

## WAYS OF REDUCING OF THE BROKEN QUAIL EGGS WHEN CAGED POULTRY KEEPING

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**Formulation of the problem.** In recent years, quail breeding has become widespread in the households of the population of Ukraine. Indeed, in addition to tasty, dietary and environmentally friendly high-quality eggs and meat, which have numerous useful properties, keeping birds of this species is quite profitable and quickly paying off [1]. Quail breeding does not need large areas, the birds are unpretentious in maintenance, resistant to infectious diseases, multiply rapidly and are in demand among consumers.

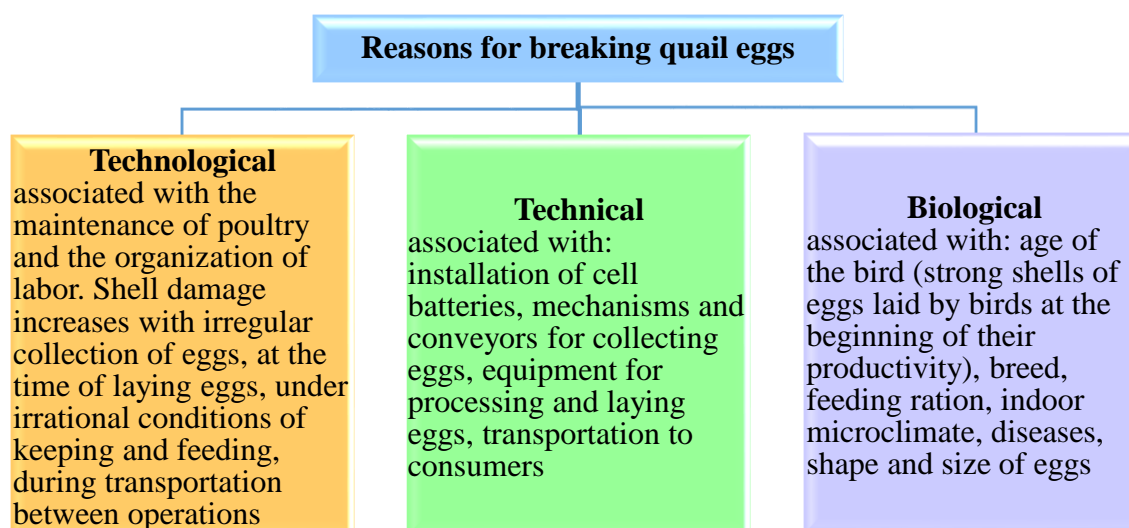
The average weight of one quail egg is 10-13 g, which is almost five times less than the mass of an average chicken egg. Despite its tiny weight, the product contains 27 trace elements. A true find for diet food. There are especially many vitamins of groups A and B in a quail egg, as well as potassium, phosphorus and iron – two to four times more than in a chicken product [2]. Eggshell is also the richest source of calcium and is used to prevent bone fragility, rickets and hypocalcemia.

Quite profitable for both entrepreneurs and gourmets is the egg direction of keeping quails. The average annual egg production of a female quail is 280-300 eggs. To obtain 1 kg of egg mass, the total feed costs are 2,8 kg. Quail egg laying begins at the age of 35-40 days. The weight of eggs that a female lays in a year is 24 times the body weight of the bird itself [2]. Perhaps one of the few drawbacks of this business is the loss due to violation of the integrity of the egg shell, because its thickness in quails is 0,22 mm (for birds – 0,35-0,4 mm, for guinea fowls – 0,5 mm). Consequently, the broken of eggs leads to a deterioration in the commercial quality of these products and financial losses.

**Statement of the problem.** There are several varieties of egg broken: in the form of a notch, a dent (crumpled side) and a wide open crack. The broken of quail eggs causes significant economic damage to farms. Egg production losses due to slaughter are at least 10 % (4 % in poultry houses, 3-4 % during collection and packaging, about 2 % during transportation), which is approximately 28-30 eggs per year per quail [1]. There is a need to consider the causes, analyze the prerequisites and consequences of the broken of quail eggs in the caged poultry keeping.

**Basic materials.** The reasons for the fight of quail eggs can be divided into technological, technical and biological (Fig. 1).

Damaged bird eggs immediately lose their ability to store and incubate.



**Fig. 1. Reasons for breaking quail eggs**

Eggs with damaged shells, but without signs of content leakage, are used by farms in industry, in the household – for animal feed.

There are two main ways to reduce the loss of eggs due to the breaking: by increasing the strength of the shell and by reducing the level of mechanical stress on the laid egg. Preservation of eggs from breaking by 30-80 % depends on the strength of the shell, which is achieved by optimizing mineral nutrition, primarily by increasing the calcium content in feed [3, 4]. However, a significant part of normal and even eggs with a fairly thick and strong shell can fall into the «broken» category. In some cases, the level of mechanical stress on the laid egg largely affects the amount of the breakage. A strong single impact or a sharp short-term pressure exceeding the resistance of the shell leads to its instant destruction. However, slight bruises, repeated many times, or slight but prolonged pressure can damage the shell. The number of mechanical influences, and consequently, the level of the broken, increase with an increase in the amount of movements of the eggs between themselves or the surface with which they interact. It is possible to reduce the possibility of impact on the egg by optimizing all technical means interacting with the egg on the way of its movement from the female quail to the consumer.

The best way to keep adult quails is cellular. In the cage keeping of birds, the laid egg interacts, first of all, with the floor grate. Its main technical characteristic should be shock-absorbing properties, the higher they are, the less the shell is damaged. Breakage of the shell integrity causes a fall from a height of less than 1 cm if the egg falls on a rigid, heavy grate that is practically devoid of cushioning properties. If the amplitude damping of the foot grate is more than 1 mm, the egg does not break even when falling from a height of twenty centimeters.

The shock-absorbing properties of the foot grating depend on its total mass, the angle of inclination, the thickness and condition of the surface of the wire (rods) from which it is made, on the size of the cells and the degree

of its stress under the weight of quails. The practice of holding quails shows that the optimal cell size is  $2,5 \times 2,5$  cm in order to prevent the loss of eggs due to falling onto a tray with litter (Fig. 2) [2]. The total mass of the foot grate with cells of the same size is proportional to the thickness of the bars. The larger their diameter, the harder the foot grate and, accordingly, the higher the breaking.

Egg breaking can be minimized by using a grate with a wire diameter of no more than 2 mm. Also, the reduction of the broken will become possible after the grating is covered with a polymer material, which, when demolished, will significantly soften the impact of the egg. The wire from which the foot grate is made must be smooth, because any irregularities on the surface will necessarily lead to injury to the bird, additional damage to the shell and delaying the rolling of eggs [2].

With a large inclination of the foot grate, when falling, the egg experiences a sliding impact, which slightly increases its braking distance, which reduces the broken, but also increases the speed of the egg rolling to the front side of the cage. Insufficient inclination of the foot grate leads to retention of eggs on it, which increases their contamination and the likelihood of breaking. When the foot grate is tilted by  $5^\circ$ , the number of eggs that did not roll out of the cage is 2,8 %, and at  $8^\circ$  it decreases to 1,9 %. The slope of  $8-10^\circ$  is considered optimal [5]. At the same time, the foot grate should be monitored from time to time for the presence of deflections, because the retention of eggs under the paws of a bird with sharp claws exposes them to additional notches, bruises and pecks. Such deflections are not eliminated by laying angle steel slats under the lattice, since in this case the rigidity and mass of such a lattice increases sharply with the broken of eggs, especially over the slats. If the quails are planted too tightly, the foot grate is strongly strained, which increases its rigidity and leads to an increase in the breaking.



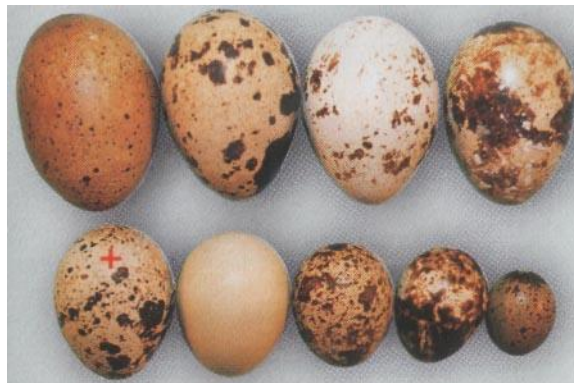
**Fig. 2. General view of the foot grate with optimal cell size and shock-absorbing properties**

A sharp increase in the broken of eggs can occur in stressful situations, when, during the restless movements of quails, the laid egg is subjected to

numerous blows with its paws. When quails are caged, the breaking can occur in the storage trough, when the slope towards the trough exceeds 6-8 °, its main cause is the collision of eggs in the tray. It is possible to reduce such a broken by establishing a gutter and constant technical care for it.

The broken of bird eggs can occur at a high speed of their rolling out into the chute (more than 30 cm/s), which can occur with an increased inclination of the foot grate. The broken is noticeably reduced if the way the eggs roll out along the foot grate is shortened, and this can be achieved by reducing the depth of the cage. If the egg rolling path is reduced from 75 to 60 cm, the damage is reduced by 1,5 %, while the eggs are under the feet of quails for almost 15 % less time and, accordingly, are less polluted and unstuck [1].

The probability of a broken is less if the egg comes out of the cloaca with a sharp end forward, and this is due to the heredity of birds. If the egg shape index deviates from the norm (70-80 %), shown in Figure 3, there is an additional mechanical effect on the shell, since the technical characteristics of the egg processing and packaging mechanisms are designed for their optimal shape.



+ – quail egg with an optimal shape index

**Fig. 3. Deviation of the shape index of quail eggs from the norm**

The breaking largely depends on the mass of the eggs, the larger the egg, the higher its kinetic energy when rolling out of the cage and the greater the impact force it perceives from interference at the same speed of movement. In addition, large eggs, compared to smaller ones, usually have less sphericity, and therefore less strength, for the same shell thickness.

As practice shows, the broken does not increase when eggs are stored in stacks of 6-8 trays [2]. To reduce the breaking, it is important to develop an optimal egg harvesting regimen, which is built taking into account the dynamics of laying during the day. The maximum number of quail females lays eggs (depending on the light regime) during the absence of light in the poultry house [6]. It is during this time period that most of the eggs from the total daily output come from quails. With an increase in the frequency of egg harvesting, the broken decreases.

It is impossible to exclude the influence of the human factor on the

breaking of eggs. The movement of the bird, the unusual actions of the attendants cause hysteria and increased arousal of quails, as a result of which the number of cases of hidden damage to the shell, which manifests itself due to squeezing the egg in the uterus, increases. During cleaning, packaging and transportation, latent damage to eggs turns into obvious ones. The attendants must observe one color of clothing, carefully remove the eggs from the receiving trays into the container and sort them. It is necessary to maintain a calm environment in the poultry house, to avoid sudden noises and not to carry out work (even nearby), accompanied by noise and heavy traffic of people. It is known from literary sources [1] that sounds with a power of 90 dB, caused by a hammer striking metal, increase the egg breaking up to 4 % within 15 minutes, and up to 6 % within 30 minutes and per hour – up to 12 %. The loudness of industrial noise according to the norms should not exceed 60 dB.

The level of egg breaking outside the farm depends on the methods of packaging, loading (unloading) and on the means of delivery to the consumer.

**Conclusions.** It is possible to significantly reduce the broken of quail eggs by optimizing the design of cell batteries and the functioning of technical means, establishing regular collection, rationalizing the conditions for feeding and poultry keeping. Eggs are more likely to be damaged in multiple transfer operations, and at times their integrity even depends on the number of layers of trays in a stack.

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