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# Quality of Eggs Handeled and Stored by Different Methods

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TWO BREEDS and their two reciprocal crosses were used to study the effect of storage periods, storage temperature and transpartation on egg quality. The two breeds were White Leghorn and Rhode Island Red. Thirty birds from each breed and cross were use for each treatment. Ten eggs were used per individual for each test. Characters studied were : Egg weight, yolk weight, total albumen volume, percentage of thick albumen to total albumen, volume of thick albumen, albumen hieght, yolk hieght, shell thickness (at the broad end, at the arrow end, at the waist and their average), deformation, shape index, breaking strength, specific gravity including air cell, specific gravity without air cell and volume of air cell. Quality of egg was found to be influenced by storage Periods, storage temperature and transporation. Shell quality was affected greatly by storage temperature. Deformation proved o be the most practical method for measuring shell quality

Loss in weight is one of the most obvious changes in aging egg. It is caused chiefly by the evaporation of moisture, at first prencipally from the albumen. Almost immediately after the egg is laid, the air cell is produced by the contraction the egg contens as they cool from the hen's body temperature to the temperature of the external environment (Lee *et al.*, 1945, The rate of water loss is positively related to the holding period and temperature (Romanoff, 1949). For the changes occuring in egg and shell quality by holding periods and temperature, many workers used different methods for storing eggs, different holding temperatures (ORR and Snyder ; 1959 and Fletcher *et al.* ; 1959).

The aim of this work is to study the effect of storage temperature, and transportation and storage periods on egg contents and shell quality for two breeds, namely. White Leghorn and Rhode Island Red and their reciprocal crosses.

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## Material and Methods

A series of experiments was done at the Agriculture University, Wageningen, the Netherlands. Eggs of equal numbers of two breeds, Wite Leghorn (WL) and Rhode (RIR) and their reciprocal two crosses where used. Pullets were trapnested and the characters described in table 1 were measured on each egg in the following cases :

1. Fresh eggs.
2. Stored eggs after 1, 4, 7, 14, and 21 days.
3. Stored eggs at 5-9°C and 20°C with relative humidity of 60 - 65% and of 70-75% for three weeks of storing.
4. Eggs packed and nonpacked, to examine the effect of transportation on eggs. Transportation effect was examined here by dropping, with a- fixed angle, a case of standard packed eggs (full box with 360 eggs on key trays) from two metres hight.

Each group contained 10 birds. Ten eggs per bird had been tested for the characters mentioned in table 1. The remaining eggs were used to study the influence of packing and grading according to weight on breakage during transportation.

*Methods of determination*

1. Specific gravity: At 4 p.m., eggs were weighted on a Mettler balance. After weighing, specific gravity was determined by weighing the egg under water at 20°C using the same balance with a special attachment. During weighing in water air bubbles were avoided to ensure the correct reading. Specific gravity was calculated as follows :

Specific gravity = Egg weight / Egg volume, where
Egg volume = Egg weight — Egg weight in water.

2. Shape index : Shape index was determined by a semi-automatic apparatus (Van Doorn) which gives a direct reading of the index. without measuring the breadth and length separately.

3. Deformation: This is a rather new method of determination of the resistance of the shell against deformation without damaging the shell. It was measured with a special apparatus designed by Schoorl and Boersma (1962). This apparatus measures the bending of the egg, under a certain load (500 g). The deformation was measured on the waist part of the egg. Measuring on that place was chosen because the shell at the waist shows less variability and may thus give higher correlation coefficient with shell thickness. Reading of deformation were on 0.001 mm.

4. Breaking strength : The measurements of breaking strength were made with a device constructed especially for this purpose. This apparatus is designed in a way such that a pressure is applied on the egg by a blot placed

on the large of end the egg. The source of pressure was by means of granulated lead shot. When the lead was poured, the pressure on the shell was produced. As soon as the shell is broken the lead stops pouring automatically ; the quantity of lead poured is weighted on the same apparatus gives the breaking strength in kilograms and grams.

The ordinary analysis of variance was practiced. Correlations were calculated between the different characters. Only the significant correlations are presented in the results ; the insignificant ones were neglected.

TABLE 1. Symbols and description for the characters studied.

| Symbols | Description of the traits |
|---|---|
| | A—Egg Quality |
| EW . . . | Weight of egg in grams. |
| Yw. . . . | Yolk weight in grams. |
| TA . . . | Total albumen volume (ml). |
| TA% . . | Percentage of thick albumen to total albumen. |
| VA. . . . | Volume of thick albumen in relation to egg weight. |
| AH . . . | Albumen hight (mm). |
| YH . . . | Yolk hight (mm). |
| SI . . . . | Shape index. |
| VC . . . | Volume of air cell by weighing the egg under water with air chamber filled with water. |
| | B—Shell Quality |
| D . . . . | Deformation of the egg under 500 grams pressure on the blunt end. |
| BS . . . . | Breaking strenght measured at the blunt end. |
| SG . . . | Specific gravity including air chamber. |
| SGW . . | Specific gravity without air chamber. |
| SB . . . . | Shell thickness at the broad and (0.01 mm). |
| SN . . . | Shell thickness at the narrow end (0.01 mm). |
| SW. . . . | Shell thickness at the waist (0.01 mm) |
| SS . . . . | Average of the three measurements of thickness. |

## Results and Discussion

*Bread effect*

No much differences are observed betweeen the two breeds and their crosses in the average egg weight; figures obtained are around 59.6 g, (Table 2) Total thich albumen, volume of thick albumen and albumen and yolk hight showed almost the same means in the two purebreds. The values obtained for the two crosses are much lower. Differences between breeds and crosses for these characters to be highly significant. Yolk weight showed a slight increase in weight in behalf of the two crosses over the purebreds. Mostageer and Kamar (1961) found such conclusion in Fayoumi, White Leghorns and their two crosses.

TABLE 2. Mean values for the characters studied for the two breeds and their crosses.

| Item | Breeds and crosses | | | | F values between breeds) |
|---|---|---|---|---|---|
| | WL | RIR | WR | RW | |
| EW . . | 59.62 | 59.66 | 59.61 | 59.83 | 0.16 |
| YW . . | 17.70 | 17.60 | 18.04 | 18.48 | 5.19** |
| TA . . | 32.34 | 32.59 | 32.15 | 32.62 | 1.19 |
| TA% . | 53.73 | 52.98 | 46.04 | 48.03 | 31.25** |
| AA. . . | 17.41 | 17.30 | 14.86 | 15.72 | 24 04** |
| HV . . | 0.51 | 0.53 | 0.44 | 0.44 | 52.90** |
| YH . . | 1.91 | 1.90 | 1.85 | 1.83 | 28.72** |
| SI . . . | 73.87 | 74.26 | 73.67 | 73.87 | 1.29 |
| VC . . | 0.78 | 0.77 | 0.94 | 0.94 | 21.23** |
| D . . . | 18.17 | 18.85 | 19.39 | 18.76 | 2.07 |
| BS . . | 3811.5 | 3891.8 | 3817.2 | 3758.5 | 0.85 |
| SG . . | 0.76 | 0.76 | 0.72 | 0.71 | 19.29** |
| SGW . | 0.91 | 0.91 | 0.91 | 0.91 | 0.97 |
| SB . . . | 34.63 | 34.22 | 33.90 | 33.84 | 1.26 |
| SN . . | 35.16 | 34.84 | 34.28 | 34.46 | 1.65 |
| SW . . | 34.79 | 34.64 | 34.24 | 34.19 | 0.7 |
| SS . . | 34.86 | 34.57 | 24.14 | 34.17 | 1.3 |

* Significant at 5% level. ** Significant at 1% level.

Specific gravity showed significantly lower means in the two crosses compared to purebreds which had almost the same mean. Volume of air cell showed the reverse trend, the two crosses had much higher means compared to purebreds.

*Effect of storage periods*

Egg weight and contents were influenced to a great extent by storage periods, the egg decreased in weight by aging from 60.5 at the first day of storage to 58.1 g. at the 21 st day (Table 3). The same holds true with all the characteristics of egg components except yolk weight which suffers no loss.

TABLE 3. **Effect of storage periods on the characters studied.**

| Item | Storage time in days | | | | | F values (between) periods |
|---|---|---|---|---|---|---|
| | 1 | 4 | 7 | 14 | 21 | |
| EW . | 60.53 | 60.63 | 59.73 | 59.39 | 58.11 | 12.69** |
| YW . | 17.59 | 17.81 | 17.95 | 18.35 | 18.06 | 2.15 |
| TA . | 33.23 | 32.80 | 32.18 | 32.43 | 31.47 | 8.56** |
| TA% | 59.50 | 53.43 | 49.08 | 47.33 | 41.61 | 80.03** |
| VA. . | 19.79 | 17.53 | 15.79 | 15.35 | 13.15 | 77.29** |
| AH . | 0.63 | 0.52 | 0.46 | 0.42 | 0.39 | 144.79** |
| YH . | 1.96 | 1.92 | 1.88 | 1.82 | 1.79 | 61.40** |
| SI . . | 73.88 | 74.04 | 73.51 | 74.61 | 73.46 | 4.10** |
| VC . | 0.45 | 0.61 | 0.78 | 1.06 | 1.41 | 272.94** |
| D . . | 18.86 | 19.16 | 19.04 | 18.28 | 18.63 | 0.82 |
| BS . | 3778.5 | 3782.8 | 3730.4 | 3880.2 | 3927.3 | 1.49 |
| SG . | 0.82 | 0.79 | 0.75 | 0.71 | 0.63 | 183.07** |
| SGW | 0.91 | 0.91 | 0.90 | 0.92 | 0.91 | 1.45 |
| SB . . | 34.50 | 34.14 | 34.11 | 34.33 | 33.64 | 0.82 |
| SN . | 34.90 | 34.71 | 34.72 | 34.94 | 34.13 | 0.92 |
| SW. . | 34.66 | 34.35 | 34.45 | 34.45 | 34.30 | 0.14 |
| SS . | 34.70 | 34.41 | 34.43 | 34.61 | 34.02 | 0.60 |

* Significant at 5% level. ** Significant at 1% level.

TA% decreased from 59.5 at the first day of storage to 41.6 at the 21 st day. AH decreased also from 0.63 for the fresh eggs to 0.39 at the 21 st. day of storage. This agree well with Romanoff (1949) who found that loss in aging egg is caused cheifly by evaporation of moisture, mainly from albumen.

Specific gravity decreased after 21 days of storage from 0.82 to 0.63 while air cell volume increased during this period from 0.45 to 1.41. Fromda *et al.* (1953) found seasonal variation for specific gravity of about 1.070 in January to 1.031 in March.

Mean values for shape index in different storage periods showed very similar values although differences proved to be significant. Sterkie (1956) reported that egg shape is influenced most by the isthmus, according to some authors, and by the uterus, according to others.

*Effect of storage temperature*

Yolk weight showed a high significant increase by increasing storage temperature (Table 4). Albumen characteristics decreased greatly by increasing storage temperature. It may be concluded, that water evaporated from egg in warm storage is mainly from albumen.

Shell thickness decreased markedly in warm storage, differences proved to be highly significant. "The Vant Hoff rule" of linear ratio states that (within a certain limits) the the speed of chemical reactions is doubled or trebled (that is, increasec by 100 or 300 percent) for an increase of 10°C or 18 °C in temperature, or is increased by 20 to30 percent for an increase in tempeture of 1°C Sanuel 1945). This may clarify the decrease in shell thickness observed, since chemical reactions is thought to increase in egg by increasing storage temperature, and shell is the only source of menirals for chemical reactions. Warren and Schnepal (1940) obtained thinner egg shells almost immediately after experimentally increasing the environmental temperature from 20°C to 32.5°C, a recovery in shell thickness occured after a subsequent decrease in temperature. Also Wilhelm (1940) and Brant *et al.* (1953) reported from their work on high environmental temperature and shell thickness, that the usual pattern followed is a gradual thinning of the shell.

Breaking strength decreased also owing to the decrease in shell thickness. Specific gravity, measured with or without air cell, seems to have the same trend. Heuzer and Norris (1946) reported that breaking strenght is greatly influenced by environment, it is lower during July and August than during the Winter. Specific gravity is highly correlated withs shell thickness and also with breaking strength. Baker *et al.* (1958) and Godfrey (1949) reported highly significant positive correlations between the last two items.

TABLE 4. Effect of storage temperature on the traits studied

| Item | Storage temperatures | | F values between storage temperature |
|---|---|---|---|
| | Cool (5- 9 °C) RH% 60-65% | Warm (20 °C) RH% 70-75% | |
| EW | 59.77 | 59.59 | 0.46 |
| YW | 17.63 | 18.27 | 13.60** |
| TA | 32.65 | 32.19 | 5.02* |
| TA% | 51.37 | 49.01 | 12.37** |
| VA | 16.80 | 15.84 | 14.28** |
| AH | 0.49 | 0.48 | 2.15 |
| YH | 1.87 | 1.88 | 2.49 |
| SI | 74.93 | 72.91 | 86.96** |
| VC | 0.85 | 0.87 | 1.16 |
| D | 18.74 | 18.85 | 0.10 |
| BS | 3690.4 | 3949.1 | 19.02** |
| SG | 0.7 | 0.73 | 1704** |
| SGW | 0.9 | 0.89 | 14.59** |
| SB | 34.63 | 33.66 | 9.22** |
| SN | 35.14 | 34.23 | 8.88** |
| SW | 35.00 | 33.92 | 9.86** |
| SS | 34.93 | 33.94 | 11.01** |

* Significant at 5% level. ** Significant at 1% level.

*Effect of transportation*

It is quite clear that during transportation, most large eggs had been craked and the remainder were relatively the smallest ones (Table 5). Yolk weight, total albumen and volume of air cell have relatively lower means, while, albumen hight, yolk hight and specific gravity have relatively higher means. Small eggs seems to have thicker shell and accordingly higher breaking strength and specific gravity which can be conculded from the results obtained here.

TABLE 5. Effect of method of transportation on the characters studied.

| Item | Packed | Nonpacked | F values (between methods |
|---|---|---|---|
| EW | 58.71 | 60.66 | 58.13** |
| YW | 17.43 | 18.47 | 35.70** |
| TA | 31.57 | 33.27 | 70.18** |
| TA% | 50.86 | 49.53 | 3.92 |
| VA | 16.13 | 16.52 | 2.40 |
| AH | 0.50 | 0.47 | 21.61** |
| YH | 1.89 | 1.86 | 23.75** |
| SI | 73.93 | 73.90 | 0.01 |
| VC | 0.79 | 0.93 | 47.41** |
| D | 18.65 | 18.94 | 0.69 |
| BS | 3848.7 | 3790.7 | 30.95** |
| SG | 0.76 | 0.72 | 81.06** |
| SGW | 0.92 | 0.89 | 30.89** |
| SB | 34.30 | 33.99 | 0.91 |
| SN | 34.67 | 34.70 | 0.90 |
| SW | 34.73 | 34.20 | 2.37 |
| SS | 34.57 | 34.30 | 0.81 |

** Significant at 1% level.

*Correlations*

*Egg quality*

Egg weight is significantly correlated with yolk weight total albumen volume and yolk hight, while volume of thick albumen was highly significant (Table 6). Similar results were reported by many woker such as Dickerson (1957), Hale (1954), Jaap *et al.* (1962), Jaffe (1964) and Quinn (1963). Percentage of thick albumen to total albumen (TA%) is significantly highly correlated with volume of albumen (VA) (r= 0.912), and significantly correlated with albumen hight (AH) Rr = 0.327). One of the most intersting results is that

TA% is correlated with both shape index and volume of air cell, the latter being negative. Correlation obtained between volume of cell and specific gravity is also high and negative (r = -0.584). Values of r obtained between volume of thick albumen and total albumen, and between albumen and yolk hight are positive and significant. Shape index was significantly correlated only with TA% and VA. One may suggest that egg shape is determined by albumen volume. Dickerson (1957), kinney and Lowe (1968) and Kinney *et al.* (1968), reported estimates around -0.12 for the correlation between albumen quality and egg shape.

TABLE 6. **Phenotypic correlations between the traits studied.**

**A-Egg quality**

| | EW | TA | TA% | VA | SG | | |
|---|---|---|---|---|---|---|---|
| YW . . | 0.314* | | | | | | |
| TA . . | 0.290* | | | | | | |
| VA . . | 0.428 | 0.494 | 0.912 | | | | |
| AH . . | | | 0.327* | 0.385 | | | |
| YH . . | 0.308* | | | 0.315* | | | |
| SI . . . | | | 0.333* | 0.385 | | | |
| VC . . | | | 0.379 | | —0.584 | | |

**B-Shell quality**

| | SB. | SN | SW | SS | BS | D | SG |
|---|---|---|---|---|---|---|---|
| SN . . | 0.712 | | | | | | |
| SW. . . | 0.894 | 0.775 | | | | | |
| SS . . . | 0.928 | 0.885 | 0.961 | | | | |
| BS . . . | 0.340* | 0.238* | 0.312* | 0.351* | | | |
| D . . . | | 0.460 | 0.389 | 0.403 | 0.542 | | |
| SG . . | | 0.431 | 0.354 | 0.361 | 0.300* | —0.556 | |
| SGW . | | 0.420 | 0.445 | 0.412 | 0.355 | —0.641 | 0.651 |

0 Only the significant figures are presented.

* P = 0.05

P = 0.01

*Shell quality*

Many workers had calculated high positive correlation values for thickness of the different regions of the shell (Morgan, 1932 ; Novikoff *et al.*, 1949 ; Godfrey, 1949 ; Rouch, 1959 ; and Hill *et al.*, 1969). Their figures agree well with those obtined in this study.

The correlations between the thickness of the different parts of the shell characteristics (except deformation)are all highly positive. These figures agree with the finding of Morgan (1932). Novikoff *et al.* (1949), Godfrey (1949) and Rauch (1959). Schoorl and Boersma (1962) reported a negative correlation between shell thickness and deformation.

It may be concluded that deformation method, is a reliable measurement for shell quality. This measurement gives a good estimate without damaging the egg. On the other hand, specific gravity is not a very reliable measurement for shell quality unless precautions are taken to prevent weight loss of the egg by evaporation prior to the determination.

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# تاثير تداول وتخزين البيض بعدة طرق على مواصفاته

يوسف عفيفى ، على عبيده وجمال قمر

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أجرى هذا البحث على نوعى اللجهورن الابيض والرود ايلند رد والخلطان العكسية لهما لمعرفة تاثير فترات لتخزلن والنقل على مواصفاتالبيضة فى البحث ثلاثون طائرا من كل نوع من خليطة فى كل معاملة ،وقدكانتالصفات التى تم دراستهاهى : وزن البيضة ، وزن الصفار ، الحجم الكلى للبياض،نسبة البياض السميك الى البياض الكلى ، حجم البياض السميك ، ارتفاع البياض ، ارتفاع الصفار ، اسماك القشرة ( للقمة العريضة ، الضبيقة وعلى الاجباب ومتوسطهم قدرة تحمل القشرة ، دليل البيضة ، تحمل القشرة للكسر االوزن النوعى للبيضة بفراغها الهوائى ، الوزن النوعى للبيضة بدون فراغهـا الهوائى ، و حجم الفراغ الهوائى .

وقد أورت النتائج أن خواص البيضة تاثرت معنويا بنوع الطائر ، فترات التخزين ، درجة حرارة التخزين والنقل . بالنسبة لصفات القشرة فقد تاثرت معنويا بدرجة حرارة التخزين . يعتبر طريقة قدرة تحمل القشرة أفضل وسيلة لمعرفة درجة تحمل القشرة للكسر دون ما تلف لقشرة البيضة المختبرة .