thighs, wings and abdominal fat weights. In another study, feeding with alternative-doped PSF (control+cassava starch, control+sucrose, control+corn gluten, control+blood plasma and control+corn gluten flour+sucrose) for the first 7 days, did not have a significant effect on carcass quantity and composition (Longo *et al.*, 2007). Similarly, Mahdavi *et al.* (2017) reported that the use of PSF during the first 10 days of feeding did not affect slaughter weight and carcass characteristics such as carcass yield, breast, leg and wing weight. The results of the present study concerning carcass parameters support the findings of previous studies that examined the effects of PSF on broiler performance (Saleh *et al.*, 1997; Rodriqueiro *et al.*, 2000; Bidar *et al.*, 2007; Longo *et al.*, 2007; Azizi *et al.*, 2011; Ivanovich *et al.*, 2017; Mahdavi *et al.*, 2017).

## CONCLUSION

The results obtained from the present study suggest that approximately 100 g of PSF given per chick during the first five days after hatching had positive effects on broiler growth performance and feed conversion rate up to four weeks of age. The results also showed that high-quality chicks have 1.33 g more live weight at the beginning of the trial according to low-quality counterparts and provided an average of 37.59 g more body weight gain in total per chicken throughout the trial. In conclusion, it could be suggested that applying quality classification at hatching in broiler chicks with low quality could be off value for overall performance besides pre-starter feeding during the first five days after hatching for low or high-quality broiler chicks grown for grill up to 4 weeks of age.

## ACKNOWLEDGEMENTS

The authors would like to offer special thanks to Çukurova University Scientific Research Projects Unit for supporting this work (Project No: FLY-2018-9946).

### Supplementary material

There is supplementary material associated with

this article. Access the material online at: <https://dx.doi.org/10.17582/journal.pjz/20210618190643>

### Statement of conflict of interest

The author have declared no conflict of interests.

## REFERENCES

- Ali, Z., and Latshaw, D., 1994. Decreasing the effect of high temperature on broiler chicks by increasing dietary energy. *Poult. Sci.*, **73**: 111-118.
- Azizi, B., Sadeghi, G.H., Karimi, A., and Fakhradin, A.B.E.D., 2011. Effects of dietary energy and protein dilution and time of feed replacement from starter to grower on broiler chickens performance. *J. Cent. Eur. Agric.*, **12**: 44-52. <https://doi.org/10.5513/JCEA01/12.1.879>
- Bidar, N., Rezai, M., Sayyah Zadeh, H., and Kermanshahi, H., 2007. Effect of feeding periods and sodium levels of pre-starter diet on broiler performance and serum electrolytes. *J. Anim. Vet. Adv.*, **6**: 959-963.
- Cerrate, S., Wang, Z., Coto, C., Yan, F., and Waldroup, P.W., 2008. Effect of pellet diameter in broiler prestarter diets on subsequent performance. *Int. J. Poult. Sci.*, **7**: 1138-1146. <https://doi.org/10.3923/ijps.2008.1138.1146>
- Çelik, L., and Açıkğöz, Z., 2006. Development of the digestive system in poultry and relationship between digestive system development and nutrition. *J. Anim. Prod.*, **47**: 38-47.
- Durmuş, M., Kurşun, K., Baylan, M., and Kutlu, H.R., 2021. The effect of flock age on hatching results and chick quality in ross 308 broiler. *Turk. J. Agric. Fd. Sci. Technol.*, **9**: 362-367. <https://doi.org/10.24925/turjaf.v9i2.362-367.4005>
- Durmuş, M., and Kutlu, H.R., 2019. Factors affecting chick quality in meat chicken production and qualitative parameters used in quality classification. *Çuk. J. Agric. F. Sci.*, **34**: 194-206.
- Ebling, P.D., Kessler, A.M., Villanueva, A.P., Pontalti, G.C., Farina, G., and Ribeiro, A.M.L., 2015. Rice and soy protein isolate in pre-starter diets for broilers. *Poult. Sci.*, **94**: 2744-2752. <https://doi.org/10.3382/ps/pev279>
- Garcia, A.R., Batal, A.B., and Dale, N.M., 2006. Biological availability of phosphorus sources in prestarter and starter diets for broiler chicks. *J. appl. Poult. Res.*, **15**: 518-524. <https://doi.org/10.1093/japr/15.4.518>
- Ivanovich, F., Karlovich, O.A., Mahdavi, R., and Afanasyevich, E.I., 2017. Nutrient density of

- prestarter diets from 1 to 10 days of age affects intestinal morphometry, enzyme, serum indices and performance of broiler chickens. *Anim. Nutr.*, **3**: 258-265. <https://doi.org/10.1016/j.aninu.2017.06.005>
- Junqueira, O.M., Fonseca, L.E.C., Araujo, L.F., Duarte, K.F., Araujo, S., and Rodrigues, E.A.P., 2003. Feed restriction on performance and blood parameters of broilers fed diets with different sodium levels. *Br. J. Poult. Sci.*, **5**: 47-56. <https://doi.org/10.1590/S1516-635X2003000200003>
- Kamanlı, S., and Durmuş, İ., 2014. Method of chick quality evaluation and novel approach in increasing chick quality. *J. Poult. Res.*, **11**: 40-44.
- Kita, K., and Okuten, A., 2013. Influence of dietary rice grain replaced from corn on serum concentrations of amino acids in young chickens. *J. Poult. Sci.*, **50**: 114-119. <https://doi.org/10.2141/jpsa.011113>
- Lamot, D.M., Van Der Klein, S.A.S., Van De Linde, I.B., Witten, P.J.A., Kemp, B., Van der Brand, H., and Lammers, A., 2016. Effects of feed access after hatch and inclusion of fish oil and medium chain fatty acids in a pre-starter diet on broiler chicken growth performance and humoral immunity. *J. Anim. Sci.*, **10**: 1409-1416. <https://doi.org/10.1017/S1751731116000288>
- Leeson, S., 2008. Predictions for commercial poultry nutrition. *J. appl. Poult. Res.*, **17**: 315-322. <https://doi.org/10.3382/japr.2007-00101>
- Lilburn, M.S., 1998. Practical aspects of early nutrition for poultry. *J. appl. Poult. Res.*, **7**: 420-424. <https://doi.org/10.1093/japr/7.4.420>
- Longo, F.A., Menten, J.F.M., Pedroso, A.A., Figueiredo, A.N., Racanicci A.M.C., and Sorbara, J.O.B., 2007. Performance and carcass composition of broilers fed different carbohydrate and protein sources in the prestarter phase. *J. appl. Poult. Res.*, **16**: 171-177. <https://doi.org/10.1093/japr/16.2.171>
- Mahdavi, R., Karlovich, O.A. and Ficinin, V.I., 2017. Effects of supplying time of prestarter on subsequent broiler performance, carcass yield and intestinal morphometry. *Anim. Husb.*, **43**: 326-331. <https://doi.org/10.3103/S1068367417040103>
- Maiorka, A., Dahlke, F., and De Azevedo Morgulis, M.S.F., 2006. Broiler adaptation to post-hatching period. *Ciência Rural.*, **36**: 701-708. <https://doi.org/10.1590/S0103-84782006000200057>
- Mcloughlin, L., and Gous, R.M., 1999. The effect of egg size on pre-and post-natal growth of broiler chickens. *World Poult. Sci. J.*, **15**: 34-38.
- Mcquoid, D., 2000. Operation of multiple-stage and single-stage incubation systems. *World Poult. Sci. J.*, **18**: 18-22.
- Meijerhof, R., 2005. *What counts for chick quality?* The Poultry Site, Hybro B.V., Boxmeer, The Netherlands.
- Nabizadeh, A., Golian, A., Hassanabadi, A., and Zerehdaran, S., 2017. Effects of isolated soy protein and broken rice in corn-soy pre-starter diet on performance, intestinal microflora, and gut morphology in broiler chickens. *Poult. Sci. Assess.*, **27**: 133-144. <https://doi.org/10.3382/japr/pfx025>
- Omede, A.A., and Iji, P.A., 2017. Response of broiler chickens to processed soy protein product when offered at different inclusion levels in mash or crumbled prestarter diets. *Poult. Sci. Assess.*, **27**: 159-179. <https://doi.org/10.3382/japr/pfx048>
- Powell, J.C., and Bowman, J.C., 1964. An estimate of maternal effects in early growth characteristics and their effects upon comparative tests of chicken varieties. *Br. Poult. Sci.*, **5**: 12-132. <https://doi.org/10.1080/00071666408415524>
- Pretorius, C., 2011. *The effect of highly digestible carbohydrate and protein sources included in pre-starter diets of broilers on their performance.* PhD thesis, Stellenbosch University, Stellenbosch, South Africa.
- Reijrink, I., and Molenaar, R., 2006. *Chick length and Organ development.* HatcTech Incubation Technology.
- Rodrigueiro, R.J.B., Murakami, A.E., Pozza, P.C., Scapinello, C., and Moreira, I., 2000. Effect of two feeding prog on the performance and carcass yield of two commercial brands of broilers. *Rev. Bras. Zootec.*, **29**: 502-506. <https://doi.org/10.1590/S1516-35982000000200025>
- Ross (Aviagen), 2018. *Ross broiler management handbook preface.* Huntsville, AL, USA.
- Saleh, E.A., Watkins, S.E., and Waldroup, W., 1997. Changing time of feeding diets for broilers 2. Birds grown to 2.2 kg. *J. appl. Poult. Res.*, **6**: 64-73. <https://doi.org/10.1093/japr/6.1.64>
- Stringhini, J.H., Resende, A., Café, M.B., Leandro, N.S.M., and Andrade, M.A., 2003. Effect of the initial weight of the chicks and the prestarter diet period on the performance of broiler chickens. *Rev. Bras. Zootec.*, **32**: 353-360. <https://doi.org/10.1590/S1516-35982003000200014>
- Tabedian, S.A., Toghyani, M., Toghyani, A., Barekatin, M.R., and Toghyani, M., 2015. Effect of pre-starter diet ingredients and moisture content on performance, yolk sac utilization and small intestine morphology in broiler chickens. *J. appl. Poult. Res.*, **43**: 157-165. <https://doi.org/10.1080/0>

- 9712119.2014.928633
- Tona, K., Bamelis, F., De Ketelaere, B., Bruggeman, V., Moraes, V.M., Buyse, J., Onakbesan, O., and Decuyper, E., 2003. Effects of egg storage time on spread of hatch, chick quality, and chick juvenile growth. *Poult. Sci.*, **82**: 736–741. <https://doi.org/10.1093/ps/82.5.736>
- Tona, K., Onagbesan, O., Jago, Y., Kamers, B., Decuyper, E., and Bruggeman, V., 2004. Comparison of embryo physiological parameters during incubation, chick quality and growth performance of three lines of broiler breeders differing in genetic composition and growth rate. *Poult. Sci.*, **83**: 507–513. <https://doi.org/10.1093/ps/83.3.507>
- Tona, K., Bruggeman, V., Onagbesan, O., Bamelis, F., Gbeassor, M., Mertens, K., and Decuyper, E., 2005. Day-old chick quality: Relationship to hatching egg quality, adequate incubation practice and prediction of broiler performance. *Poult. Avian Biol. Rev.*, **16**: 109–119. <https://doi.org/10.3184/147020605783438787>
- Vieira, S.L., and Moran, E.T., 1999. Effects of egg of origin and chick post-hatch nutrition on broiler live performance and meat yields. *World Poult. Sci. J.*, **55**: 125-142. <https://doi.org/10.1079/WPS19990009>
- Wolanski, N.J., Luiten, E.J., Meijerhof, R., and Vereijken, A.L.J., 2003. Yolk utilisation and chick length as parameters for embryo development. *Poult. Avian Biol. Rev.*, **15**: 233–234. <https://doi.org/10.3184/147020604783637877>

Online First Article

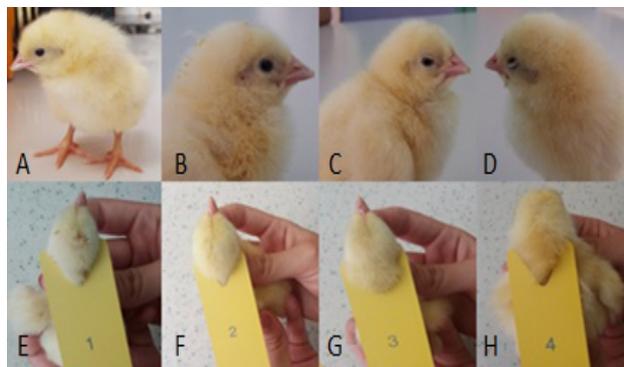


## Supplementary Material

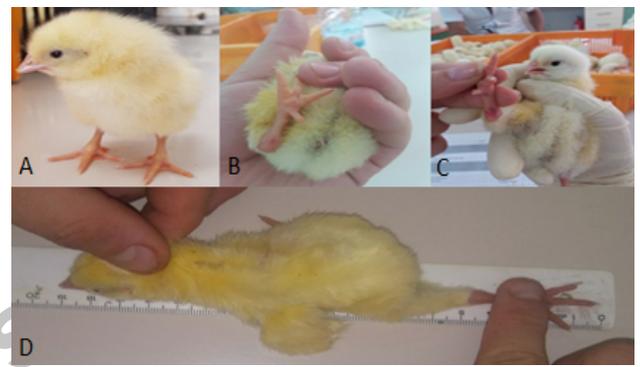
# Effects of Chick Quality and Pre-Starter Feed on Fattening Performance and Carcass Characteristics of Broilers

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Supplementary Fig. 1. Eye condition (A): Perfect eye, Score = 30; (B): Clear but matt eye, Score = 15; (C): Low or matt eye, Score = 15; (D): Fully enclosed eye, Score = 0) and feather color (E: DSM-S 1, Score = 10; F: DSM-S 2, Score = 15; G: DSM-S 3, Score = 15; H: DSM-S 4, Score = 20).



Supplementary Fig. 2. Leg structure (A): Perfect leg, Score = 30; (B): Redness on the leg, Score = 15; (C): Bruising on the leg, Score = 15) and chick length (D: Short chick length (less than 19.2 cm), Score = 0; Medium chick length (between 19.2-19.6 cm), Score = 10; Long chick length (longer than 19.6 cm), Score = 20).

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0030-9923/2022/0001-0001 \$ 9.00/0



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**Supplementary Table I. Ingredient of the feeds used in the experiment.**

Ingredients (g/kg)	Starter	Grower	Finisher
Corn	450.70	481.80	536.10
Soybean meal-46	239.70	166.10	96.50
Full-fat soybean	160.70	198.30	210.00
Wheat Flour-feed grade (46-52)	50.00	70.00	80.00
Corn Gluten Meal-60	30.10	19.20	15.00
Sunflower Meal-34	20.00	20.00	25.00
Meat-Bone Meal-35	20.00	20.00	17.50
Limestone (Granule)	6.70	5.90	5.50
Di-Calcium Phosphate-18	5.00	2.40	-
Lysine Sulphate	4.10	3.80	3.60
Common Salt	2.70	2.50	2.50
Toxin Binder	2.00	2.00	1.50
Liquid Methionine (MHA)	1.80	1.70	1.50
DL-Methionine	1.50	1.50	1.30
L-Threonine	1.10	0.90	0.70
Trace Mineral Mixture <sup>a</sup>	1.00	1.00	1.00
Vitamin Mixture <sup>b</sup>	1.00	1.00	1.00
Cocciostat (Maxiban)	0.60	0.60	-
Sodium bicarbonate	0.50	0.50	0.50
Choline	0.50	0.50	0.50
Organic acid (Biacid)	0.30	0.30	0.30

(a) Each kg of trace mineral mixture contains 100.000 mg Manganese, 80.000 mg Iron, 80.000 mg Zinc, 8.000 mg Copper, 200 mg Cobalt, 1000 mg Iodine, 150 mg selenium (sodium selenite), 500.000 choline chloride.

(b) Each kg of vitamin mixture contains 13.500.000 IU Vitamin A, 4.000.000 IU Vitamin D<sub>3</sub>, 100.000 mg vitamin E, 5.000 mg Vitamin K<sub>3</sub>, 3.000 mg Vitamin B<sub>1</sub>, 8.000 mg Vitamin B<sub>2</sub>, 60.000 mg Niacin, 18.000 mg Ca-D-Pantotenate, 5.000 mg Vitamin B<sub>6</sub>, 30 mg Vitamin B<sub>12</sub>, 2.000 mg Folic Acid, 200 mg D-Biotin ve 100.000 mg Vitamin C.

**Supplementary Table II. Nutrient compositions of the feeds used in the experiment.**

Nutrients (g/kg)	Starter	Grower	Finisher
Dry matter	883.10	881.90	880.10
Crude protein	247.30	225.20	199.90
Crude fiber	37.80	36.30	34.90
Ether Extract	56.90	65.70	78.80
Crude Ash	55.50	50.60	44.40
Starch	323.00	351.40	384.00
Metabolizable energy (Kcal/Kg)	2980	3070	3200
Lysine	14.50	13.10	11.50
Metionine	6.90	6.20	5.20
Metionine + Cystine	11.00	9.90	8.60
Threonine	10.30	9.20	8.00
Valine	11.30	10.10	9.20
Isoeucine	10.10	9.00	8.20
Arginine	15.10	13.60	12.80
Tryptophan	3.00	2.70	2.50
Leucine	15.90	14.40	12.60
Calcium	8.90	7.90	6.80
Total phosphorus	7.60	7.00	6.30
Available phosphorus	4.50	4.10	3.50
Sodium	1.70	1.60	1.60