Estimation of optimum slaughter age in broiler chicks

Hasan Cicek* and Murat Tandogan

Department of Animal Health Economics and Management,
Faculty of Veterinary Medicine, Afyon Kocatepe University, 03200, Afyonkarahisar, Turkey

ABSTRACT
In this study, optimum slaughter age of the commercial broilers was estimated regarding maximum net income. Study materials were average target performance (live weight gain and feed consumption) of Cobb 500 and Ross 308 commercial hybrids, prices of feed, chicks and broiler meat. The optimum slaughter age was estimated by a mathematical function \( y = f(x) = a + bx - cx^2 \) that reflects the quadratic (parabolic) relationship. According to this function, the optimum slaughter age was calculated as 5.62 weeks (39.34 days). As a result, it can be said that genetic improvement positively affects the correlation between live weight gain and feed consumption of broilers. However, prices of feed, chicks, and broiler meat have more decisive role on slaughter age.

Key words: Broiler, Cobb 500, Mathematical function, Ross 308, Slaughter age.

INTRODUCTION
Commercial broiler breeding has a shorter production period compared to other animal production. The production period is completed in 6-7 weeks in broiler breeding. However, this period takes 3-12 months in cattle breeding. Genetic studies have provided significant improvements in live weight performance of broiler chicks and have led to the decline of the slaughter age. Through these studies, it was reported that slaughter age decreased average 0.75 days each year (Szőllősi et al., 2014).

When the subject is evaluated in terms of production economics, it can be said that slaughter age is important for costs and product income. Prolongation of slaughter age can be seen as an advantage for live weight gain and broiler meat income. Nevertheless, this situation reduces the productivity; it leads to increased costs (Schmidt, 2008). Because the daily live weight gain of broiler chicks decreased after a certain period of time, it continues to increase in feed consumption and other inputs. This situation can be explained with the input-output relations in production. It is observed that yield amount does not increase as linearly with the increase of input amount. On the contrary, a decreasingly growing of yield amount was observed. In economies, this issue is called as “The Law of Diminishing Returns” (Müftüoğlu, 1999). In accordance with this law, the production should be ceased when the maximum income is reached.

Optimum slaughter age can be determined for broiler chicks with a mathematical function. The time that ensures the maximum net income can be predicted by creating a mathematical function between net income and production period (Oguz and Parlat, 2003; Dagdemir et al., 2007). For this purpose, it is possible to make use of feed, a day old chick and broiler meat prices. Because, 80-86% of the costs in broiler production consists of feed and a day old chick input (Van Horne and Bondt, 2013).

MATERIALS AND METHODS
The study materials were average of target performance (live weight gain and feed consumption) value of commercial hybrids Cobb 500 and Ross 308 (Aviagen, 2014; Cobb-Vantress, 2012). Besides, prices of feed (0.394€/kg), a day old chick (0.336€/head) and broiler meat (2.324€/kg) were used in the calculation (Tandogan and Çiçek, 2014; TSI, 2014).

The optimum slaughter age was estimated with a mathematical function \( y = f(x) = a + bx - cx^2 \) which presents parabolic relation (Tari, 2010). In this function, the relation is not linear between “y” and “x”. Therefore, the model was converted to a standard linear format \( Y = b_0 + b_1X_1 + b_2X_2 + u \) and slaughter age was analysed using “Least Squares” method. In this model, net income \( (Y) \) and production period \( (X) \) express dependent and independent variable, respectively. Equality of \( dY/dX = 0 \) was used to determine the time that provides maximum net income (Tari, 2010).

RESULTS AND DISCUSSION
The mean target live weight gain (TLWG), cumulative target live weight gain (CTLWG), mean target feed intake (TFI), feed cost (FC) and cumulative day old chick cost (CDCC) of Cobb 500 and Ross 308 commercial hybrids...
hybrids were presented in Table 1. Chick meat income (CMI), feed + chick costs (FCC) and net income (NI) were presented Table 2.

In both tables, it was shown that feed cost is constantly increasing along with an increment of feed consumption. However, a decrease of live weight gain was observed after 6th weeks which causes the decrease of sales income.

The following function was obtained as a result of analysis using the Least Squares method:

\[ y = f(x) = -0.420 + 0.472x - 0.042x^2 \]

(SE): (0.029) (0.016) (0.002)

(Adj. R²): (0.997)

Production time that provides maximum net income:

\[ \frac{dy}{dx} = 0.472 - 0.084x = 0 \]

\[ x = 5.62 \text{ week (39.34 day)} \]

Broiler chicks should be sent to slaughter 40th days according to the target performance values, feed, a day old chick and broiler meat prices that used in the calculations. Maximum net income is that determined the optimal slaughter age:

\[ y = f(x) = -0.420 + 0.472(5.62) - 0.042(5.62)^2 \]

\[ y = 0.906€ \]

It can be said that obtained slaughter age is fit with other research findings that used the same method (Oguz and Parlat, 2003; Dagdemir et al., 2007). Optimum slaughter age was calculated about 41 days in the mentioned studies. Nonetheless, the optimum slaughter age was found 40 days for male chicks in another research. It is expressed that sex difference is affected by physiological and nutritional requirements. Therefore, female chicks’ FCR values were higher than male chicks. For this reason, it raises the cost of feeding and slaughter age for female chicks (Samarakoon and Samarasinghe, 2012).

FCR and live weight gain are two important performance indicators that affects slaughter age. FCR has a major role in the improvement of growth productivity and decreasing of production costs (Marcu et al., 2013). Broiler chicks reach to the determined live weight with less time and lower FCR value through genetic progress. Today, it is known that male chicks reach to 2 kg live weight at 28-30 day with 1.4 FCR. Besides, it is estimated that chicks will reach to 2.3 kg live weight at 34 day with 1.37 FCR in 2022 (Szöllősi et al., 2014).

It was reported that two other studies used the same method at the end of 6th week and it was reached to 1.957 kg and 1.967 kg live weight with  as 1.75 and 1.87 FCR values, respectively (Oguz and Parlat, 2003; Dagdemir et al., 2007). In this study, it was estimated that will reach to  the average 2.771 kg target live weight with 1.70 FCR value at the end of 6th week. The less feed consumption for gaining more live weight for the same time shows that genetic performance is effective for decreasing of the slaughter age. Because, in this study, the input (feed + a day old chick) and output (broiler meat) prices were higher than the other two studies. Live weight gain is a function of the income. It is possible to reach to maximum net income at an increment of daily live weight which is the highest point. It is seen that increases of daily target live weights for Cobb 500 and Ross 308 which reached to the highest value (665/7: 95 g) at 6th week (36th-42nd days) (Aviagen, 2014; Cobb-Vantress, 2012). After the 6th week, live weight gain is reduced (No. 1 column in Table

---

### Table 1: Mean target performance values and costs for Cobb500 and Ross308 hybrids

<table>
<thead>
<tr>
<th>Week</th>
<th>TLWG (kg/week)</th>
<th>CTLWG (kg/week)</th>
<th>TFI (kg/week)</th>
<th>FC(€*/week)</th>
<th>CDCC(€*/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.183</td>
<td>0.183</td>
<td>0.158</td>
<td>0.062</td>
<td>0.336</td>
</tr>
<tr>
<td>2</td>
<td>0.287</td>
<td>0.470</td>
<td>0.344</td>
<td>0.136</td>
<td>0.205</td>
</tr>
<tr>
<td>3</td>
<td>0.441</td>
<td>0.910</td>
<td>0.616</td>
<td>0.243</td>
<td>0.163</td>
</tr>
<tr>
<td>4</td>
<td>0.559</td>
<td>1.469</td>
<td>0.923</td>
<td>0.364</td>
<td>0.128</td>
</tr>
<tr>
<td>5</td>
<td>0.637</td>
<td>2.106</td>
<td>1.228</td>
<td>0.484</td>
<td>0.102</td>
</tr>
<tr>
<td>6</td>
<td>0.665</td>
<td>2.771</td>
<td>1.432</td>
<td>0.564</td>
<td>0.081</td>
</tr>
<tr>
<td>7</td>
<td>0.643</td>
<td>3.413</td>
<td>1.552</td>
<td>0.611</td>
<td>0.063</td>
</tr>
</tbody>
</table>

*1€= 2.3282 Turkish Lira

### Table 2: Weekly income, costs and net income

<table>
<thead>
<tr>
<th>Week</th>
<th>TLWG (kg/week)</th>
<th>CMI(€/week)</th>
<th>FCC(€/week)</th>
<th>NI(€/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.183</td>
<td>0.425</td>
<td>0.398</td>
<td>0.027</td>
</tr>
<tr>
<td>2</td>
<td>0.287</td>
<td>0.667</td>
<td>0.341</td>
<td>0.326</td>
</tr>
<tr>
<td>3</td>
<td>0.441</td>
<td>1.025</td>
<td>0.406</td>
<td>0.619</td>
</tr>
<tr>
<td>4</td>
<td>0.559</td>
<td>1.299</td>
<td>0.492</td>
<td>0.807</td>
</tr>
<tr>
<td>5</td>
<td>0.637</td>
<td>1.480</td>
<td>0.586</td>
<td>0.894</td>
</tr>
<tr>
<td>6</td>
<td>0.665</td>
<td>1.545</td>
<td>0.645</td>
<td>0.900</td>
</tr>
<tr>
<td>7</td>
<td>0.643</td>
<td>1.494</td>
<td>0.674</td>
<td>0.820</td>
</tr>
</tbody>
</table>
Therefore, the determination of the maximum net income obtained on the day of the 6th week and dispatching of chicks to the slaughter are important for a profitable and productive production.

Efforts are reached the target value in live weight gain and feed consumption under field conditions, but it is often not possible. Herd size, stocking density, temperature, light, feed and water factors are affecting the production performance (Esmail, 2013). It was found that 2.436 kg live weight was reached in 42 days with 1.805 FCR value in a study that conducted between 2012-2013 years in Balikesir, Bolu and Sakarya in Turkey (Tandogan and Çiçek, 2014). In our research, it is recommended that dispatching the average 2.486 kg live weight of to 1.638 FCR value (target values in 39th day) to the slaughter in terms of maximum net income, according to feed, a day old chick and broiler meat prices that used in the calculation. Taking into account of other input costs, the optimum slaughter age is determined at a point close to live weight under field conditions. However, it is understood that is consumed more feed (FCR: 1.805) to reach the live weight in the field conditions. In this situation, slaughter age is found to be increased, net income is found to be decreased.

As a result, it can be said that the genetic improvement positively affects correlation between broiler chicks live weight gain and feed consumption. However, feed, a day old chick and broiler meat prices have a more decisive role on the slaughter age. In parallel with the positive developments in the broiler chicks production performance, optimum slaughter age should always be calculated based on input and output prices.

ACKNOWLEDGEMENTS

This research was supported by Afyon Kocatepe University, Scientific Research Coordination Unit (Project no: 15.HIZ.DES.11). This article was also presented in the 3rd International Poultry Meat Congress (22-26 April 2015, Antalya, Turkey).

REFERENCES

Aviagen. (2014). Ross 308 broiler performance objectives. USA, pp. 3