

A market study on the quality of eggs from different housing systems

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Abbreviated title: Egg quality different housing systems

Summary

To study the quality and evaluate the differences between commercial eggs, 47 fresh egg samples from the Belgian market were sampled. Sixteen samples concerned cage-eggs, 5 floor housing eggs, 12 free range eggs, 7 organic eggs, 5 samples from farm retail and 2 from private backyards. The labelling, weight category, freshness, bacteriological safety (*Salmonella*) and proportion of cracked and dirty eggs were studied. Presence of inhibitory substances and coccidiostats was controlled in 30 of the egg samples, while PCB analyses were performed on 10 samples of eggs from hens with outdoor access.

Four samples were judged negative for weight. Up to 20% of the egg samples did not meet the requirements for freshness. In none of the eggs *Salmonella* was detected. Fifty % of the samples (12 eggs) contained 1 or more eggs with cracks and on average 7% of the eggs were cracked. Blood and/or meat spots were found in 12% of the eggs. In none of the 30 samples sulfonamides and fluoroquinolones were found, while 4 samples contained coccidiostats with

concentrations (1.5 – 9 µg/kg) lower than the Belgian action limit of 10 µg/kg. Four of the 10 tested samples contained very low concentrations (11 – 30 ng/g fat) of PCB's and met the Belgian criteria.

Keywords: egg quality, housing systems, laying hens

Materials and methods

Eggs

In total 47 fresh egg samples from the Belgian market were bought from different supermarkets, shops or home retail. Sixteen samples concerned cage-eggs, 5 floor housing eggs, 12 free range eggs, 7 organic eggs, 5 samples from farm retail and 2 from private backyards. Egg samples contained 24 eggs.

Analysis on individual eggs

Twelve eggs of each sample were individually weighed and the average egg weight was calculated. The internal bearing of blood and meat spots was controlled by visual inspection of 12 broken out eggs per sample. To determine the percentage of cracked eggs (hair cracks and open cracks), 12 eggs were observed by visual examination using a candle light. Eggshell dirt was also evaluated visually on 12 eggs per sample. To evaluate the freshness, air cell height (mm) was determined on two eggs per sample using a homemade measuring card.

Analysis on pooled eggs

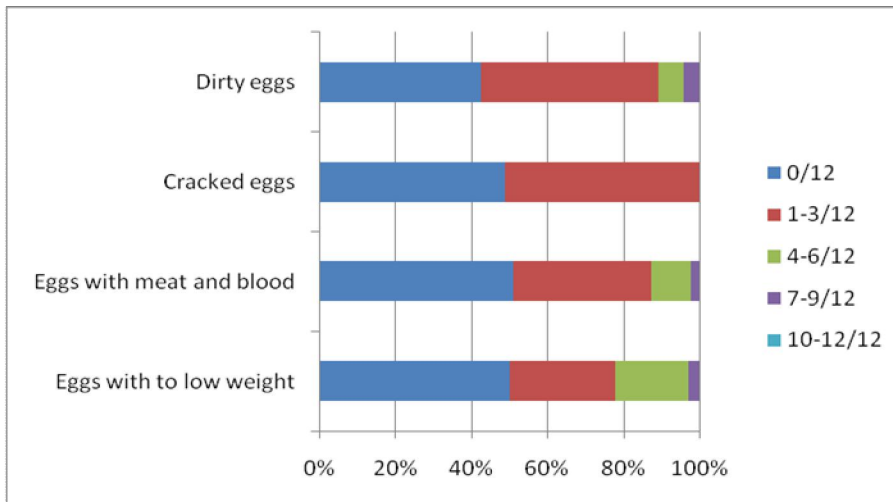
Salmonella was detected on 25g of 6 pooled eggs per sample according to AFNOR V 08-052 (1997). Possible residue presence was assessed for sulfonamides, fluoroquinolones and coccidiostats on 30 samples. Presence of sulfonamides was analysed according to Charm II Sulfa Eggs (Charm Sciences Inc., Lawrence, MA) while fluoroquinolones by the Fluoroquinolones EIA kit (EuroProxima b.v., Arnhem, The Netherlands). Coccidiostats were analysed using LC-MS/MS (Mortier et al., 2005a and 2005b). On the 10 egg samples from hens with outdoor access,

the detection of the seven PCB marker congeners was performed according to the Beltest I14 method (Beltestdocument I 014-REV 4-17/7/2000-1/17) using gas chromatography-low mass resolution mass spectrometry. The analyses on sulfa drugs, fluoroquinolones and coccidiostats were performed on respectively 5ml, 0.5 ml and 10g of 6 pooled eggs per sample. For the determination of PCB's, analysis was performed on 0.5 g of fat extracted from the eggs.

Results

Each of the 36 egg samples having the weight category (XL, L, M or S – EC regulation 589/2008) mentioned on their pack; was evaluated on the individual weight of the 12 eggs and the average weight. Four of the 36 samples (11%) were judged negative for weight. In all 4 cases the average weight was higher than the corresponding mentioned weight category but > 40% of the individual eggs had an underweight. In 50% of the packages all eggs of the sample met the weight requirements (Figure 1). If eggs of different sizes were packed, the total weight of all eggs was compared to the indicated net weight on the package (3 egg samples). In all 3 cases the total weight was higher than the indicated net weight. More than 50% of the samples did not have blood or meat spots in one of the 12 eggs. In the other egg samples blood and meat spots ranged from 1 until 7 individual eggs. Forty-nine percent of the samples contained no cracked eggs (0/12). The remaining 51% had 1 or 2 cracked eggs, except for one sample having 3 cracked eggs. On average 7% of the eggs were cracked. In 43 % of the samples all eggs were clean, 47% of the tested samples had 1 to 3 dirty eggs while the remaining 10% of the eggs had 4 till 7 eggs with eggshell dirt.

Figure 1: Percentage egg samples with defective eggs



In table 1 the results obtained for the previously mentioned quality variables are summarized per housing system.

Table 1: Percentage of defective eggs per housing system

Housing system	n	Cracks (% eggs)	Blood and meat (% eggs)	Weight (% eggs)	Eggshell dirt (% eggs)
Organic	7	3.6	9.5	13.3	7.1
Free range	12	5.6	2.1	9.7	3.5
Floor housing	5	8.3	11.7	13.3	2.8
Cage housing	16	7.8	17.7	7.2	17.2
Farm retail + private backyard	7	8.3	15.4	n.a.	13.1

n = number of samples per housing system; n.a.: not applicable

Freshness of the eggs was measured by the air space. According to the EC regulation 589/2008 (Anon. 2008) the height of the air space of fresh eggs (Grade A eggs) may not exceed 6 mm. Up to 20% of the egg samples (10 on 47) did not meet those requirements for freshness.

In none of the 30 samples the inhibitory substances sulfonamides and fluoroquinolones were found, while 4 samples contained coccidiostats with concentrations (1.5 – 9 µg/kg) lower than the Belgian action limit of 10 µg/kg. Detailed results on coccidiostats and the type of positive eggs were: 1.5 µg/kg nicarbazin (organic), 1 µg/kg robenidin (free range), 9 µg/kg lasalocid (cage) and 3 µg/kg salinomycin (farm retail).

Three of the 10 tested samples contained very low concentrations (11 – 30 ng/g fat) of PCB's. It concerned one sample from farm retail and both private backyard samples.

Discussion

Notwithstanding the fact that 50% of the egg samples, having the weight category mentioned on their pack, had 1 or more eggs with a weight lower than the mentioned weight category, the average weight was still higher compared to the mentioned minimum weight. In the study of Hidalgo *et al.* (2008) no significant difference in meat spots (ranging from 11 till 18% of the eggs) was found between the four sampled housing systems (cage, free range, barn and organic), while blood spots significantly differed from 3% for free range eggs till 11% for organic eggs. Remarkable is that in the present study cage-eggs had more blood and meat spots (17.7%) compared to the other commercial housing systems organic, free range and floor housing (2.1-11.7%). Our results on cracked eggs correspond with those obtained by Prencipe *et al.* (2005). In their study 57% of the egg samples (6 eggs per sample) contained no cracked eggs (49% in our study). The remaining 43% had 1 or 2 cracked eggs. In the study of Tauson *et al.* (1999) cracks varied from 2.2% to 7.7%, with no significant difference between the housing systems conventional, furnished and floor housing systems. Hidalgo *et al.* (2008) also did not found significant difference ($P > 0.05$) in appearance of cracked eggs between cage (14%), free range (10%), barn (11%) and organic (5%) eggs. The percentages of cracked eggs we found per housing system were lower (3.6 till 8.3%). The results regarding shell cleanliness detected non-compliance to the legal limits (EC regulation 589/2008 and 598/2008), since 57% of the packages contained 1 or more dirty eggs. Of course the visual examination used is subjective and differences in evaluation of the shell cleanliness may cause various results between different studies. De Reu *et al.* (2009) did not found a significant difference in eggshell dirt between furnished cages, floor housing systems and aviaries; eggshell dirt ranged from 21% till 26% of the eggs. In the

study of Prencipe *et al.* (2005) in 69% of the samples all 6 eggs were clean. Again the higher % of eggs with eggshell dirt for the cage-eggs was remarkable in the present study. Freshness was non-complaint with the A grade standard in 10 of the 47 samples or 21%. In a study of Prencipe *et al.* (2005) 43% of the egg samples (35) contained defective eggs with respect to air cell height. In the study of Hidalgo *et al.* (2008) air cell height varied from 3.30 mm for floor housing eggs till 3.80 mm for organic eggs. In our study especially the eggs from farm retail and private backyard were less fresh (air cell height up till >10 mm). Factors other than egg age, such as the environment conditions (temperature and relative humidity) of handling from farm to retail also influence air cell height.

None of the 30 samples contained residues of inhibitory substances as sulfonamides and fluoroquinolones. The search on inhibitory substances was limited to these 2 families to limit the study costs and was based on the experience that the last years in monitoring results no problems with residues of other groups of antimicrobials were encountered. Nine out of the 35 samples in the Italian study of Prencipe *et al.* (2005) contained veterinary drug residues; in 8 samples sulfadiazine was found.

Coccidiostat residues were detected in four samples. Recently European Legislation was published concerning coccidiostats, namely Regulation 124/2009 mentioning maximum values that can be present in food resulting from the unavoidable carry-over of these substances in non-target food. Levels for nicarbazin, robenidine and salinomycin levels were set at respectively 100 µg/kg, 25 µg/kg and 3 µg/kg. For lasalocid a MRL-value of 150 µg/kg was set by Commission Regulation 1353/2007. So when applying this legislation on the samples all results were compliant. For PCB's there is no European legislation but in Belgium the Royal decree of May 19, 2000 was published in which a maximum level of 200 ng/g fat was set for some foods containing more than 2 % fat, including eggs. The obtained results were in agreement with this Belgian legislation.

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