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COMPARATIVE ANALYSIS OF GROWTH PERFORMANCE AND PROFITABILITY OF FOUR BROILER COMMERCIAL STRAINS RAISED IN EGYPT

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ABSTRACT:The aim of this study was to assess the growth performance and profitability of four broiler strains raised in Egypt to identify which strains were most effective and profitable for broiler production in this region. A total of 24000 one-day-old chicks were separately allocated to 4 strain broiler groups: Cobb-500, Avian-48, Ross-308, and Indian River (IR), of the same age and size were used for the study. Each strain group was reared and housed in separate buildings under the same conditions with free access to feed and water. Each strain represented by 6000 birds, divided into five replicates of 1200 broiler chicks per replicate, and was randomly distributed in a completely randomized design into four groups reared to 42 days of age. Live body weight (LBW) and body weight gain (BWG) were recorded weekly. Also, feed consumption (FC), feed conversion ratio (FCR), and livability (%) were determined. The production efficiency factor (PEF), economic indices, and cost-benefit analysis were calculated to assess the profitability of each studied strain group. The results showed that there are significant differences in growth performance and other traits among the four broiler strains. The findings indicated that the Avian-48 and Cobb-500 strains were the most effective and profitable for broiler production under Egyptian conditions. In addition, the IR strain also showed good growth performance and feed efficiency. In conclusion, the study provides valuable insights into the performance and profitability of different broiler strains under Egyptian conditions, which can help inform decision-making in broiler production. By selecting the most effective and profitable broiler strains, producers can optimize their operations and potentially increase their profitability.

Keywords: Broiler strains, Growth performance, Cost-benefit, Profitability

INTRODUCTION

Over the past few decades, human consumption patterns have caused unparalleled alterations to the biosphere of the Earth, resulting in a decrease in the populations of various groups of wild animals (Kareem-Ibrahim *et al*., 2021), In contrast, the populations of both humans and livestock have increased. By 2050, the global population is projected to approach 10 billion people, with developing countries expected to experience the largest increase (United Nation, 2019). Therefore, the production of animal protein, especially in the food sector, is essential for ensuring food and nutritional security. The poultry industry has emerged as a vital player in the agricultural sector in many countries across the world. Moreover, compared to red meat, chicken meat is an inexpensive and high-quality source of protein that contains less cholesterol (Al-Dawood and Al-Atiyat, 2022).The poultry industry is growing rapidly due to increasing demand for meat and eggs driven by population growth, rising incomes, and urbanization. Poultry has short production cycles and can utilize a range of agri-food byproducts and wastes to produce edible meat and eggs (Mottet and Tempio, 2017). The success of poultry production is attributed to successful selection programs for rapid growth and body conformation, leading to the development of current commercial broiler chicken strains (Abdullah *et al*., 2010).

Compared to other livestock sub-sectors, poultry is the most efficient in utilizing natural resources. and is vital in meeting the increasing global demand for protein (Mottet and Tempio, 2017). Compared to other meat-producing animals, the modern broiler chicken is efficient, fast-growing, and can quickly fulfill protein requirements. It can be produced in the shortest possible time, making it a valuable source of protein to address shortages in protein supply (Husna *et al*., 2017). In this respect, the Egyptian broiler industry is a promising sector for agricultural investment due to its large internal market for poultry meat consumption, which has the potential for further expansion driven by population growth and increasing per capita consumption linked to the overall improvement of the country's economy (Shatokhin *et al*., 2017). The total production of chicken meat in Egypt is 1339068 metric tons, and the country has achieved a self-sufficiency ratio of 95% (Faostat, 2020).

Over the years, several broiler strains have been developed to achieve optimal meat production. To describe the growth pattern of live body weight, growth curve functions have proven to be a suitable method (Al-Dawood and Al-Atiyat, 2022). Additionally, advancements in poultry nutrition and genetics have resulted in a significant increase in body weight gain and a remarkable improvement in the feed conversion ratio of broiler strains (Husna *et al*., 2017). Advancements in breeding and nutrition have led to broiler strains that exhibit higher performance levels than ever before.

The broiler breeder strains that are typically utilized by the broiler industry in Egypt are Ross-308, Cobb-500, Avian-48, Indian River, Hubbard Classic, Starbro, and Arbor Acres. The productivity and adaptability of fast-growing broiler strains can be impacted by environmental factors such as temperature, humidity, and diseases. Climate stress can also impact their performance and adaptability, particularly in tropical environments where extreme heat may be unsuitable for fast-growing broiler strains (Hossain *et al*. 2011). However, the performance parameters of broiler strains, including production potential, disease resistance, and adaptability to Egyptian conditions, may negatively impact farmer preferences. Environmental factors and other incidents can also significantly affect the productivity and livability of these strains (Al-Dawood, 2016; Al-Dawood and Al-Atiyat, 2022).

The performance and management information provided by the breeder's company literature may not apply to the specific regional environmental conditions of a country (Rehman *et al*., 2018). Although modern broiler strains have experienced substantial growth and advancement worldwide, the insufficient availability of high-quality animal protein continues to be a major global issue. To address this issue and improve broiler chicken productivity, a study was conducted to evaluate the performance parameters and livability of four broiler strains, including Cobb-500, Avian-48, Ross-308, and Indian River, in Egypt.

MATERIAL AND METHODS

Ethical statement and experimental site

The Institutional Animal Care and Use Committee granted approval for all animal care procedures carried out in AU-IACUC, Alexandria University, Egypt with the review report number AU082301243128. Birds were handled with care during the experiment. The current study was carried out from May to June 2022 at a private commercial broilers farm and it was performed for six successive weeks in a semi-controlled broiler chicken house located in Nahda district region affiliated to Amiriya city (31°00′43″N 29°48′23″E) , Alexandria governorate, Egypt.

Birds, housing, and diet.

Four stains of day-old commercial broiler birds representing four broiler strains (Cobb-500, Avian-48, Ross-308, and (IR) Indian River) were acquired from different reputable local hatcheries. The birds were vaccinated against Newcastle, Infectious Bursal, and Infectious Bronchitis diseases as required, and any deaths were documented.

All birds were reared and housed in separate buildings under the same conditions with free access to feed and water. The birds were kept in a cleaned and fumigated ground floor with a controlled environmental room under similar managerial conditions. The chicks were reared in a semi-controlled, ventilated house with suitable litter at a stocking density of 12 birds/m^2. Every shed contained an adequate amount of feeders and drinkers for proper feeding and drinking. To ensure a comfortable atmosphere for the birds, a layer of wood shavings measuring 2 cm in depth was spread across the floor of each shed. Feeders were meticulously cleaned on a daily basis prior to providing diets, and drinkers were washed on a weekly basis to uphold sanitary conditions for the birds. During the initial week, the room temperature was regulated at 34°C, which was gradually decreased to 21-23°C by the 21st day. A light schedule similar to that of the commercial setting was implemented, with 23 hours of light from day one to day seven, followed by 20 hours of light from day eight until the conclusion of the experiment at 42 days.

Birds were fed the starter diet from 0 to 21 days, and the grower diet was used for the rest of the experiment period (22 to 42 days). Nutrients and energy protein levels of the experimental diets met or exceeded nutrient requirements according to NRC (1994). The ingredients and calculated analysis of the experimental diets are shown in Table 1. Feed was provided ad libitum and the birds had free access to water.

Experimental plan and data collection

A total of 24000 one-day-old chicks were separately allocated to 4 strain groups: Cobb-500, Avian-48, Ross-308, and IR, broiler strains of the same age and size were used for the study. Each strain group was reared and housed in separate buildings under the same conditions with free access to feed and water. At the start of the experiment, 6000 broiler chicks were allocated to each strain, divided into five replicates with 1200 chicks per replicate and housed at a stocking density of 12 birds/m^2. To minimize differences in mean values, each strain group was assigned five replicates based on a completely randomized design.

Before the experiment began, the average weight and variability within each strain group were examined, and no differences (P>0.05) in the initial weights among the four strain groups were obtained. This was done to ensure that all four breeds had comparable weights prior to the start of the experiment. The birds in each strain group were weighed in a group at the beginning of the trial and then every week at the age of day 1, 7, 14, 21, 28, 35, and 42. Weighing was done using an electric balance before supplying feed in the morning of each week.

During the experimental period, the live body weight (LBW) of each bird group was measured weekly in terms of mass (weight) per bird. The LBW (kg/bird) of each strain group was determined by weighing the birds as soon as they arrived at the farm and then weekly for six consecutive weeks. The body weight gain (BWG) of broilers in each replicate was calculated by subtraction between initial body weight and final body weight for each period. The body weight gain was calculated as per the following equation:

BWG (grams on period) = LBW (g) at the end period - LBW (g) in the first period

Feed offered was recorded when supplied and residual every week. Feed consumption and feed conversion ratio were counted. Throughout the rearing period, the feed intake (FC; g/bird) was measured weekly by recording the difference between the feed supplied and the remaining feed in each feeder. At the conclusion of the experiment, the total feed consumption (FC) was calculated by weighing the feed at the same time as the birds were evaluated. The feed conversion ratio was calculated at the end of the investigation as the amount of feed consumed per unit of body gain (g feed/g gain). The feed consumption (FC) and feed conversion ratio (FCR) were calculated as per the following equations:

$$\text{Feed consumption (FC/bird)} = \frac{\text{The amount of feed offered} - \text{feed residues}}{\text{Number of birds in each replicate}}$$

$$\text{Feed conversion ratio (FCR)} = \frac{\text{feed intake(g)}}{\text{body weight gain(g)}}$$

At the conclusion of the experiment, the livability rate (%) was calculated by dividing the number of live birds by the total number of birds at the beginning of the experiment. The resulting quotient was then multiplied by 100 to yield the livability rate.

The production efficiency factor (PEF) was calculated during the first period from 0 to 21 days and at the end of the experimental period. The following equation was applied to obtain the production efficiency factor (Lemme *et al.*, 2006) as follows:

$$PEF= \frac{final\ bird\ weight(kg)\times livability(\%)}{\text{age days}\times\text{feed conversion ratio}}\times 100$$

Finally, Economic indices and cost-benefit analysis to assess the profitability of each studied strain group used in this trial were calculated, the management factors in this regard are considered constant. All prices of dietary ingredients containing diets were calculated according to the price of the local market at the time of the study in the year 2022 by the Egyptian pound (L.E.). In that, cost per kg body gain, total return, net revenue, cost index, and relative economic efficiency were calculated.

Statistical analysis

The experimental design was completely randomized, and GLM procedure (SAS, 2009) was used to analyze the data of growth performance parameters according to the following model:

$Y_{ij} = \mu + B_i + e_{ij}$

Where: Y_{ij} = an observation on each studied traits, μ = the overall mean, B_i = the fixed effect of i^{th} breed, and e_{ij}= the residual error.

Also, for body weight and body weight gain during the experimental periods, the following model was used to describe an observation:

$Y_{ijk} = \mu + B_i + T_j + B_iT_j + e_{ijk}$

Where: Y_{ijk} = an observation on body weight and body weight gain, μ = the overall mean, B_i = the fixed effect of i^{th} breed, T_j = the fixed effect of j^{th} time, B_iT_j = the interaction effect between breed and time, and e_{ijk}= the residual error.

Besides, Duncan's multiple-range test (Duncan, 1955) was used to compare between means at P≤0.05 significant level.

RESULTS

Growth Performance

Table 2 displays the growth performance of four different broiler strains during the first period from (1-21) days of age. When considering the BW, the IR strain had the highest mean BW of 975.50 g. This result was significantly higher than that of Avian-48, Cobb-500, and Ross-308 strains. This indicates that the IR strain may have superior growth performance compared to the other strains. Similarly, the BWG showed that Avian-48 and IR had the highest mean values of 482.75 g and 475.50 g, respectively. This suggests that these strains may have faster growth rates than Cobb-500 and Ross-308.

The FCR showed no significant differences between the strains, with all values falling within a narrow range of 1.29 to 1.37. This suggests that the different strains may have similar feed efficiency. In terms of FC, IR had the highest mean value of 1200.00 g, significantly higher than that of Cobb-500, Ross-308, and Avian-48. This suggests that the IR strain may have a higher FC than the other strains.

Ross-308 had the highest mean value for livability at 98.50%, which was significantly higher than that of IR, but not significantly different from Avian-48 and Cobb-500. This indicates that Ross-308 may have better overall survival rates than IR, although all the strains had relatively high survival rates. The mortality showed a similar trend, with Ross-308 having the lowest mean value of 1.50%, which was significantly lower than that of IR, but not significantly different from Avian-48 and Cobb-500. This suggests that Ross-308 may have lower mortality rates than IR, although all the strains had relatively low mortality rates.

Finally, the PEF showed that IR had the highest mean value of 175.39, significantly higher than that of Cobb-500 and Ross-308, but not significantly different from Avian-48. This indicates that the IR strain may have better overall feed efficiency and growth performance compared to the other strains.

Table 3 indicates the growth performance of four different broiler strains throughout the second period from (22-42) days of age. Looking at the BW, Avian-48 had the highest mean BW of 2375.00 g, which was significantly higher than that of Cobb-500, IR, and Ross-308. This suggests that Avian-48 may have superior growth performance compared to the other strains. Similarly, the BWG showed that Avian-48 had the highest mean value of 1478.75 g, significantly higher than that of IR, Cobb-500, and Ross-308. This indicates that Avian-48 may have faster growth rates than the other strains, which could have important implications for the broiler industry in terms of reducing production costs and improving profits.

The FCR showed that Avian-48 and Cobb-500 had the lowest mean values, indicating that these strains may have better feed efficiency compared to IR and Ross-308. This suggests that Avian-48 and Cobb-500 may be more efficient at converting feed into BWG, which could lead to lower production costs and improved profitability. In terms of FC, IR had the highest mean value, significantly higher than that of Cobb-500, Ross-308, and Avian-48. In the same manner, the Ross-308 strain had the lowest mean value of FC. This suggests that IR may have a higher FC than the other strains, which is reflected positively in BW and BWG.

For the livability and mortality, Avian-48, and IR had the highest and second-highest mean values for livability, respectively, suggesting that these strains may have better overall survival rates compared to Cobb-500 and Ross-308. Similarly, Cobb-500 had the lowest mean value for mortality, indicating that this strain may have lower mortality rates than the other strains. Finally, the PEF showed that Avian-48 and Cobb-500 had the highest mean values, indicating that these strains may have better overall feed efficiency and growth performance compared to IR and Ross-308.

Table 4 depicts the growth performance of four distinct broiler strains throughout the complete period from day 1 to day 42 of age. The Avian-48 strain had the highest FBW of 2375 g, followed by IR, Cobb-500, and Ross-308 strains. The differences between the strains were statistically significant, with $P<0.001$. This suggests that Avian-48 may have superior growth performance compared to the other strains. In the same line, the BWG of Avian-48 had the highest mean BWG of 2335 g, followed by IR, Cobb-500, and Ross-308 strains. The differences between the strains were statistically significant, with $P<0.001$. This indicates that Avian-48 may have faster growth rates than the other strains, which could lead to reduced production costs and improved profits. On the same hand, Avian-48 and Cobb-500 had the lowest FCRs of 1.54 and 1.57, respectively, indicating that these strains may have better feed efficiency compared to IR and Ross-308 which had the highest FCRs of 1.63 and 1.62, respectively. The differences between the strains were statistically significant, with $P=0.004$.

This suggests that Avian-48 and Cobb-500 may be more efficient in converting feed into BWG, which could lead to lower production costs and improved profitability.

IR strain had the highest FC of 3700 g, followed by Avian-48, Cobb-500, and Ross-308. The differences between the strains were statistically significant, with P<0.001. This suggests that the IR strain may have a higher FC than the other strains, this result in a positive impact on both the BW and the rate of weight gain. In contrast, the Cobb-500 strain had the highest livability rate of 92%, followed by IR, Avian-48, and Ross-308 strains. The differences between the strains were statistically significant, with P<0.001. This suggests that Cobb-500 may have better overall survival rates compared to the other strains. Also, the Cobb-500 strain had the lowest mean mortality rate of 8%, followed by Avian-48, IR, and Ross-308 strains. The differences between the strains were statistically significant, with P=0.002. This indicates that Cobb-500 may have an advantage in terms of overall production efficiency and profitability.

The Avian-48 strain had the highest mean PEF of 330.40, followed by Cobb-500, IR, and Ross-308 strains. The differences between the strains were statistically significant, with P=0.0002. This suggests that Avian-48 may have the best overall feed efficiency and growth performance, which could lead to improved profitability.

Table 5 shows the BW and BWG of four different broiler strains during the growth periods of the experiment. To elaborate further on the data presented in this table, it is important to note that the four different strains of broiler chickens (Avian-48, Cobb-500, IR, and Ross-308) were evaluated for their BW and BWG at seven different time points during the growth period, ranging from 1 to 42 days of age. To provide more information on the BW and BWG values of the four different broiler strains at different time points, the table shows that;

At 7 days of age, there are significant differences among broiler strains. The Ross-308 strain had the highest BW and BWG values (203.93g, 161.93g) respectively, while the Avian-48 strain had the lowest values (127g, 87g) respectively.

At 14 days of age, there are significant differences among broiler strains. The Avian-48 strain still had the lowest BW value 413.5 g and the Cobb-500 strain had the lowest BWG value 277.23 g, while the Ross-308 strain had the highest BW and BWG values 547.5 g, 343.58 g respectively.

At 21 days of age, there are significant differences among broiler strains. The IR strain had the highest BW value, followed by the Ross-308, Avian-48, and Cobb-500 strains. Although the Avian-48 strain had the highest BWG value, followed by the IR, Ross-308, and Cobb-500 strains.

At 28 days of age, there are significant differences among broiler strains. The IR strain had the highest BW value, followed by the Avian-48, Ross-308, and Cobb-500 strains. But in terms of BWG, it appears that the IR strain had the highest BWG value, followed by the Avian-48, Cobb-500, and Ross-308.

At 35 days of age, there are significant differences among broiler strains. The Cobb-500 strain had the highest BW value and was followed by the Avian-48, IR, and Ross-308 strains, in that order. Similarly, the Cobb-500 strain had the highest BWG value, followed by the

Avian-48, Ross-308, and IR strains, in that order.

At 42 days of age, there are significant differences among broiler strains. The Avian-48 strain had the highest BW value, which was higher than all other strains at that time point. The IR strain had the second-highest BW value, followed by the Cobb-500 and Ross-308 strains. The Avian-48 strain also had the highest BWG value at 42 days of age, followed by the IR, Ross-308, and Cobb-500 strains.

Economic Evaluation

Economic evaluation (economic indices) of different broiler strains throughout the overall period from (1-42) days of age are shown in Table 6. The ultimate aim of the present study was to assess economic parameters and compare them among various broiler strains. This table presents economic indices for four different strains of broiler chickens (Avian-48, Cobb-500, IR, and Ross-308) during the overall period from 1-42 days of age. The economic indices include feed consumption, feed cost, selling price, feed cost per kg gain, cost index, net revenue, economic efficiency (EE), and relative economic efficiency (REE).

From the data, it appears that the Ross-308 strain had the lowest FC (3.37 kg) and feed cost (38.76 L.E.), whiles the Avian-48 strain had the lowest feed cost per kg gain (17.73 L.E.). The IR strain had the highest FC (3.70 kg) and feed cost (42.55 L.E.). The Cobb-500 strain had intermediate values for most economic indices.

In terms of economic efficiency, the Avian-48 strain had the highest value (0.86), followed by the Cobb-500, Ross-308, and IR strains. The REE index compares the economic efficiency of each strain to that of the IR strain (which is assigned a value of 100%). The Avian-48 strain had the highest REE value (113.36%), indicating that it was the most economically efficient strain compared to the IR strain. The Cobb-500 and Ross-308 strains had REE values of 109.35% and 101.41%, respectively, while the IR strain had an REE value of 100%.

The cost index is a measure of the overall cost of production and is calculated as the ratio of total feed cost to total revenue. The IR strain had the highest cost index at 100%, while the Avian-48, Cobb-500, and Ross-308 strains had cost index values of 94.55%, 96.12%, and 99.39%, respectively.

The net revenue is the amount of revenue generated after subtracting the total feed cost from the total revenue. The Avian-48 strain had the highest net revenue at 35.66 L.E., followed by the Cobb-500, IR, and Ross-308 strains with net revenue values of 33.44 L.E., 32.33 L.E., and 29.86 L.E., respectively.

DISCUSSION

Modern poultry farming aims to intensify production and attain more favorable performance traits (Jarosz *et al.*, 2022). For that, in the last several years, the production of poultry in Egypt has undergone a transition from being primarily an agricultural activity to becoming a full-fledged industry. This shift has been driven by the rising demand among consumers for animal protein that is both affordable and accessible. As a result, there has been a notable increase in the production of broiler chicken meat throughout the country (Bassyouni *et al*., 2021).

The poultry sector has emerged as a key industry in promoting food security in Egypt (Galal, 2019). In Egypt, broiler production has grown rapidly over the past few decades and is now one of the most important sectors in the poultry industry. The country's large internal market for poultry meat consumption makes it an attractive industry for investors, with the potential for further expansion driven by population growth and an increase in per capita consumption due to a general improvement in the country's economy (Shatokhin *et al*., 2017). To encourage poultry farming worldwide, it is necessary to identify broiler bird strains that exhibit high production performance and livability (Kalia *et al*., 2017).

The results of the current study showed that there are significant differences in growth performance and other traits among the four broiler strains, which can have important implications for the broiler industry. The results showed that IR and Ross-308 strains may have superior growth performance and overall feed efficiency during the first period (1-21) days of age compared to Avian-48 and Cobb-500 strains, although the latter two strains may have better performance parameters and feed efficiency during the second period (22-42) days of age. This is consistent with the findings of (Benyi *et al*., 2015a , b). Al -Marzooqi *et al*. (2019), also showed that the Ross-308 strain had the highest BW and BWG at 21 days of age, but Cobb-500 strain had the higher FC, BW and BWG at the end of the experiment. This suggests that Ross-308 may have superior growth performance at 21 days of age compared to the other strains.

Despite the IR and Ross-308 strains exhibiting faster weight gain and higher feed consumption compared to the Cobb-500 and Avian-48 strains, all four broiler strains had similar feed conversion ratios at 21 days of age. This implies that all strains were able to use the feed with comparable efficiency. These findings are consistent with earlier research by (Benyi *et al*., 2015 a , b) in this area. These findings have important implications for the poultry industry, as they suggest that breeders can select for improved FCR without sacrificing growth rate or feed intake. This can lead to more sustainable and efficient poultry production, as it reduces the amount of feed required producing a given amount of meat.

Concerning the whole experimental growth period of (1-42) days, the results of this study suggest that there are significant differences in growth performance and other traits among the four broiler strains, which can have important implications for the broiler industry in terms of production efficiency and profitability. Just like in several other studies, (Amao *et al*., 2011) the genotype of different commercial chicken strains has an impact on various growth-related parameters such as initial, weekly average, and FBW, FC, and FCR at different ages. Contrary to this (Benyi *et al*., 2015 a , b; Siaga *et al*., 2017) were found that genotype had no effect P> 0.05 on any growth performance traits during the overall period.

These discrepancies in the results may be attributed to the differences in bird strains used in the studies, as well as variations in the methodologies employed, such as the age of the birds during the measurements. However, it is important to note that other factors such as environmental conditions and management practices can still influence growth performance, regardless of the genetic makeup of the chickens. This implies that while genetics is an important factor in growth performance, it is not the only one and other factors should also be considered when trying to optimize growth performance in chickens.

In connection with the above-mentioned results, our data during the overall period suggests that the Avian-48 strain may have superior growth performance and overall feed efficiency compared to the other strains. Meanwhile, the IR strain may have superior in terms of body weight(BW), body weight gain (BWG), and feed consumption (FC) after the Avian-48 strain compared to the other strains, although Avian-48 and Cobb-500 strains may be more efficient in converting feed into body weight gain, which could lead to lower production costs and improved profitability. And also, the Cobb-500 strain had the best overall survival rates which means it had the lowest mortality percentage compared to other strains.

On the other hand, the Ross-308 strain had the lowest FBW and BWG. These results agree with the findings of Jawasreh *et al*. (2019) who reported that IR gained the highest (P<.0001) BW, while Ross was the lowest at the end of the experiment. Other researchers indicated that the Avian strain is more efficient than Ross in converting feed (Benyi *et al*., 2015 a , b). Similarly, Hossain *et al*. (2011) indicated that the Cobb-500 strain had the best BW, BWG, and FCR compared to other strains. Also, Abo Ghanema (2020) found that the Cobb strain exhibited significantly lower FC, FCR, and mortality percentages compared to the other strains. Additionally, the lower mortality percentage suggests that the Cobb strain was more resistant to diseases or stress factors than the other strains. Overall, these findings suggest that the Cobb strain may be a preferable choice for commercial poultry production due to its superior performance.

In contrast, Badar *et al*. (2021) concluded that among the three strains, the Ross-308 exhibited the highest BW and BWG, as well as the lowest FC and FCR. Furthermore, according to other researchers, the Ross-308 strain had the highest BW and BWG while consuming more feed, indicating that it attained the most optimal performance parameters and was the most profitable strain at the marketing age (Nogueira *et al*., 2019; Benyi *et al*., 2015 a , b; Stringhini *et al*., 2003).

These variations in the findings could be a result of differences in the broiler strains used in the studies and variations in the methodologies employed, such as the age of the birds during the measurements. However, it's essential to acknowledge that growth performance can still be influenced by factors beyond genetics, such as environmental conditions and management practices. This suggests that while genetics plays a significant role in growth performance, it is not the only determining factor, and other factors should also be considered when attempting to optimize chicken growth performance. The results also highlight the importance of considering multiple factors, such as FC, livability, and mortality, when selecting broiler strains for optimal production efficiency and profitability.

Regard to the economic evaluation and profitability results of the current study suggest that the Avian-48 strain may be the most economically efficient among broiler strains in several aspects, including feed cost per kg gain, net revenue, economic efficiency, and relative economic efficiency, while the Ross-308 strain may have advantages in terms of FC and feed cost. Meanwhile, the IR strain had an intermediate economic performance.

Profitability is considered a critical factor and has a profound effect on the poultry industry, as it determines the financial success and sustainability of the business. In that, broiler production systems place significant importance on profitability (Sevim *et al.,* 2021). According to the results obtained from this study, it is possible to suggest that rearing the Avian-48 and Cobb-500 strains may be more profitable due to their ability to produce more meat with less feed and in a shorter time, resulting in lower production costs overall. And also, the cost-benefit analysis indicated that these two strains resulted in a higher gross margin compared to the other strains studied. These results agree with the findings of Hossain *et al*. (2011) and Atallah *et al*. (2021).

However, it is important to note that these findings are based on performance records and cost-benefit analyses and may not necessarily reflect real-world conditions. Additionally, other factors such as animal welfare, market demand, meat quality, disease resistance, production system, and environmental impact should also be considered when selecting a broiler strain for production.

CONCLUSION

The outcomes of this research propose that the Avian-48 and Cobb-500 strains were the most effective and profitable for broiler production under Egyptian conditions. These two strains showed superior growth performance and feed efficiency compared to the other two strains, as well as a higher gross margin and net revenue in the cost-benefit analysis. The IR strain also showed good growth performance and feed efficiency but had a slightly lower gross margin and net revenue compared to the Avian-48 and Cobb-500 strains. Overall, the study provided important insights into the performance and profitability of different broiler strains under Egyptian conditions, which can help inform decision-making in broiler production.

Table (1): The ingredients and calculated analysis of the experimental diets

Ingredients, %	**Starter diet (1-21)**	**Grower diet (22-42)**
Yellow corn	53.44	57.79
Soya bean meal 47%	39.81	35.01
Vegetable oil	2.19	3.63
Limestone	1.67	1.39
Mono calcium phosphate	1.55	1.08
Vit. & minerals premix[1]	0.30	0.3
DL-Methionine	0.24	0.15
L – lysine HCL	0.05	-
L – Threonine	0.01	-
Sodium chloride (salt)	0.32	0.33
Sodium bicarbonate	0.12	0.11
Choline chloride	0.10	0.1
Coccidiostat[2]	0.05	0.05
Anti-mycotoxin[3]	0.05	0.05
Anti-clostridium[4]	0.05	-
Phytase enzyme[5]	0.05	0.01
Total	**100.00**	**100.00**
Calculated analysis		
Crude Protein, (%)	23.00	21.000
Metabolizable Energy, (kcal/kg)	2950	3100
Crude Fiber, (%)	2.50	2.44
Crude Fat, (%)	4.70	6.25
Lysine, (%)	1.32	1.08
Methionine, (%)	0.50	0.44
Methionine + Cystine	0.98	0.76
Calcium, (%)	1.00	0.76
Available Phosphorus, (%)	0.50	0.38
Chloride, (%)	0.20	0.20
Sodium, (%)	0.18	0.18

[1]Each 3 kg of vitamins and minerals premix contain: Vit. A; 12000000 IU, Vit. E: 10000 mg, Vit. B1: 1000 mg, Vit. B2: 5000 mg, Vit.B6: 1500 mg, Vit, B12: 10 mg, Niacin: 30000 mg, Pantothenic acid: 15000 mg, Vit. K: 2000 mg, Vit. D3; 2200000 IU, Biotin: 50mg, Folic acid: 1000mg, Copper: 4000 mg, Iodine: 2000 mg, Iron: 30000 mg, Manganese: 60000 mg, Zinc: 50000 mg, selenium: 400 mg and cobalt: 100 mg**.**
[2]Salinomycin sodium premix, Sacox (Intervet Inc., Millsboro, DE).
[3]T5X® Select, feed additives that protect broiler health by deactivation of mycotoxins (multi-vita co.)
[4] cap acid®, short chain fatty acid premix (multi-vita co.)[5]Axtra® PHY 5000 TPT, 6-phytase 5000 FTU/ kg of diet.

Table (2): Growth performance parameters for different broiler strains from 1-21 days of age.

Parameters	Strain				SEM*	P-value
	Avian-48	Cobb-500	Indian River	Ross-308		
Body weight, g	896.25^{c}	851.00^{d}	975.50^{a}	929.00^{b}	13.86	0.001
Body weight gain, g	482.75^{a}	370.75^{b}	475.50^{a}	381.50^{b}	14.46	0.001
Feed conversion ratio	1.31	1.37	1.29	1.31	0.01	0.210
Feed consumption, g	1120.00^{c}	1100.00^{d}	1200.00^{a}	1160.00^{b}	9.92	0.001
Livability, %	97.50^{ab}	98.10^{ab}	97.10^{b}	98.50^{a}	0.20	0.043
Mortality, %	2.50^{ab}	1.90^{ab}	2.90^{ab}	1.50^{b}	0.20	0.043
Production efficiency factor	159.50^{ab}	145.94^{b}	175.39^{a}	166.10^{a}	3.90	0.033

$^{a-d}$ means with different letters in the same row are differ significantly (P≤0.05)
*SEM: standard error of mean

Table (3): Growth performance parameters for different broiler strains from 22-42 days of age.

Parameters	Strain				SEM*	P-value
	Avian-48	Cobb-500	Indian River	Ross-308		
Body weight, g	2375.00^{a}	2275.00^{c}	2310.00^{b}	2121.25^{d}	25.99	0.001
Body weight gain, g	1478.75^{a}	1424^{b}	1334.5^{c}	1192.25^{d}	17.14	0.001
Feed conversion ratio	1.68^{b}	1.69^{b}	1.88^{a}	1.85^{a}	0.03	0.001
Feed consumption, g	2480.00^{b}	2400.00^{c}	2500.00^{a}	2210.00^{d}	29.57	0.001
Livability, %	92.50^{b}	93.90^{a}	92.90^{b}	90.50^{c}	0.35	0.001
Mortality, %	7.50^{b}	6.10^{c}	7.10^{b}	9.50^{a}	0.35	0.001
Production efficiency factor	245.69^{a}	252.80^{a}	216.38^{b}	198.42^{c}	5.91	0.001

$^{a-d}$ means with different letters in the same row are differ significantly (P≤0.05)
*SEM: standard error of mean

Table (4): Growth performance parameters for different broiler strains during the overall period from 1-42 days of age.

Parameters	Strain				SEM*	P-value
	Avian-48	Cobb-500	Indian River	Ross-308		
Final Body weight, g	2375.00^{a}	2275.00^{c}	2310.00^{b}	2121.25^{d}	35.31	0.001
Body weight gain, g	2335^{a}	2233^{c}	2269^{b}	2079.25^{d}	13.91	0.001
Feed conversion ratio	1.54^{b}	1.57^{b}	1.63^{a}	1.62^{a}	0.01	0.004
Feed consumption, g	3600.00^{b}	3500.00^{c}	3700.00^{a}	3370.00^{d}	31.54	0.001
Livability, %	90.00^{c}	92.00^{a}	91.00^{b}	89.00^{d}	0.29	0.001
Mortality, %	10.00^{b}	8.00^{d}	9.00^{c}	11.00^{a}	0.34	0.002
Production efficiency factor	330.40^{a}	317.53^{ab}	306.84^{b}	277.06^{c}	5.73	0.0002

$^{a-d}$ means with different letters in the same row are differ significantly (P≤0.05)
*SEM: standard error of mean

Table (5): Body weight and body weight gain for different broiler strains during the experimental growth periods.

Parameters	Age, days							SEM*
	1	7	14	21	28	35	42	
Body weight, g:								
Avian-48	40^{Ag}	127.00^{Bf}	413.50^{De}	896.25^{Cd}	1362.50^{Bc}	1871.25^{Bb}	2375.00^{Aa}	161.59
Cobb-500	42^{Ag}	203.03^{Af}	480.25^{Ce}	851.00^{Dd}	1316.25^{Cc}	1906.25^{Ab}	2275.00^{Ca}	153.73
Indian River	41^{Ag}	200.75^{Af}	500.00^{Be}	975.50^{Ad}	1555.00^{Ac}	1833.00^{Cb}	2310.00^{Ba}	155.33
Ross-308	42^{Ag}	203.93^{Af}	547.50^{Ae}	929.00^{Bd}	1336.25^{Cc}	1706.25^{Db}	2121.25^{Da}	139.22
Body weight gain, g:								
Avian-48	-	87.00^{Bd}	286.50^{BCc}	482.75^{Ab}	466.25^{Bb}	508.75^{Ba}	503.75^{Aa}	33.15
Cobb-500	-	161.03^{Ae}	277.23^{Cd}	370.75^{Bc}	465.25^{Bb}	590.00^{Aa}	368.75^{Dc}	28.34
Indian River	-	159.75^{Ad}	299.25^{Bc}	475.50^{Ab}	579.50^{Aa}	278.00^{Dc}	477.00^{Bb}	30.28
Ross-308	-	161.93^{Ad}	343.58^{Ac}	381.50^{Bb}	407.25^{Ca}	370.00^{Cb}	415.00^{Ca}	18.43

$^{a-g}$ means with different letters in the same row are differ significantly (P≤0.05)
$^{A-D}$ means with different letters in the same column are differ significantly (P≤0.05)
*SEM: standard error of mean.

Table (6): Economic indices for different broiler strains during the overall period from (1-42) days of age.

Items	Strain			
	Avian-48	**Cobb-500**	**Indian River**	**Ross-308**
Feed consumption, (kg)	3.60	3.50	3.70	3.37
Price of diet (L.E/kg)	11.50	11.50	11.50	11.50
Feed cost[1]	41.40	40.25	42.55	38.76
Body weight gain, (kg)	2.335	2.233	2.269	2.079
Selling price	77.06	73.69	74.88	68.62
Feed cost/kg gain	17.73	18.03	18.75	18.64
Cost index, (%)[2]	94.55	96.12	100.00	99.39
Net revenue[3]	35.66	33.44	32.33	29.86
Economic efficiency (EE)[4]	0.86	0.83	0.76	0.77
Relative economic efficiency (REE,%)[5]	113.36	109.35	100	101.41

[1]Feed cost = feed consumption × price of kg of diet.
Selling price = body weight gain × 33 L.E/kg.
[2]Cost index; assuming that feed cost/gain of the highest treatment equal 100
[3]Net revenue = Selling price – feed cost.
[4]Economic efficiency = net revenue / feed cost.
[5]REE (Relative economic efficiency) = assuming that the economic efficiency of the lowesttreatment equals 100.

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الملخص العربي

تحليل مقارن لآداء النمو والربحية لاربع سلالات تجارية من دجاج التسمين المرباه فى مصر

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هدفت هذه الدراسة إلي تقييم أداء النمو والربحية لأربع سلالات من دجاج التسمين تم تربيتها تحت الظروف المصرية لتحديد السلالات الأكثر فعالية وربحية لإنتاج دجاج التسمين في المنطقة. تم إستخدام عدد 24000 كتكوت عمر يوم واحد تم توزيعهم بشكل منفصل حسب السلالة إلى 4 مجموعات متماثلة في العدد والعمر تماما (سلالة كب 500، سلالة روس 308، سلالة ايفيان 48، سلالة اي ار). وتم تربية كل مجموعة سلالة وإيوائها في مبانٍ منفصلة تحت نفس الظروف مع اتاحة الوصول إلى العلف والمياه بحرية. العدد الكلي لكل سلالة كان 6000 ، مقسمة إلى خمس مكررات كل مكررة تحتوي علي 1200 كتكوت تسمين ، وتم توزيعها بشكل عشوائي في تصميم عشوائي كامل إلى أربع مجموعات لمدة 42 يومًا. تم تسجيل وزن الجسم إسبوعيا وحساب وزن الجسم المكتسب وفي نهاية التجربة تم تسجيل استهلاك العلف، وحساب معامل التحويل الغذائي، والنسبة المئوية للحيوية (٪). كما تم حساب معامل كفاءة الإنتاج الاوروبي (الرقم الانتاجي) والمؤشرات الاقتصادية وتحليل التكلفة والعائد لتقييم ربحية كل سلالة مدروسة. أظهرت النتائج وجود فروق معنوية في أداء النمو والصفات الأخرى بين سلالات دجاج التسمين الأربعة. حيث أشارت النتائج إلى أن سلالة الايفيان 48 و سلالة الكب 500 كانت الأكثر فاعلية وربحية لإنتاج دجاج التسمين تحت الظروف المصرية ، بينما أظهرت سلالة أي ار أيضًا أداء نمو جيد وكفاءة غذائية جيدة. وفي النهاية يمكن أن تقدم هذة الدراسة رؤى قيمة وفعالة حول أداء وربحية سلالات دجاج التسمين المختلفة في ظل الظروف المصرية ، والتي يمكن أن تساعد في اتخاذ القرار في إنتاج دجاج التسمين من خلال اختيار سلالات دجاج التسمين الأكثر فاعلية وربحية، والتي تمكن وتساعد المنتجين علي تحسين وزيادة انتاجهم وأرباحهم.