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The analysis of ostrich chick vitality

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SUMMARY

Examinations on ostrich chick vitality can help to improve the effectiveness of Hungarian ostrich husbandry and hatching technology. The investigations were carried out on an ostrich breeder farm in Eastern Hungary. For the analyses, the Tona et al. (2003) scoring system was applied presenting eight main criteria (activity, feather, condition, eyesight, the condition of navel and leg, the amount of the remaining shell membrane and egg content, and the size and tenderness of the abdomen). Most chicks (98.08%) were vigilant and had clean and dry feathers. There was no difference between the average hatching weights between May and August but a decreasing tendency was shown during the laying season. The vitality total score was above 90 in each evaluated month and was not affected by the hatching month. Our results revealed that the vitality of chicks was not affected by either the hatching month (P=0.51) or the weight category (P=0.11). Neither the hatching weight of chicks and leg condition were correlated (P=0.79). Results showed that the Tona scoring system with small modifications can be well applied to ostrich chicks. Practical on-farm usage of the system can be suggested as an aid in day-old chick evaluation. After individual marking of chicks, the investigation of growth and culling rate could be carried out for more precise conclusions, involving more farms and laying seasons.

Keywords: *ostrich; chick vitality; hatching month; hatching weight; weight categories; Tona scoring system*

INTRODUCTION

Chick quality is a determining factor in poultry breeding for hatchers and broiler growers as well. The quality of freshly hatched chicks is an indicator of chick vitality and is affected by many factors from the fertilisation of eggs to the housing. The heritability of chick quality is low (0.08–0.09), so environmental conditions have a significant role in this respect (Liptói and Hidas, 2006). The influencing factors are divided into factors before and during incubation (Ipek and Sözcü, 2013).

Factors before incubation include the age, genotype and health condition of breeders, the quality of eggs, egg treatment and storage. Factors related to incubation are incubation temperature and humidity, ventilation, rotation (Christensen et al., 2001; Decuypere and Bruggeman, 2007) and hygiene (Brassó et al., 2022).

The age of hens has a strong relationship with the weight of eggs and the weight, size and quality of chicks (Tona et al., 2004). Older females lay heavier eggs (Roque and Soares, 1994) with a higher yolk ratio (Suarez et al., 1997), and thinner shells (Peebles et al., 2000). Chicks hatched from the eggs of older females are heavier (O'Dea et al., 2004), however, the ratio of weak-quality progenies also (Boerjan, 2002). In eggs produced by younger hens, the quality of the albumen and the thickness of the eggshell is better resulting in a higher number and quality of chicks (Tona et al., 2004). Egg treatment and storage time are other significant effects. Eggs can be stored for up to seven days without a relapse in hatchability. The storage over seven days increases the frequency of abnormalities and mortality of embryos (Decuypere and Bruggeman, 2007). In addition, the hatchability of eggs, the albumen quality and yolk/albumen ratio, and the weight of hatched chicks decrease (Decuypere and Bruggeman, 2007). Also, during the laying season, the nutritional reserves of females are depleted (Ankney and Macinnes, 1978), so the nutrient composition of eggs is supposed to change resulting in lower chick vitality. The hatching weight of chicks also has a great impact on their vitality. Verwoerd et al. (1999) reported that the hatching weight between 780 and 975 g is optimal. According to Gonzalez et al. (1999), the hatching weight of chicks generally ranges between 53 and 70% of egg weight. The optimal hatching weight is around 63% of the initial egg weight (El-Safty, 2012). Consequently, chicks in the 801 to 900 g weight category are supposed to have the best vitality and survival. Also, Cloete et al. (2001) agree that chicks below 762 g at hatch, have the highest mortality up to 28 days.

Incubation parameters strongly impact embryo development, hatchability and post-hatch growth (Willemsen et al., 2008). The balance in the temperature during incubation positively affects organ development, embryo growth, embryo quality, and post-hatch performance (Shafey, 2004). Lower-than-optimal humidity in the incubator results in weak, dehydrated, sticky chicks. However, higher-than-optimal humidity inhibits navel closure (Du Preez, 2007). Ventilation is essential for the air change and the appropriate heat release of the embryo. If the intensity of ventilation is not adequate, liquid accumulation arises around the developing embryo due to the lack of oxygen (Deeming, 2000). Turning eggs is necessary for the optimal development of the extraembryonic membranes. The lack of rotation through the adherence of shell membranes, wrong embryo position, reduced development of germinal layers, inappropriate gas exchange, and diminished albumen and yolk usage lead to weak hatchability, longer incubation time and sticky chicks (Deeming, 2000). Furthermore, both the type of

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incubator and the chick nursing technology have a great impact on the chicks' quality and vitality (Jong et al., 2016; Mesquita et al., 2021).

Chick quality or vitality can be assessed by quantitative and qualitative scoring (Decuypere and Bruggeman, 2007). The quantitative method is based on the weight of the yolk and chick, indicating the ratio of yolk absorbed by the embryo during development (Meijerhof, 2005). This method is destructive, requiring the death of chicks.

The qualitative method scores according to the appearance of the chicks. The Tona and Apgar standard scoring systems investigate the chick vitality, the ratio of absorbable yolk and the extent of navel closure (Du Preez, 2007). The Pasgar scoring measures the activity, and the condition of the beak, navel, and leg. The best scores are close to 9 as the standard. For every negative trait, one score is detracted (Boerjan, 2002). The Tona scoring indicates a maximum of 100 scores with differences in the level of conditions in each parameter. The better the condition is, the higher score is given (Tona et al., 2003). So far, vitality scoring systems have been established only for broiler chicks.

Our study aimed to evaluate if the method of Tona scoring (Tona et al., 2003) is applicable to ostrich chicks and after small modifications of the criteria the system was optimised. Chick quality was also investigated to get an insight into the Hungarian husbandry and hatchability technology. We hypothesised that the hatching weight and vitality of chicks would decrease by hatching month due to the depletion of the females' nutrient reserves. Also, the hatching weight of chicks was supposed to affect chick vitality, i.e. higher-than-optimal or lower-than-optimal hatching weight can negatively impact chick vitality.

MATERIALS AND METHODS

Vitality assessments were done in May, July and August 2022 on one large farm in Hungary, located in Hajdú-Bihar County. The farm worked with a hundred breeders kept in trios and harems. The breeders were aged between five and twelve years but we did not know which breeders the eggs and chicks originated from.

Hatching technology and husbandry system

Eggs were collected daily and stored at 16 ˚C for ten days. In the storage room, eggs were turned 45˚, twice a day. The incubation was carried out at 36.5 ˚C and 20% relative humidity. Continuous ventilation was provided. Incubators were disinfected only at the time of the first annual incubation. Eggs were candled on the 10th, 21st and 38th days and rotated 45˚, hourly. The eggs were placed in the hatcher on the 38th day of incubation where 35 ˚C and 25% relative humidity were applied. The mean incubation time was 42 days. After hatching, chicks spent one more day in the hatcher to dry and get strong, and then they were placed in battery cages. On the first three days, the temperature was 30 ˚C which was decreased by 0.5–1 ˚C on every 3rd day. At one month of age, above 15 ˚C, they were allowed to the yard.

On the 5th day, they were fed with water and feed to stimulate the absorption of yolk. Until the age of six to eight weeks, they got ad libitum ostrich starter feed and chopped alfalfa. From 8 weeks to 8 months, grower, from the 8th month, finisher was provided.

Description of the assessed criteria

Activity

The activity of chicks included vigilance and active movements. The chicks were interested in their environment and reacted to the approach of humans and other chicks. Sick ones were inactive and could be described with opposite characteristics.

Feather

The condition of the feather could be dry or wet, clean or dirty, and a combination of that. The dry and clear feather was optimal without any remaining yolk, albumen or membrane on it (10 scores). If the feather was wet in parts due to the excessive remaining egg content, it was a good place for bacterium proliferation. If less amount of egg content remained on the feather, the process of drying was faster. When the chick was already dry at the time of judgement, however, some part of the feather was covered with dried egg content and extra down was stuck to the feather indicating some problems during the development (8 or 0 scores, depending on the amount of remaining egg content and the level of dirt and wetness).

Eyesight

When the eyes were completely open and bright, the chicks showed good quality and vitality (6 scores). Faint eyesight was related to weakness. Closed eyes were a sign of extreme weakness due to developmental problems. Chicks with faint and closed eyes were weak at hatching (0 scores).

Legs

The chicks with normal legs could stand. There was no hock or injury on the skin (16 scores). Oedematous and deformed legs (with deformed fingers) were signs of lower vitality (8 scores). Higher-than-optimal humidity, lower-than-optimal temperature, and insufficient ventilation can result in oedema not only on the leg but also on the head, neck and thigh (0 scores).

Navel

The navel of the completely developed chick is closed by the time of hatching (16 scores). Through the open navel, the chick is vulnerable to microbial infection (8 scores). As the immune system is not yet well developed at this age, microbial infection can lead to serious diseases or even mortality. When the navel is swollen, it is open and a reddish ring surrounds that (0 scores). Poor egg treatment and hatching technology can cause navel problems.

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Remaining membrane

If the feather of the chick was sticky and the humidity in the hatcher was low, the shell membrane could easily stick to the body and be peeled off. The size of the remaining membrane was in a strong relationship with relative humidity and the stickiness of the feather (0, 8, 12, or 16 scores).

Remaining yolk and albumen

The amount of yolk remaining around the navel or on the feather indicated the amount of unused part of egg content (0, 8, 12, or 16 scores). When the incubation temperature is too low, the humidity is too high, and the ventilation and the turning of eggs are weak, the absorption of egg content is inappropriate.

Tenderness of the abdomen

The tenderness of the abdomen showed the quantity of yolk closed into the abdomen of chicks. A full and hard abdomen indicated that there was a satisfactory amount of yolk for later nutrition (12 scores). Flat abdomen received 6 scores. Due to the gas produced by putrefactive bacteria penetrating into the abdominal cavity, the abdomen was enormous and the tenderness was very smooth. Also, the cloaca was open as a result of the excessive gas content in the abdominal cavity (0 scores).

The method of the judgement

Regarding the sensitivity of ostriches to handling and also the high individual value of the chicks, the qualitative method was applied in the evaluation. The observations were carried out on 208 post-hatch chicks within 24–36 hours after hatching. Disinfectants and gloves were used to avoid bacterial infection. Scores were recorded on an observation sheet with the table according to Tona et al. (2003). The individual marking of chicks was unfeasible, so the traceability of growth and mortality of chicks was not possible. Therefore, only the vitality of the chicks was evaluated at the time of hatching. The judgement was conducted on dry chicks, in hand (at least a couple of hours after hatch) when chicks were transported to the battery cages.

First, the weight of the chicks was measured with a two-decimal digital scale, and then all the parameters were assessed according to *Table 1*.

The condition of the eyesight, legs and navel, and the quantity of the remaining egg content are considered the most significant signs of chick quality and vitality which is why they have a higher level in the maximum categories (Tona et al., 2003). The total score of vitality was the sum of the scores reached in each parameter.

The assessment required around 1 minute for each individual.

Table 1. **The criteria of the Tona scoring system**

Quality criteria	Condition categories	Scores in each category
Activity	active, responsive/passive, unconcerned	6/0
Feather	dry, clean/wet/dirty	10/8/0
Eyesight	bright/faint/closed eyelids	16/8/0
Legs	normal, stands firm/oedematous/strongly oedematous, unstable	16/8/0
Navel	normal/open/open with colour change	16/8/0
Remaining membrane	none/small/large/extremely large	12/8/4/0
Remaining yolk and albumen	none/little/medium/much	16/12/8/0
Tenderness of abdomen	full and hard/flat and smooth/chubby	12/6/0

(Tona et al., 2003)

Statistical evaluation

For data collection and preparation, as well as for the calculation of total scores and percentages, Microsoft Office Excel 2016 was applied. The effect of hatching month on hatching weight and vitality total score, and the effect of hatching weight category on vitality total score were analysed in separate models with univariate analysis using the IBM SPSS Statistics 23.0 program. The weight of chicks was examined by categories since the literature states that chick vitality varies by weight categories (Verwoerd et al., 1999; Cloete et al., 2001). Heavier chicks were supposed to have worse leg conditions compared to lighter ones (considering that the oedema was mainly present on the leg). The relationships between hatching weight and leg condition, and between chick weight and vitality total score were examined with Pearson correlation in the IBM SPSS Statistics 23.0 program.

RESULTS AND DISCUSSION

The ratio of chicks in the different quality categories

Almost all of the chicks were active and vigilant (*Table 2*). Only four of them showed weakness and inactivity. Most of them had optimal-quality, clean and dry feathers. More than 10% had wet feathers and less than 1% showed dirty feathers. More than 90% of chicks showed vigilance and were curious about their environment which is a reliable sign of health and vitality. A small ratio of them was faint and closed their eyes due to weakness or agony. The greatest differences between categories were found in the leg. Half of the population was normal, however, less than half of them were characterised with oedematous legs. Less than 5% was strongly oedematous and in some cases, the neck and thigh were also thick due to the extra amount of

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interstitial fluid. Most chicks with strongly oedematous legs were chubby, had matted feathers, and deformed legs. 11% of chicks were found to have x-shaped or deformed (rotated tibiotarsal or rolled toes) legs. Almost 90% of chicks had a normal, closed navel of which some had the dried umbilical cord present but around 10% were open. Less than 1% showed discoloured (red or brown), and swollen navels. More than 90% of chicks did not have any remaining membranes. About 6% of chicks were covered with the shell membrane on a small part of their body surface. Around 0.5% had large and less than 1% had extremely large membranes. Chicks with large and extremely large membranes had also problems with activity, leg condition, eyes, navel and abdomen. No remaining egg content on the feather or around the navel was established in more than 90% of birds. Less than 4% showed a small amount of egg content around the navel or on the feather and only a few of them had large or extremely large amounts. Most chicks had appropriately filled and normally hard abdomens. A small percentage presented small and flat abdomens, however, almost 6% of chicks were chubby. Most of the chicks with chubby abdomens had oedematous legs and some showed open navels and matted feathers.

We established that the condition of the legs is not influenced by the amount of the remaining egg content since chicks with both oedematous and normal legs had the least remaining egg content. The condition of the legs was not related to the tenderness and size of the abdomen. The tenderness and size of the abdomen were normal (full and appropriately hard) for chicks with normal and oedematous legs, respectively. The relationship between the tenderness and size of the abdomen and the amount of the remaining egg content was positive. We did not have information on the ratio of assisted chicks. Brand et al. (2019) also stated that the neck and legs were oedematous and the moving of chicks was uncertain, even if they were already dried up. Oedema can be caused by the unsatisfying intensity of ventilation during incubation (Deeming, 2000). Around 10% of chicks had deformed legs (tibiotarsal rotation or rolled toes). Leg deformation is a common problem in ostrich chicks. Mushi et al. (1999) found that 15.3% of the evaluated chicks showed deformed legs of which more than 70% had tibiotarsal rotation and around 30% were characterized with rolled toes. The longer-than-seven days storage time of eggs increases the prevalence of deformities (Decuypere and Bruggeman, 2007). 90% of chicks had normal, closed navels and in some, the dried umbilical cord was also present. Around 10% of chicks had open navels. The higher-than-optimal humidity in the incubator and hatcher inhibits navel closure (Preez, 2007), however, the initial weight of eggs also significantly affects their weight loss during incubation (Ograk and Altinel, 2010). The lack of turning or the inappropriate turning of eggs can result in the egg content sticking to the plumage (Deeming, 2000). The literature does not mention the prevalence of the inner shell membrane and the different sizes of the remaining egg content either in ostrich or poultry. The problems with the navel and the restricted yolk are the characteristics of chicks weak at hatching and oedematous chicks due to the lack of oxygen in the last week of incubation (Dzoma and Dorrenstein, 2001). The success of yolk sac retention is also influenced by many other factors, such as the weight loss and number of eggs incubated together, early chick feeding and husbandry condition (Raines, 1994). The heritability of egg weight loss during incubation is 0.40–0.41 in ostrich (Brand et al., 2008), so the genetic background of weight loss affecting chick vitality is significant and can be a selection aspect.

Table 2. **The ratio (%) of ostrich chicks in the different quality categories**

Quality criterion	Score	Ratio (%)
Activity	6/0	98.08/1.02
Feather	10/8/0	87.02/12.02/0.96
Eyes	16/8/0	95.19/3.37/1.44
Legs	16/8/0	49.52/45.67/4.81
Navel	16/8/0	89.42/9.62/0.96
Remaining membrane	12/8/4/0	91.83/5.77/0.48/0.96
Remaining yolk and albumen	16/12/8/0	94.71/3.37/1.44/0.48
Tenderness and size of the abdomen	12/6/0	91.83/2.40/5.77

Relationships between hatching traits and chick condition

Though there was more than a 30 g difference between the smallest mean weight of chicks in August and the largest mean weight in May, the difference was not significant (P=0.052) (*Table 3*). However, the tendency showed that as the laying season proceeded, the hatching weight of chicks decreased. Also, the extent of the decline was twice higher between July and August than in May and August. The month of hatching had no significant effect on the vitality total score (P=0.51). The mean vitality score for all the examined months was above 90. No correlation was established between the weight category and the vitality of chicks (P=0.11). Neither the hatching weight of chicks and leg condition were correlated (P=0.79). However, the tendency showed that the hatching weight of chicks with the worst leg condition was the highest ($\bar{x}$=870 g), however, the weight of the birds was significantly lower ($\bar{x}$=803 g) in the middle-category group. The mean hatching weight of chicks with leg deformities was 812.45 g, ranging on a large scale, from 690 to

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965 g. No literature data are available on the effect of the laying month on chick hatching weight. Verwoerd et al. (1999) found that chicks between 780 and 925 g showed the best quality and more than 60% of chicks belonged to this weight category.

Table 3. **The effect of the month on the hatching weight of the chicks and the vitality total score**

Hatching month	Chick hatching weight (g)	Vitality total score
May	825.75±9.02	92.68±1.05
July	817.68±11.24	93.29±1.31
August	792.62±10.44	91.29±1.22

Relationships between the hatching weight category and chick vitality

The total vitality scores ranged between 28 and 100, however, there was no significant difference between the weight categories (*Table 4*). The weight category did not significantly influence chick vitality. In our previous research, it was stated that the hatching month, the hatching order and the hatchability of eggs significantly influenced the long-term survival of birds (Brassó et al., 2022). However, our unpublished results showed that the survival rate of chicks is unchanged during the first week of age. After one week, the probability of survival decreases by 16%. Consequently, the long-term survival cannot be accurately estimated only by the evaluation of the day-old vitality but it is rather dependent on the post-hatch husbandry technology.

Table 4. **Chick vitality total scores as affected by the weight category**

Hatching weight categories	Vitality total scores
600–700 g	92.86±1.85
701–800 g	92.27±1.26
801–900	93.16±1.01
900 g <	89.54±1.92

CONCLUSIONS

It can be concluded that most of the examined chicks had good quality and vitality. Among the assessed criteria, the leg condition showed the greatest variability. A relatively high number of chicks were found to have leg deformities. Our results revealed that the vitality of chicks was not affected by either the hatching month (P=0.51) or the weight category (P=0.11). Neither the hatching weight of chicks and leg condition were correlated (P=0.79). The other examined criteria were not related. Regarding the applied method based on the Tona scoring system, it would be practical to extend the judgement scale and apply scores with greater differences. After reliable marking, the individual monitoring of chicks (growth, mortality, etc.) would be useful in the future to see, how the day-old vitality corresponds with the post-hatch performance and survival.

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