EFFICIENCY OF SALES OF EDIBLE EGGS BY WEIGHT AND CATEGORIES. PRICING METHODOLOGY

Alexey Kavtarashvili1,*

1Laboratory of the Technology of Egg Production, Federal Scientific Center «All-Russian Research and Technological Institute of Poultry” of Russian Academy of Sciences, Sergiev Posad, Russia

Abstract. The yields of eggs of various categories from modern highly productive crosses of chickens (SP-789, Lohmann LSL Classic, Lohmann Brown Lite) were studied. The comparative efficiency of the egg sale by weight and categories, the development of a pricing methodology are discussed. It was found that for the considered crosses the first category is the modal class or the class of the highest frequency of occurrence. The average weight, the cost of 1 g of egg weight, and the new selling price of eggs of the first category practically coincide with the average values of these parameters of the general set. The most economically feasible is the sale of edible eggs by weight. However, it requires additional financial investments for the purchase, installation, and maintenance of weighing equipment. In this regard, the author has developed and proposed a methodology for determining the single-piece price sale of eggs of different categories, which makes it possible to increase the income of an enterprise as compared to selling eggs by weight. According to the new methodology the selling price of the first category eggs is taken as a basis for assessing the selling price of eggs of other categories. This value is multiplied by the coefficients for the corresponding categories, which are calculated by dividing the new price of eggs of each category by the new price of eggs of the first category. These coefficients should be developed for each specific cross, taking into account the duration of the productive seasons and the conditions of the farms.

1 Introduction

In modern economic conditions increasing the efficiency of production in poultry farming becomes not only the main direction of its development but also practically the only opportunity to further increase the production of eggs and poultry meat, and to increase the competitiveness and profitability of the industry [1-4]. The efficiency of the productive activity of poultry farms depends on a set of interrelated factors: housing conditions, productivity, livability and duration of productive use of poultry, product quality, feed and labor costs for production, market prices of products [5-12].

Currently, poultry farms in Russia and the CIS countries sell edible eggs to the consumer by item, taking into account weight categories [13] while in the EU countries edible eggs are sold by weight [14].

According to the Russian State Standard GOST 31654 - 2012 “Edible chicken eggs. Specifications” [15], edible eggs are divided into 5 weight categories: the third (35-44.9 g), the second (45-54.9 g), the first (55-64.9), selected (65-74.9 g), and the highest (75 g and more). The disadvantage of this standard is that each weight category of eggs has a fairly large interval (9.9 g) [16]. So, when eggs are sold by the categorized items, the selling price of the lightest and the heaviest eggs within each category and the resulting income of the farm will be the same.

Analysis of the work of poultry enterprises in Russia showed that there is no single methodology for determining the selling price of eggs of various categories, and this process is arbitrary. For example, during the period of studies the selling price of 10 eggs of the third, second, first, selected and highest categories amounted to 24.7, 27.3, 38.8, 45.7 and 52.6 rubles (SP1) at the Selection and Genetic Center “Zagorskoe Experimental Breeding Farm” of the Moscow region. These selling prices at the Mendeleevskaya poultry farm in the Perm Territory were 20.0, 29.1, 35.4, 38.2, and 41.5 rubles (SP2); and 29.0, 31.0, 37.0, 38.0 and 39.0 rubles (SP3) at the Druzhba poultry farm in the Krasnodar Territory.

The purpose of this work was to study the yields of eggs of different categories for some modern highly productive crosses of chickens, to compare the efficiency of egg selling by weight and categories, and to develop a unified pricing methodology.

2 Materials and methods

The studies were carried out at the Selection and Genetic Center “Zagorskoe Experimental Breeding Farm” of the Federal Scientific Center “All-Russian Research and Technological Insti-tute of Poultry” of Russian Academy of Sciences (SGC ARRTPI) of the Moscow region and the poultry farm Mendeleevskaya of the Perm Territory.
The total and average weights of all weighed eggs during their productive period. The laboratory scales weighed individually monthly (three days in a row) from crosses Lohmann LSL Classic and Lohmann Brown Lite (Mendelevskaya), respectively, were selected, first, second, third categories [15]; the total and average weights of eggs by category were determined.

### 3 Results and discussion

During the productive period the yields of eggs of the third, second, first selected and highest categories were as follows:
- 0.79, 22.84, 57.69, 17.75, and 0.93%, respectively, for the SP-789 cross with an average egg weight of 43.46, 51.22, 59.71, 68.01, 79.77 g;
- 0.28, 17.52, 63.49, 17.87, and 0.84% for the Lohmann LSL Classic with an average egg weight of 43.23, 52.40, 59.80, 68.00, 77.43 g;
- 3.18, 10.03, 60.24, 25.79, and 0.76% for the Lohmann Brown Lite with an average egg weight of 41.63, 51.10, 60.62, 68.09, 83.91 g, respectively.

The total and average weights of all weighed eggs were 82,840 and 59.30 g for the SP-789 cross, 86,381 and 60.07 g for the Lohmann LSL Classic, 88,447 and 61.17 g for the Lohmann Brown Lite (Table 1).

Taking into account the listed characteristics and the selling prices for eggs categories, mathematical calculations were performed to determine the comparative efficiency of selling the edible eggs by weight and by category (by item). The following parameters were calculated:
- The cost of 1 g of egg weight - by dividing the

### Table 1. Weight and yield of eggs by category.

| Egg categories | SP-789 cross | Lohmann LSL Classic cross | Lohmann Brown Lite cross |
|----------------|--------------|---------------------------|--------------------------|
|                | Number of eggs | Mass of eggs, g | Number of eggs | Mass of eggs, g | Number of eggs | Mass of eggs, g |
|                | pcs.  % total   average | pcs.  % total   average | pcs.  % total   average |
| Third          | 11  0.79  478  43.46 | 4  0.28  173  43.23 | 46  3.18  1915  41.63 |
| Second         | 319 22.84 16338 51.22 | 252 17.52 13204 52.40 | 145 10.03 2409 51.10 |
| First          | 806 57.69 48127 59.71 | 913 63.49 54600 59.80 | 871 60.24 52802 60.62 |
| Selected       | 248 17.75 16667 68.01 | 257 17.87 17475 68.00 | 373 25.79 25398 68.09 |
| Highest        | 13 0.93 1037 79.77 | 12 0.84 929 77.43 | 11 0.76 923 83.91 |
| Total and in average | 1397 100 82840 59.70 | 1438 100 86381 60.07 | 1446 100 88447 61.17 |

### Table 2. Prices when selling eggs by category according to SP1 prices and by weight.

| Egg categories | Selling price of 1 egg, rub. | Income, rubles | Cost of 1 g of egg mass, rub. | Income based on the price of 1 g of egg mass of the 1st category, rubles (new price) |
|----------------|-------------------------------|----------------|-----------------------------|----------------------------------------------------------------------------------|
| SP-789 cross   |                               |                |                             |                                                                                  |
| Third          | 2.47                          | 27.2           | 0.057                       | 31                                                                              |
| Second         | 2.73                          | 871            | 0.053                       | 1062                                                                             |
| First          | 3.88                          | 3127           | 0.065                       | 3128                                                                             |
| Selected       | 4.57                          | 1133           | 0.067                       | 1096                                                                             |
| Highest        | 5.26                          | 68             | 0.066                       | 67                                                                              |
| Total and in average | 3.74  5226  0.063 | 5384           | 3.85                       |                                                                                  |
| Lohmann LSL Classic cross |                  |                |                             |                                                                                  |
| Third          | 2.47                          | 10             | 0.057                       | 11                                                                              |
| Second         | 2.73                          | 688            | 0.052                       | 858                                                                              |
| First          | 3.88                          | 3542           | 0.065                       | 3549                                                                             |
| Selected       | 4.57                          | 1174           | 0.067                       | 1136                                                                             |
| Highest        | 5.26                          | 63             | 0.068                       | 60                                                                              |
| Total and in average | 3.81  5477  0.063 5614 | 3.90           |                                                                                  |
| Lohmann Brown Lite cross |                  |                |                             |                                                                                  |
| Third          | 2.47                          | 114            | 0.059                       | 123                                                                             |
| Second         | 2.73                          | 396            | 0.054                       | 474                                                                              |
| First          | 3.88                          | 3379           | 0.064                       | 3379                                                                             |
| Selected       | 4.57                          | 1705           | 0.067                       | 1625                                                                             |
| Highest        | 5.26                          | 58             | 0.063                       | 59                                                                              |
| Total and in average | 3.91  5652  0.064 | 5660           | 3.91                       |                                                                                  |
The presented data show that it is most economically feasible to sell edible eggs by weight. When selling eggs by weight based on the cost of 1 g of egg weight of the 1st category in comparison with selling by categories (by item) according to the prices SP1, SP2, and SP3 for SP-789, Lohmann LSL Classic, and Lohmann Brown Lite, the additional income was 158, 137 and 83, 91 and 63, 141, 166 and 128 rubles. Per 10 eggs it is 1.13, 0.95 and 0.06; 0.60, 0.63, and 0.44; 1.01, 1.15, and 0.89 rubles, which in the scale of a poultry farm of average capacity producing 155 million eggs per year will provide additional income of 17.52, 14.73, and 0.93; 9.30, 9.77, and 6.82; 15.66, 17.83, and 13.80 million rubles per year, respectively.

So, the data in Tables 2, 3, and 4 indicate that when selling edible eggs by weight, compared to selling by categories (by item), income from the SP-789, Lohmann LSL Classic, and Lohmann Brown Lite crosses rises by

| Egg categories | Sales of eggs by category | Sales of eggs by weight | The cost of 1 egg for the cost of 1 g of egg mass of the 1st category, rubles (new price) |
|----------------|---------------------------|-------------------------|----------------------------------------------------------------------------------|
|                | Selling price of 1 egg, rub. | Income, rubles | Cost of 1 g of egg mass, rub. | Income based on the price of 1 g of egg mass of the 1st category, rub. |            |
| SP-789 cross   |                            |                        |                                     |                                        |            |
| Third          | 2.00                       | 22                     | 0.046                               | 28                                    | 2.56       |
| Second         | 2.91                       | 92                     | 0.057                               | 964                                   | 3.02       |
| First          | 3.54                       | 2853                   | 0.059                               | 2839                                  | 3.52       |
| Selected       | 3.82                       | 947                    | 0.056                               | 995                                   | 4.01       |
| Highest        | 4.15                       | 54                     | 0.052                               | 61                                    | 4.71       |
| Total and in average | 3.44               | 4804                   | 0.058                               | 4887                                  | 3.50       |
| Lohmann LSL Classic cross |                  |                        |                                     |                                        |            |
| Third          | 2.00                       | 8                      | 0.046                               | 10                                    | 2.55       |
| Second         | 2.91                       | 733                    | 0.056                               | 779                                   | 3.09       |
| First          | 3.54                       | 3232                   | 0.059                               | 3221                                  | 3.53       |
| Selected       | 3.82                       | 982                    | 0.056                               | 1031                                  | 4.01       |
| Highest        | 4.15                       | 80                     | 0.054                               | 55                                    | 4.57       |
| Total and in average | 3.48               | 5005                   | 0.058                               | 5096                                  | 3.54       |
| Lohmann Brown Lite cross |                 |                        |                                     |                                        |            |
| Third          | 2.00                       | 92                     | 0.048                               | 111                                   | 2.41       |
| Second         | 2.91                       | 422                    | 0.057                               | 430                                   | 2.96       |
| First          | 3.54                       | 3083                   | 0.058                               | 3063                                  | 3.52       |
| Selected       | 3.82                       | 1425                   | 0.056                               | 1473                                  | 3.95       |
| Highest        | 4.15                       | 46                     | 0.050                               | 54                                    | 4.87       |
| Total and in average | 3.51               | 5068                   | 0.058                               | 5131                                  | 3.55       |
They are calculated by dividing the new price of eggs in the first category by the new price of eggs in the first category for the studied crosses. Coefficients have been developed (Table 5) to determine the selling price of eggs of different categories for the studied crosses. They are calculated by dividing the new price of eggs in each category by the new price of eggs in the first category (see tables 2, 3 and 4).

Table 4. Prices when selling eggs by category according to SP3 prices and by weight.

| Egg categories | Sales of eggs by category | Sales of eggs by weight | The cost of 1 egg for the cost of 1 g of egg mass of the 1st category, rubles (new price) |
|----------------|---------------------------|-------------------------|------------------------------------------------------------------------------------|
|                | Selling price of 1 egg, rub. | Income, rubles | Cost of 1 g of egg mass, rub. | Income based on the price of 1 g of egg mass of the 1st category, rub. |
| SP-789 cross   |                           |                        |                           |                                                                                       |
| Third          | 2.90                      | 32                     | 0.067                     | 30                                                                                     | 2.70 |
| Second         | 3.10                      | 989                    | 0.061                     | 1013                                                                                   | 3.18 |
| First          | 3.70                      | 2982                   | 0.062                     | 2984                                                                                   | 3.70 |
| Selected       | 3.80                      | 942                    | 0.056                     | 1046                                                                                   | 4.22 |
| Highest        | 3.90                      | 51                     | 0.049                     | 64                                                                                     | 4.95 |
| Total and in average | 3.58                  | 4996                   | 0.061                     | 5137                                                                                   | 3.68 |

Lohmann LSL Classic cross

|                |                           |                        |                           |                                                                                       |
| Third          | 2.90                      | 12                     | 0.067                     | 11                                                                                     | 2.68 |
| Second         | 3.10                      | 781                    | 0.059                     | 819                                                                                   | 3.25 |
| First          | 3.70                      | 3378                   | 0.062                     | 3385                                                                                   | 3.71 |
| Selected       | 3.80                      | 977                    | 0.056                     | 1084                                                                                   | 4.22 |
| Highest        | 3.90                      | 47                     | 0.050                     | 62                                                                                     | 4.80 |
| Total and in average | 3.61                  | 5195                   | 0.061                     | 5361                                                                                   | 3.73 |

Lohmann Brown Lite cross

|                |                           |                        |                           |                                                                                       |
| Third          | 2.90                      | 133                    | 0.070                     | 117                                                                                   | 2.54 |
| Second         | 3.10                      | 450                    | 0.061                     | 452                                                                                   | 3.12 |
| First          | 3.70                      | 3223                   | 0.061                     | 3221                                                                                   | 3.70 |
| Selected       | 3.80                      | 1417                   | 0.056                     | 1549                                                                                   | 4.15 |
| Highest        | 3.90                      | 43                     | 0.047                     | 56                                                                                     | 5.12 |
| Total and in average | 3.64                  | 5266                   | 0.060                     | 5394                                                                                   | 3.73 |

Table 5. Coefficients for determining the selling price of eggs of various categories.

| Egg categories | SP-789 cross | Lohmann LSL Classic cross | Lohmann Brown Lite cross |
|----------------|--------------|---------------------------|--------------------------|
|                | SP1 | SP2 | SP3 | In average | SP1 | SP2 | SP3 | In average | SP1 | SP2 | SP3 | In average |
| Third          | 0.727 | 0.727 | 0.730 | 0.729 | 0.722 | 0.722 | 0.722 | 0.722 | 0.686 | 0.685 | 0.687 | 0.687 |
| Second         | 0.858 | 0.858 | 0.860 | 0.859 | 0.877 | 0.875 | 0.876 | 0.876 | 0.843 | 0.841 | 0.843 | 0.843 |
| First          | 1.139 | 1.139 | 1.141 | 1.140 | 1.136 | 1.136 | 1.136 | 1.137 | 1.124 | 1.122 | 1.122 | 1.122 |
| Selected       | 1.338 | 1.338 | 1.338 | 1.338 | 1.293 | 1.295 | 1.294 | 1.294 | 1.384 | 1.384 | 1.384 | 1.384 |
| Highest        | 3.02 | 2.50 | 0.14 % for SP1 prices; by 1.73, 1.82 and 1.24 % for SP2 prices, and by 2.82, 3.20, and 2.43 % for SP3 prices. As a result of the study, it was found that for all three crosses, the modal class or the class of the highest frequency of occurrence is the first category (57.69-63.49%). The average weight of eggs, the cost of 1 g of egg weight and the new selling price of eggs of this category practically coincides with the average values of the general set.

It should be noted that the sale of eggs by weight requires additional financial investments for the purchase, installation and maintenance of weighing equipment. In this regard, in order to minimize financial losses of enterprises when selling eggs, coefficients have been developed (Table 5) to determine the selling price of eggs of different categories for the studied crosses. They are calculated by dividing the new price of eggs in each category by the new price of eggs in the first category (see tables 2, 3 and 4).

Example: if the estimated selling price of 10 eggs of the first category is 42 rubles, then for the SP-789 cross the selling price of 10 eggs of the third, second, selected and highest categories will be 30.62 (42 rubles x 0.729), 36.08 (42 x 0.843), 47.75 (42 x 1.137), and 54.35 (42 x 1.294) rubles. For the Lohmann LSL Classic cross the prices will be 30.32 (42 x 0.722), 36.79 (42 x 0.876), 47.17 (42 x 1.123), and 58.13 (42 x 1.384) rubles, respectively.
4 Conclusion

The study showed that for all the considered crosses the modal class or the class of the highest frequency of occurrence is the first category (57.69-63.49%). The average weight of eggs, the cost of 1 g of egg weight and the new selling price of eggs of this category practically coincide with the average values of these parameters of the general set. It was found that it is most economically reasonable to sell edible eggs by weight. The developed methodology for de-termining the selling price of eggs of different categories makes it possible to increase the income of enterprises to the level of income when selling eggs by weight.

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