CONTRIBUTION REGARDING THE EFFECT PROVIDED BY STORAGE CONDITIONS ON QUALITY OF CONSUMPTION EGGS

Usturoi M. G.

University of Agricultural Sciences and Veterinary Medicine-Iasi, Romania (umg@uaiasi.ro)

ABSTRACT

Investigations took place on 3 batches of eggs (150 eggs/batch), stored for 21 days, at different parameters (Lc=10-11°C and 75% RH; L1exp=4°C and 90% RH; L2exp=20-25°C and 45% RH). Comparative with the storage in refrigeration conditions (L1exp), the other storage variants (Lc and L2exp) leads to achievement of low values face to the ones which are specific to fresh eggs, with 1.14-3.48% for eggs' weight, with 1.21-3.40% for specific weight, with 11.69-26.41% for yolk index, with 4.8-13.94% for albumen index and with 2.2-7.96 for Haugh index. Under microbiologic aspect, storage of consumption eggs in refrigeration conditions (L1exp), determine a brake of microorganisms development, so at the end of storage period, their number was lower with 11.62-40.57% face to batches Lc and L2exp. In these conditions we recommend the storage of consumption eggs from weight class of 55-60g at temperature of la +4°C and relative moisture of 90%.

Key words: eggs, quality, conditions, storage

INTRODUCTION

Storing the shell eggs for a too long period under inappropriate conditions, leads to a loss of their inner commercial properties (Braun, P. 2000; Jones, D.R. and M.T. Musgrove, 2005; Raji A.O. and all, 2009); moreover, the germs existing on the eggshell begin to multiply, thus increasing the risk of the eggs' intrinsic content contamination (Usturoi, M.G., 2008).

Considering these facts, the aim of the researches was to study the evolution of some quality and microbiological indexes of the consumption shell eggs, stored in different stocking conditions.

MATERIAL AND METHODS

Three study groups were set up: a control (witness) group (L_c) and 2 experimental groups (L_1exp and L_2exp.), which differed through the storage microclimate conditions *(tab. 1)*.

Table 1

Experimental design

Group	Storage type	Total amount of eggs	Temperature (°C)	Humidity (%)
Lc	Short term	150	+10 ÷ +11	75
L1exp.	Long term	150	+4	90
L2exp.	In traders' storage	150	+20 ÷ +25	45

Eggs' storage was made assuring a high uniformity, concerning their weight and shape, in order to eliminate the influence of some factors other that the experimental ones.

The main studied indexes were: eggs weight, specific gravity, albumen and yolk indexes, Haugh index, and eggshell microbial payload. The assessments were made by common methods wide used in aviculture practice and research (Hamilton, R.M.G., 1982; Scholtyssek, S., 1993).

The indicators were measured at various moments, such as: before storage (fresh eggs) and in the 7th, 14th and 21st days of storage.

RESULTS AND DISCUSSION

1. Egg weight. Normally, the eggs stored for long periods loose approx. 0.7-1.0%/month, from their initial weight, through their water content vaporization (Bell, D. 1996).

According to the weight controls, it resulted that, at the beginning of the experiment, the average egg weight was slightly identical: 56.38±0.29g in witness group, 56.72±0.48g in L_1exp and of 56.17±0.33g in L_2exp group.

As the time passed, the average weight of the eggs decreased and reached, in the 21st day values of 54.95±1.88g in control group; of 55.93±1.69g in L_1exp group and of 53.44±2.16g in L_2exp group.

The most significant weight looses (4.87%) were found in the L_2exp. group, due to the assured storage conditions: a high environmental temperature (+20….+25°C) and a low relative humidity (45%).

The opposite situation was observed for the eggs stored at +4°C and 90% R.H. (L_1exp. groups), which had an average weight loss of 1.39% only; the weight diminutions were of 2.53% in the control group *(tab. 2)*.

Table 2

Average weight of the studied eggs

Storage period (days)	Group	Statistical estimators			Differences, as reported to fresh eggs (%)
		N	$\bar{X} \pm s_{\bar{X}}$ (g)	V%	
1	L_c	150	56.38 ± 0.29	3.41	-
	L_1exp.	150	56.72 ± 0.48	5.62	
	L_2exp.	150	56.17 ± 0.33	3.95	
7	L_c	140	55.98 ± 0.51	5.75	- 0.71
	L_1exp.	140	56.42 ± 0.37	4.18	- 0.53
	L_2exp.	140	56.05 ± 0.78	8.74	- 1.99
14	L_c	130	55.43 ± 1.02	10.89	- 1.68
	L_1exp.	130	56.17 ± 0.87	9.21	- 0.97
	L_2exp.	130	54.64 ± 1.83	19.81	- 2.72
21	L_c	120	54.95 ± 1.88	18.72	- 2.53
	L_1exp.	120	55.93 ± 1.69	16.51	- 1.39
	L_2exp.	120	53.44 ± 2.15	22.16	- 4.87

2. Specific gravity of the fresh eggs is about 1.078-1.097, decreasing at 1.040-1.059 in the eggs older than 30 days that were stored at +4^{o}C (Sauveur, B., 1988).

The progressive diminution of the eggs' specific gravity was recorded also in our studies, being proportionally to the cumulated physical parameters assured during storage.

Thus, the less significant decreasing of the specific gravity was found for the eggs belonging to the L_1exp group, of 1.17%, the fresh eggs having an average value of the analyzed indicator of 1.0811±0.005, while the 21 days old ones had a value of 1.0685±0.024.

At the L_2exp group, the specific gravity was found of 1.0807±0.009 at the first control and only of 1.0313±0.037 at the last one, the difference between the being of 4.57%.

The control group was situated between both extremes, with a decreasing of the specific gravity of 2.38%, comparing to the values found for the fresh eggs *(tab. 3)*.

Table 3

Average specific gravity of the studied eggs

Storage period (days)	Group	Statistical estimators			Differences, as reported to fresh eggs (%)
		n	$\overline{X} \pm s_{\overline{x}}$	V%	
1	L_c	150	1.0806 ± 0.007	4.69	-
	L_1exp.	150	1.0811 ± 0.005	3.22	
	L_2exp.	150	1.0807 ± 0.009	5.80	
7	L_c	140	1.0744 ± 0.013	7.73	- 0.57
	L_1exp.	140	1.0786 ± 0.009	5.16	- 0.23
	L_2exp.	140	1.0741 ± 0.015	9.06	- 0.61
14	L_c	130	1.0693 ± 0.018	10.10	- 1.05
	L_1exp.	130	1.0718 ± 0.016	8.64	- 0.86
	L_2exp.	130	1.0559 ± 0.024	13.59	- 2.29
21	L_c	120	1.0549 ± 0.030	15.79	- 2.38
	L_1exp.	120	1.0685 ± 0.024	12.11	- 1.17
	L_2exp.	120	1.0313 ± 0.037	19.90	- 4.57

3. Albumen index was of 0.106 at fresh eggs, reached 0.039 at the more aged eggs and respectively 0.032 at the very old ones (Doyon, G., 1994).

The same indicator had very closer values in all groups, when the eggs were fresh: 0.1063±0.0012 in control goup; 0.1069±0.0011 in L_1exp. group and of 0.1060±0.0011 in the L_2exp. Group. After 21 days of starage, the lowere value of the albumen index was recorded by the L_2exp. group (0.0546±0.0019), 48.49% lower than the value found for the fresh eggs; that group was folowed by the control one, with an albumen index of 0.0704±0.0017 (33.77% decreasing) and by the L_1exp. group, with an albumen index of 0.0833±0.0016 (just a decreasing of 22.08%) *(tab. 4)*.

Table 4

Average albumen index in the studied eggs

Storage period (days)	Group	Statistical estimators		Differences, as reported to fresh eggs (%)
		$\overline{X} \pm s_{\overline{x}}$	V%	
1	L_c (n=10)	0.1063 ± 0.0012	7.38	-
	L_1exp. (n=10)	0.1069 ± 0.0011	6.95	
	L_2exp. (n=10)	0.1060 ± 0.0011	6.74	
7	L_c(n=10)	0.1001 ± 0.0015	9.25	- 5.83
	L_1exp. (n=10)	0.1008 ± 0.0014	8.66	- 5.70
	L_2exp. (n=10)	0.0892 ± 0.0013	9.58	- 15.85
14	L_c(n=10)	0.0887 ± 0.0015	10.18	- 16.56
	L_1exp. (n=10)	0.0928 ± 0.0015	9.31	- 13.19
	L_2exp. (n=10)	0.0711 ± 0.0015	12.83	- 32.92
21	L_c(n=10)	0.0704 ± 0.0017	12.97	- 33.77
	L_1exp. (n=10)	0.0833 ± 0.0016	10.85	- 22.08
	L_2exp. (n=10)	0.0546 ± 0.0019	19.44	- 48.49

4. Yolk index. The vitellin membrane looses its elasticity in the aged eggs, the yolk flattening; and the vitellin membrane's resistance decreased continuously. Thus, at a brutal manipulation of the eggs, the membrane brakes and the yolk spreads into the albumen mixture (Keener, K.M. and all, 2006).

This situation obviously occurred in the eggs stored at room temperature (L_2exp.), with an yolk index of 0.0440±0.0001 in the first storage day and of 0.0311±0.0005 at the end of the experiment; the difference between the assessments was of 29.32% *(tab. 5).*

Table 5

The average yolk index of the studied eggs

Storage period (days)	Group	Statistical estimators		Differences, as reported to fresh eggs (%)
		$\overline{X} \pm s_{\overline{x}}$	V%	
1	L_c (n=10)	0.0441 ± 0.0002	2.31	-
	L_1exp. (n=10)	0.0442 ± 0.0001	1.74	
	L_2exp. (n=10)	0.0440 ± 0.0001	1.96	
7	L_c (n=10)	0.0390 ± 0.0002	3.29	- 11.56
	L_1exp. (n=10)	0.0416 ± 0.0001	2.08	- 5.88
	L_2exp. (n=10)	0.0397 ± 0.0002	3.74	- 9.77
14	L_c (n=10)	0.0385 ± 0.0004	5.81	- 12.69
	L_1exp. (n=10)	0.0398 ± 0.0003	4.98	- 9.95
	L_2exp. (n=10)	0.0358 ± 0.0004	7.34	- 18.64
21	L_c (n=10)	0.0352 ± 0.0005	7.66	- 20.18
	L_1exp. (n=10)	0.0374 ± 0.0004	6.23	- 15.38
	L_2exp. (n=10)	0.0311 ± 0.0005	9.21	- 29.32

In an opposite situation were the eggs in the L_1exp group, stored at refrigeration temperatures. Thus, the yolk index decreased from 0.0442±0.0001 (fresh eggs), to 0.0374±0.0004 (day 21), counting a 15.38% decreasing.

The difference for the eggs belonging to the control group, was of 20.18% (1^{st} day compared to the last day of storage).

5. Haugh index. Although this index is most common used to appreciate the artificial incubation eggs quality, it could be considered as a global index of consumption eggs quality, especially because it uses the dense albumen height and the egg weight values in its computation relation (Scott, T.A. and F.G. Silversidest, 2000).

The initial Haugh value was found related to the three groups, the variation limits being of 81.40±0.822 UH in L_2exp. group and 82.13±1.009 UH in L_1exp group.

The alteration of the eggs' weight and of the dens albumen consistency leaded to a gradually diminution of the Haugh index. Thus, at the end of the storage, this counted 73.41±1.354 UH in Lc group, 75.62±1.856 UH in L_1exp. group and 68.47±1.092 UH la L_2exp.; the percentage difference between fresh and 21 days old eggs was of: 10.12% in Lc; 7.92% in L_1exp and of 15.88% in L_3exp *(tab. 6).*

Table 6

Haugh index of the analyzed eggs

Storage period (days)	Group	Statistical estimators		Differences, as reported to fresh eggs (%)
		$\bar{X} \pm s_{\bar{x}}$ (UH)	V%	
1	L_c (n=10)	81.68 ± 0.875	7.19	-
	L_1exp. (n=10)	82.13 ± 1.009	8.24	
	L_2exp. (n=10)	81.40 ± 0.822	6.78	
7	L_c (n=10)	78.24 ± 1.039	8.39	- 4.21
	L_1exp. (n=10)	78.98 ± 1.195	9.56	- 3.83
	L_2exp. (n=10)	76.12 ± 0.063	7.03	- 6.49
14	L_c (n=10)	76.87 ± 1.167	8.99	- 5.89
	L_1exp. (n=10)	77.24 ± 1.319	10.11	- 5.95
	L_2exp. (n=10)	72.72 ± 0.981	7.99	- 10.66
21	L_c (n=10)	73.41 ±1.354	10.12	- 10.12
	L_1exp. (n=10)	75.62 ± 1.856	13.45	- 7.92
	L_2exp. (n=10)	68.47 ± 1.092	8.74	- 15.88

6. Eggshell microbial payload. The environment in the poultry halls has a high amount of germs, which invariably reach the eggshell, no matter the prophylactic methods are used (Usturoi, M.G. and all, 1997).

This situation was confirmed by our investigations, the eggshell microbial payload being high enough: 92.55±1.20 germsi/cm^2 of shell in control group, 92.60±0.86 germs/cm^2 pg shell in L_1exp. group and of 92.45±1.04 germs/cm^2 of shell in L_2exp group *(tab. 7).*

Table 7

The microbial payload of the eggshell

Storage period (days)	Group	Statistical estimators			Differences, as reported to fresh eggs (%)
		n	$\overline{X} \pm s_{\overline{X}}$ (germs/cm^2)	V%	
1	L_c	150	92.55 ± 1.20	8.72	-
	L_1exp.	150	92.60 ± 0.86	6.21	
	L_2exp.	150	92.45 ± 1.04	7.58	
7	L_c	140	96.70 ± 1.13	7.41	+ 4.48
	L_1exp.	140	94.15 ± 1.03	6.89	+ 1.67
	L_2exp.	140	106.30 ± 1.59	9.49	+ 14.98
14	L_c	130	99.80 ± 2.75	16.32	+ 7.83
	L_1exp.	130	96.25 ± 2.17	13.32	+ 3.94
	L_2exp.	130	119.65 ± 4.44	21.97	+ 29.42
21	L_c	120	108.75 ± 3.78	19.03	+ 17.50
	L_1exp.	120	98.05 ± 2.70	15.11	+ 5.88
	L_2exp.	120	135.40 ± 7.35	29.75	+ 46.45

At the end of the storage period (21st day), the microbial payload was of: 98.05±2.70 germs/cm^2 in the L_1exp group; 108.75±3.78 germs/cm^2 in Lc group and 135.40±7.35 germs/cm^2 in L_2exp group; the increasing was of 5.88% in L_1exp group, of 17.5% in Lc group and of 46.45% in L_2exp group.

CONCLUSIONS

A series of conclusions issued after the quality assessments that were effectuated on the eggs stored for 21 days, within different environmental conditions:

- the weight loss of the eggs were only of 1.39% when the refrigerating temperature was used (L_1exp.), comparing to 4.87% looses for the eggs stored at ambient temperature (L_2exp.); similar results were found for the specific gravity of the studied eggs;
- the age of the eggs influences their quality, being especially conditioned by the microclimate assured during storage. Thus, the results found in the L_1exp. group are evident (eggs stored at +4^{o}C and 90% R.H.), the differences of the quality indexes being lower only with 22.5% (albumen index), with 15.38% (yolk index) and with 7.92% (Haugh index), when the end of storage period results are compared with those found in its beginning;
- the warm ambient conditions facilitate the proliferation of the germs existing on the eggshell, phenomenon obviously found at the eggs belonging to the L_2exp. group, on which shell were found 46.45% germs more than at the beginning of the storage.

Considering the presented conclusions, some recommendations could be formulated:

1. eggs decontamination, before their introduction into the supply depots;

2. periodical disinfections applied into the depots, assuring the microbial chain breaking periods;
3. storage of the eggs belonging to the 55-60g weight class at +4^{o}C temperatures;
4. the humidity and the temperature in the storage depots should be correlated, in order to decrease the water looses from the eggs;
5. the eggs that cannot be stored in appropriate conditions should be converted in mélange (yolk-albumen mixture) or powder egg.

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