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THE COST-BENEFIT ANALYSIS OF APPLICATION OF VITAMIN AND MINERAL SUPPLEMENTS IN BROILER CHICKEN PRODUCTION

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Abstract

Out of all food of animal origin, the demand for poultry meat increases the most dynamically - the poultry sector can only satisfy this demand by introducing more and more intensive raising technology. The goal of this study is to measure the positive impact on production production parameters (mortality, live weight gain, feed conversion ratio) of vitamins and nutrient supplements (Gastroferm M+C®, Jolovit®, Norovit-Amino Forte®, Phylamic®, Tetraselene-400-E®, Tetravit AD3E Forte® and Vitaplan DCP®) in raising broiler chickens, and to conduct an economic analysis of their application. In the study, we measured the effects on production indices of a special feed additive mix that contains vitamin- and nutrient supplements, which were compared to those in the control group having no extra supplements. Based on the differences in the production parameters, we conducted the cost-benefit analysis of this special feed supplement mix. The Ross 308 hybrids in the experimental group were fed with supplements and produced 0.6% percentage point lower mortality rate, 0.11 kg more slaughter weight, and 0.13 kg/kg smaller feed conversation ratio on average compared to the control group. Based on the analysed production indeces, the use of the vitamin and mineral supplements had a 10.9 return on investment (ROI), and yielded 41.5 HUF extra profit per chicken in the experimental group compared to the control group.

Keywords

cost-benefit analysis, broiler chicken production, nutrient supplements

1. Introduction

The poultry sector has a very significant role within the agriculture sector, not only in Hungary, but all around the world [1]. Producing poultry meat is faster, and more cost-efficient than that of mammals. As the less-developed countries gradually close the economic distance, their population gradually changes their eating habits which requires a larger amount of meat being produced globally. Out of all food of animal origin, the demand for poultry meat increases the most dynamically, and the poultry sector can only satisfy this demand by introducing more and more intensive raising technology.

In Hungary, an average of 70% of total production costs of broiler raising are made up of the feeding costs [2]. As the livestock farmers have no way of influencing grain prices, they try to decrease other costs [3]. The goal of this study is to measure the positive impact on production parameters of vitamins and nutrient supplements in raising broiler chickens and to conduct an economic analysis of their application.

2. Overview of the global and Hungarian poultry sector

Global market outlook of the poultry sector

The poultry sector has undergone a more rapid development than other animal husbandry sectors in the XX. century, most notably in its second half. Even the economic crisis that we had to deal with in the first decade of the XXI. century, and the decrease in demand and the increase in feeding costs could not diminish this sector. Even though it doesn't show the same dynamism as before, it's still expanding steadily. The global annual poultry meat production reached 100 million tons by 2011. Based on the forecasts, this amount may go up to 122 million tons by 2020 [4]. Due to the biological traits of poultry species, poultry is the husbandry sector that adapts most easily to the consumer demands [5]. Therefore, the poultry meat production and trade is expected to grow further on a global level [6]. Based on Rabobank's [7] forecast, the global poultry meat production may even surpass the pork production by 2030.

The chicken meat production of the European Union exceeded the consumption by 181.000 tons in 2000, which is expected to be 125.000 tons more by 2025. This means that the European Union won't become a net importer by then [8]. However, the costs related to the stricter administrative, animal welfare, environmental protection and animal transport regulations, and to the more often authority checks and laboratory tests will increase [9]. This increase in production cost can be expected in both the member states that joined the EU in the last 10-15 years with less developed economies, and the older member states [2].

Production costs of the Hungarian boiler chicken sector

In broiler chicken production the feed costs are the most significant, as they give nearly three fourths of the total production cost (Figure 1). In recent years, we saw these costs fluctuated greatly year by year, but eventually increased (Figure 2). For the production the feed was generally purchased, therefore, the broiler chicken farmers are very dependent on the feed distributors.

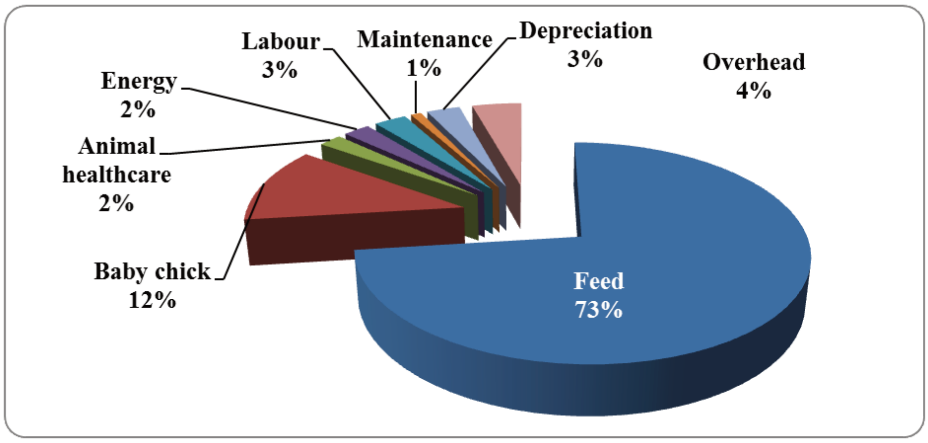

Figure 1. Distribution of broiler chicken production cost in 2012 [6]

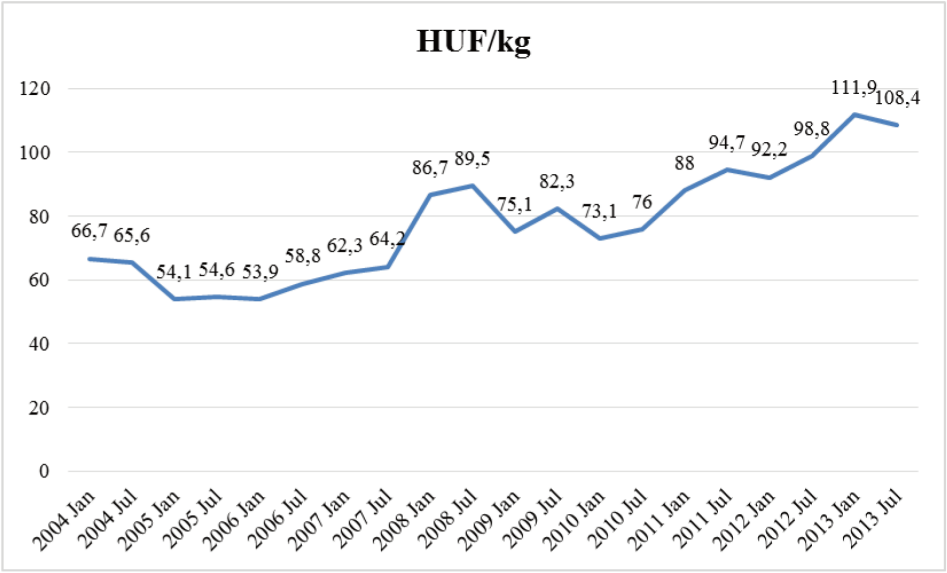

Figure 2. Monthly sale prices for broiler starter feed (2004-2013) [5]

Based on the change in feed prices in the last 10 years, we can conclude that the prices are closely related to the procurement of soya, which is a weakness for the Hungarian animal husbandry in general [11]. The changes of global market prices are fundamentally influenced by three factors; the decrease of production in some major production areas, the increasing demand for feed due to the expansion of animal husbandry, and the increasing bio-ethanol production [12]. Feed prices were between 70 and 75 HUF/kg in 2004, whereas nowadays, they're above 100 HUF/kg [8].

Sale prices of chickens for slaughter follow the changes in feed prices a little bit later. Figure 3. shows that after the avian flu outbreak in 2006, sale prices were constantly on the rise until 2008, when the global financial crisis hit in, but afterwards began to rise again.

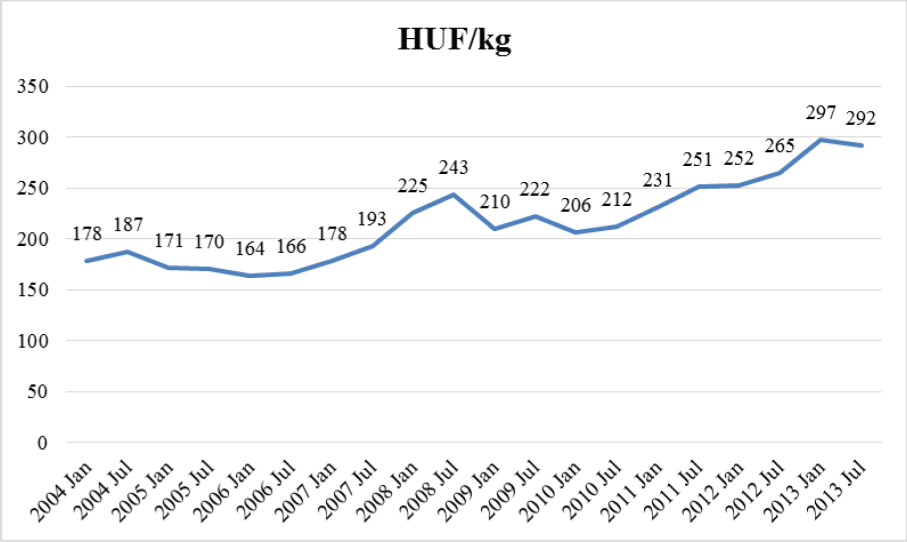

Figure 3. Monthly sale prices of chickens for slaughter in Hungary (2004-2013) [5]

3. Materials and methods

The goal of the research was to measure the effects on production indexes (mortality, live weight gain, feed conversion ratio) of a special feed additive mix containing vitamins [13, 14] and nutrient supplements [15, 16, 17] (Gastroferm M+C®, Jolovit®, Norovit-Amino Forte®, Phylamic®, Tetraselene-400-E®, Tetravit AD3E Forte® and Vitaplan DCP®), which were compared to those in the control group having no extra supplements. Based on the differences in the production parameters, we conducted the cost-benefit analysis of this special feed supplement mix. The research was done on a poultry farm in Bács-Kiskun county between June 2012 and March 2013.

The chickens were raised in four pens on the closed intensive poultry farm, each measuring 1000 m2, and there were other service buildings. The pens had automatic feeding, drinking, heating and ventilation systems with a total capacity of 70,000 broiler chickens and all-in-all-out technology was applied. Mixed gender Ross 308 hybrids were raised to be ready for slaughter in 5 and half weeks, and after the second day of Week 5, the chickens were started to be transported to the slaughterhouse, and by Week 6, the pens became empty. This was followed by a week of cleaning, and another two weeks of the service period. Thus, the rearing period was 9 weeks altogether.

The day-old chicks in the trial were settled on the 29th of November 2012, and were transported for slaughter on the 7th of January 2013, when they were 38 days old. One of the four pens was used for the experimental group, another for the control group. Up to 17,800-18,200 birds were kept in one building. In the trial, we observed 17,965 experimental and 18,078 control animals which were sorted to two separate pens, but their housing and feeding conditions were identical. The stocking density was 17 chickens/m2. In the flock an ad libitum feeding protocol for 6 weeks was applied.

In the trial, the control group didn't receive any vitamin or mineral supplements. The experimental group received the vitamin- and nutrient supplements through the drinking system. The drinking protocol in the experimental group can be seen in Table 1. The average water consumption for 17,000 chickens in the flock was as follows: 2,200 litres on Week 2, 3,700 litres on Week 3, 5,000 litres on Week 4, 5,500 litres on Week 5. During the experiment, neither the experimental, nor the control group received antibiotics for curative or preventative reasons.

Evaluation of the production and economic indices

In the trial we used those production indices that can also be expressed in monetary units in order to conduct the economic analysis. Therefore, we analysed the slaughter weight, the feed conversion ratio and the mortality - as the length of the fattening was identical for both the experimental and the control groups. We conducted representative body weighings weekly to follow the live weight gain, and measured the total weight of broiler chickens marketed. We registered the total feed consumption for the entire fattening period. The number of mortalities and that of culled chickens and their live weight were also registered. We did pathology examinations for the chickens that died in order to determine the cause of death.

Based on the aforementioned recorded data we calculated the disposal rate (%) by summing the mortalities and cullings, which was divided by the number of day old chicks settled, and afterwards multiplied by 100. We calculated the number of broilers ready to slaughter by subtracting the sum of mortalities and cullings from that of day old chicks which were settled. We divided the total slaughter weight by the number of birds marketed (slaughtered), which led to the average slaughter weight. We calculated the feed conversation ratio via dividing the total feed consumption by the total slaughter weight.

We also calculated the broiler index in order to evaluate the efficacy of broiler chicken raising better. The broiler

index (EPEF - European Production Efficiency Factor) is a relative index without unit and being related to the profitability of broiler chicken production, which is calculated by using the following formula [10]:

$$\textbf{Broiler index: } \frac{\textbf{survival rate (\%)} \times \textbf{slaughter weight(kg)}}{\textbf{fattening period (days)} \times \textbf{feed conversation ratio}} \times 100.$$

Table 1. Drinking protocol in the experimental broiler chicken group

Age (days)	Product	Dose/1000 l water	Age (days)	Product	Dose/1000 l water
1.	Jolovit®	1000 ml	**20.**	Norovit-Amino Forte®	500 ml
2.	Jolovit®	1000 ml	**21.**	*Vaccination against Newcastle disease*	-
3.	Vitaplan DCP®	200 ml	**22.**	Norovit-Amino Forte®	500 ml
4.	Vitaplan DCP®	200 ml	**23.**	-	-
5.	Vitaplan DCP®	200 ml	**24.**	-	-
6.	Gastroferm M+C®	250 g	**25.**	-	-
7.	Gastroferm M+C®	250 g	**26.**	Tetravit AD3E Forte®	1000 ml
8.	Norovit-Amino Forte®	500 ml	**27.**	Tetravit AD3E Forte®	1000 ml
9.	Norovit-Amino Forte®	500 ml	**28.**	Tetravit AD3E Forte®	1000 ml
10.	Norovit-Amino Forte®	500 ml	**29.**	Tetravit AD3E Forte®	1000 ml
11.	Tetraselene -400-E®	1000 ml	**30.**	Gastroferm M+C®	500 g
12.	*Vaccination against contagious bursitis*	-	**31.**	Gastroferm M+C®	500 g
13.	Tetraselene -400-E®	1000 ml	**32.**	Gastroferm M+C®	500 g
14.	Tetraselene -400-E®	1000 ml	**33.**	-	-
15.	Tetraselene -400-E®	1000 ml	**34.**	-	-
16.	Gastroferm M+C®	250 g	**35.**	Jolovit® + Phylamic®	1000+ 2000ml
17.	Gastroferm M+C®	250 g	**36.**	Jolovit® + Phylamic®	1000+ 2000ml
18.	Gastroferm M+C®	250 g	**37.**	Phylamic®	2000 ml
19.	-	-	**38.**	-	-

In our financial analysis, the partial budgeting method which takes into account only those costs and revenues that change after administering the feed supplements. In the calculations, we multiplied the total slaughter weight by the market price in order to get total income. The total feed costs were calculated by multiplying the costs of the given diets (e.g. pre-starter, starter, grower, finisher) per unit by their quantities consumed, and summed them up. The price of day old chicks was multiplied by the number of birds settled, which resulted in the total cost of day old chicks. We calculated the gross margin as the margin between total income and the total cost of day old chicks and feeding [10].

The difference between the gross margin of the experimental group and that of the control group gave us the extra margin for the experimental group, and afterwards, having known the price and cost data of vitamin and nutrient supplements, we were able to calculate the benefit-cost ratio (B/C) and the return of the investment (ROI) of the application of the feed additive mix [Ózsvári].

Price and cost data

In the financial analysis, we used the procurement prices of the different – pre-starter, starter, grower and finisher - feeding diets and the slaughter price of the broiler chickens (Table 2).

Table 2. Cost and price data

ITEM	HUF/kg
Old day chicken price (HUF/chicken)	94.0
Pre-starter feeding diet price (HUF/kg)	121.0
Starter feeding diet price	118.6
Grower feeding diet price	114.2
Finisher feedign diet price	112.0
Broiler chicken slaughter price	295.0

The procurement prices of vitamin and nutrient supplements administered in the experiment were calculated as the average of the sale prices of three distributors - two private veterinary pharmacies and one big veterinary wholesaler and retailer corporation. The costs of feed supplements were calculated by multiplying their average price by their quantity used up.

4. Results and discussion

Return of the vitamin- and nutrient supplements used in broiler raising

The average length of broiler fattening was 38 days in both the experimental and the control groups. The vitamins and nutrients which were given as supplements in the experimental group via drinking water during the fattening resulted in better production indices, compared to the control group (Figure 4).

Substantial improvement could be observed for cullings (experimental: 42, control: 74 animals) which together with the number of deaths diminished the disposal rate (%). The disposal rate was nearly 1 percentage point higher in the control group than in the experimental group. The mortality of chickens decreased significantly from Week 2 in the experimental group, compared to the control group. Furthermore, at the end of the 38-day fattening time, the slaugther chickens in the experimental group weighted 10 grams more on average, however their feed conversation rate was 13 grams lower. The broiler index was also significantly better, as it was 352 for the experimental group, and only 309 for the control group.

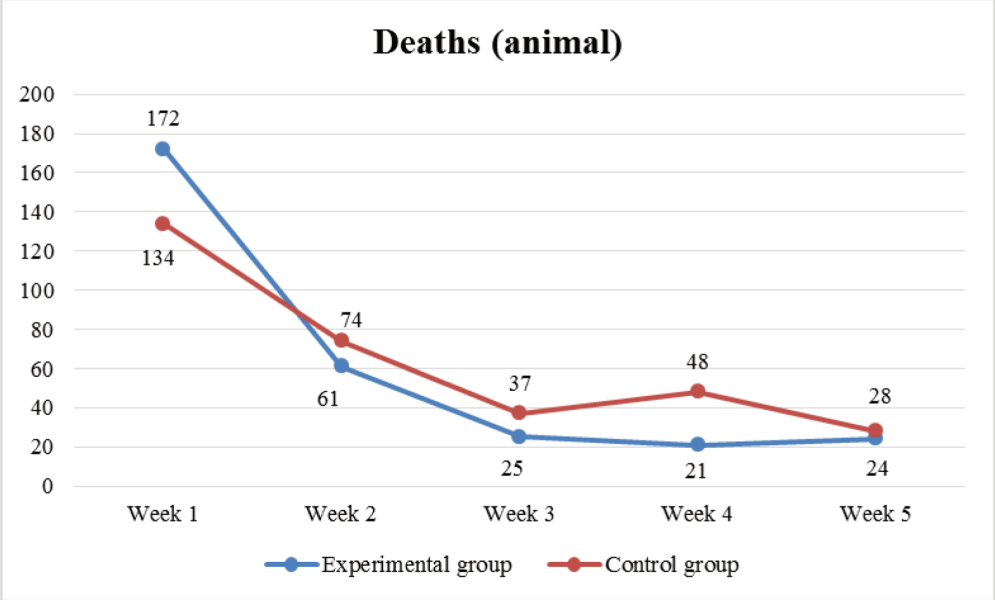

Figure 4. Mortality rate

The gross margin analysis for the control broiler chicken group can be seen in detail below:

Day old chicken price:	94 HUF/chicken
Day old chicken costs:	18,078 chickens x 94 HUF = 1,699,332 HUF
Total feed costs:	5,620 kg x 121 HUF/kg = 680,020 HUF (pre-starter diet) 9,990 kg x 118.6 HUF/kg = 1,184,814 HUF (starter diet) 27,100 kg x 114.2 HUF/kg = 3,094,820 HUF (grower diet) 29,140 kg x 112 HUF/kg = 3,263,680 HUF (finisher diet)
Slaughter price:	295 HUF/kg
Total income:	295 HUF/kg x 39,077 kg = 11,527,715 HUF
Total gross margin:	11,527,715 HUF – (1,699,332 HUF + 680,020 HUF + 1,184,814 HUF + 3,094,820 HUF + 3,263,680 HUF) = = 11,527,715 HUF – 9,922,666 HUF = 1,605,049 HUF
Average gross margin:	1,605,049 HUF/ 17,291 chickens = **92.8 HUF/ slaughter chicken**

The gross margin analysis for the experimental broiler chicken group can be seen in detail below:

Day old chicken price:	94 HUF/chicken
Day old chicken costs:	17,965 chickens x 94 HUF = 1,688,710 HUF
Total feed costs:	5,500 kg x 121 HUF/kg = 665,500 HUF (pre-starter diet) 10,000 kg x 118.6 HUF/kg = 1,186,000 HUF (starter diet) 26,800 kg x 114.2 HUF/kg = 3,060,560 HUF (grower diet) 27,900 kg x 112 HUF/kg = 3,124,800 HUF (finisher diet)
Slaughter price:	295 HUF/kg
Total income:	295 HUF/kg x 41,093 kg = 12,122,435 HUF
Total gross margin:	12,122,435 HUF - (1,688,710 HUF + 665,500 HUF + 1,186,000 HUF + 3,060,560 HUF + 3,124,800 HUF) = = 12,122,435 HUF - 9,725,570 HUF = 2,396,865 HUF
Average gross margin:	2,396,865 HUF/ 17,339 chickens = **138.2 HUF/ /slaughter chicken**

The total vitamin- and nutrient supplements costs amounted to 72,650 HUF in the experimental group.

Due to the better production parameters, the experimental broiler chicken group generated 45.4 HUF/head extra gross margin and 41.5 HUF/head extra profit compared to the control group. The benefit-cost ratio (B/C) of application of vitamin and nutrient supplements was 10.8. In other words, on every HUF invested 10.9 HUF income was generated, that is, 9.9 HUF profit. The return on investment was 990%, which means a much higher yield than the current financial investment options (Annex 1).

The results of the experiment show that the application of feed additive mix containing Gastroferm M+C®, Jolovit®, Norovit-Amino Forte®, Phylamic®, Tetraselene-400-E®, Tetravit AD3E Forte® and Vitaplan DCP® makes broiler chicken production more profitable.

5. Conclusions

Based on the cost-benefit analysis it can be stated that for broiler chicken production, it is economically beneficial to apply mixtures of vitamin and nutrient supplements administered in the drinking water, but further experiments are required to find the optimal feed additive mixture.

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Annex 1. Economic analysis of the application of broiler chicken vitamin and nutrient supplements

Parameters	Control group	Experimental group	Difference
Number of settled birds	18 078	17 965	-113
Deaths (birds)	713	584	-129
Deaths (kg)	438.2	262.7	-175.5
Mortality (%)	**3.9**	**3.3**	**-0.6**
Cullings (birds)	74	42	-32
Cullings (kg)	162.8	96.6	-66.2
Disposal rate (%)	**4.4**	**3.5**	**-0.9**
Number of ready to slaughter birds	17 291	17 339	+48
Total slaughter weight (kg)	39 077	41 093	+2 016
Average slaughter weight (kg/chicken)	**2.26**	**2.37**	**+0.11**
Total feed consumption (kg)	71 850	70 200	-1 650
Feed conversion ratio	**1.84**	**1.71**	**-0.13**
Broiler index	309	352	+43
Total income (HUF)	11 527 715	12 122 435	+594 420
Total feed costs (HUF)	9 922 666	9 725 570	-197 196
Day old chicken costs (HUF)	1 699 332	1 688 710	-10 622
Total gross margin (HUF)	1 605 049	2 396 865	+791 816
Average gross margin (HUF/slaughter chicken)	92.8	138.2	+45.4
Total vitamin- and nutrient supplement costs (HUF)	0	72 650	+72 650
Average supplement costs (HUF/slaughter chicken)			4.2
Average profit (HUF/slaughter /chicken)			41.5
Benefit-cost (B/C) ratio			10.9
Return on investment (ROI, %)			990