POLISH JOURNAL OF FOOD AND NUTRITION SCIENCES
Pol. J. Food Nutr. Sci. 2005, Vol. 14/55, SI 1, pp. 117-120

INFLUENCE OF RAISING METHOD ON THE QUALITY OF HEN EGGS

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Key words: egg, organic and conventional livestock products, quality

The aim of this work was to evaluate the quality of hen eggs available on the Tri-City market, coming from conventional and organic raising. The parameters required by the regulation of the Ministry of Agriculture and Rural Development of December 29th, 2003 concerning analytical methods of hen eggs were determined, along with weight proportion of egg components, their pH, condition and index of egg white dense, flattening and index of yolk. Of the examined eggs originated from conventional raising, 38% were classified as class A eggs, 60% as class B eggs and 2% as class C eggs. An opposite proportion was observed for organic eggs, *i.e.* class A eggs dominated (64%), whereas 32% of the examined eggs were class B eggs and 4% class C eggs. The size of air cell in organic eggs ranged from 2 to 5 mm, while in the conventional eggs the average was 4.3 mm. In this case, a statistically significant correlation was detected between both types of eggs. The examined eggs differed in weight and percent distribution of specific components. Mean acidity of yolk and white of the examined eggs coming from hen-run raising accounted for pH = 6.8 and pH = 9.1, respectively, whereas for eggs from the conventional raising - for pH = 6.6 and pH = 9.25, respectively. Mean dense white index was 0.38 for organic eggs and 0.11 for conventional eggs, whereas yolk index was 0.46 and 0.41, respectively.

Hen raising method had a statistically significant influence on white index, yolk index and pH of yolk.

INTRODUCTION

Owing to exceptional nutritional, dietetic and culinary properties, Polish eggs have become a remarkably attractive export commodity. Additional factor influencing the raising export figure is the price of Polish eggs, competitive with *e.g.* German, Danish or Italian prices. The total export to EU countries in 2004 amounted to 5% of egg production (0.5 billion eggs) and gave 30 million EUR incomes. It is estimated that this quantity rises somewhat this year (up to about 0.6 billion eggs).

In recent years, there has been observed a significant increase in domestic egg consumption as well. Average consumption of eggs in Poland in 2004 amounted to 214 eggs per annum and was *ca*. 16% greater than in the year 2000. It is still less than the recommended optimal value (220 eggs) and less than consumed by EU citizens (233 eggs per annum) [Seremak-Bulge & Hryszko, 2004; Świetlik, 2004; Statistical Yearbook, 2004].

The egg trade market in Poland comprises primarily hen eggs for consumption (more than 90% of total egg production), eggs for industrial use and egg products. Currently, *ca*. 80% of eggs on the market come from caged raising and 20% from floor and free-run raising. Due to the application of EU directive no 1999/74/EC of July 19, 1999, however, during the next several years these proportions will change to the benefit of the latter acknowledged as friendly for animals and the environment. Hitherto experience suggests that conventional animal raising poses an enormous strain on the environment and has a harmful influence on human health [Siemiński, 2001].

The main differences between conventional and ecological breeding of poultry originate from providing animals' stock with the area of farm which should amount from 0.5 to 1.5 of big stock per 1 ha.

Council Regulation (EC) No 1804/1999 of 19 July 1999 supplementing Regulation (EEC) No 2092/91 *on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs to include livestock production*, specifies conditions of organic breeding of animals, which is the most difficult task in managing the organic farm. The assumption is that organic farms tend to reach possibly closed circulation of components, including fodder and fertilizers. This necessitates the adjustment of an animal population on the farm and correlating it with land area and quantity of fodder produced in the farm, simultaneously avoiding excessive collection of manure that leads to disturbance of ecological balance. The farmer must consider the fact that achieving true fodder-manure balance on an organic farm is a long-term process and animal raising and feeding must be led the natural way [Hovi *et al.*, 2003; Siebeneicher, 1997].

Recently, raising demand for organic food has been noticed. According to the majority of consumers it is safe for the health and its benefits are nutritional values and tastefulness. Furthermore, the production of organic food based on spe-

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TABLE 1. Egg weight and distribution of egg-shell, egg-albumen and egg-yolk (degrees of freedom: k_1=1; k_2=18).

Raising method/parameter		Weight of eggs (g)	Egg-shell (%)	Egg-albumen (%)	Egg-yolk (%)
Conventionally fed hens	$\bar{x}$ ± SD	62.04 ± 2.22	10.67 ± 0.47	62.80 ± 1.75	26.53 ± 1.45
	range	58.71 – 68.61	9.64 – 11.26	59.54 – 65.48	24.43 – 29.23
Organically fed hens	$\bar{x}$ ± SD	61.18 ± 4.94	10.90 ± 1.14	62.22 ± 2.33	26.89 ± 2.36
	range	53.45 – 80.36	8.35 – 13.05	58.05 – 66.86	22.99 – 31.01
F value		1.741	0.862	1.022	0.465

$\bar{x}$ – mean; SD – standard deviation

cial standards is considered as environmentally friendly and devoid of artificial fertilizers [Newerli-Guz & Śmiechowska, 2004; Kouba, 2003].

Due to constantly increasing production and consumption levels of eggs in Poland and their importance in human diet, the study addressed a comparative analysis of the commodity quality evaluation of eggs coming from conventional and organic raising.

MATERIAL AND METHODS

The study material was hen eggs bought in Tri-City's food stores. Eggs came from two farms from the Pomeranian region: the first one was a hen farm with floor raising, the second one – an attested organic farm with poultry raising on a free-run. Ten batches of eggs from each raising method were examined. Each batch comprised 10 eggs. The study spanned from June to July 2004. The declared time from the moment of laying eggs to the moment of their testing, for both methods of raising, amounted to 5 days on average.

Attributes decisive for the quality of eggs were examined. Primarily, the parameters required by the regulation of the Ministry of Agriculture and Rural Development of December 29, 2003 concerning hen eggs' analysis methodology (including evaluation of shell shape and defects, height, stability and colour of air cell, appearance of white and yolk, presence of foreign bodies and visibility of germinal disc) [Regulation of Ministry…, 2003a]. Additionally determined properties included weight proportion of particular egg components, their active acidity, state and index of dense white, flattening and index of yolk [Bednarczyk, 1997]. The mentioned parameters significantly influence the quality of eggs. The results were evaluated statistically with the chi-square test and one-way analysis of variance at a significance level of p=0.05.

RESULTS AND DISCUSSION

The examined eggs were in most cases characterised by a clean or slightly dirty shell. Several cracked eggs and few cases of leaked eggs were detected [PN-90/A-86505]. Among the farm eggs 70% were classified as fresh, not older than 8 days and as much as 30% of eggs as stored over 8 days, including 20% over 2 weeks. On the other hand, among eggs from organic raising, 80% were fresh, only 20% over 8 days and only 10% over two weeks. Among the examined eggs from conventional raising, 38% were classified as A class eggs, 60% as B class eggs and 2% as C class eggs. With organic eggs the proportion was reversed. A class eggs dominated (64%), while B class eggs comprised 32% of the total number and C class – 4%. A statistical analysis has shown a significant influence of hen raising method (and consequently their feeding method) on the classification of eggs to the respective quality classes. The examined eggs differed in mass and relative contribution of particular components (Table 1).

In organic eggs, weighing 61.18 g on average, the mean composition was 26.89% yolk, 62.22% white and 10.90% shell, whereas in eggs from traditional farm, weighing 58.71--68.61 g, the mean composition was 26.53% yolk, 62.80% white and 10.67% shell. The results of Kouba [2003] also did not prove a statistically significant ($p<0.05$) difference in the proportion of shell, white and yolk in eggs laid by hens fed with conventional or organic fodder.

From the 10 examined batches of eggs from conventional raising, 4 may be classified to weight category M, one to L and the others containing eggs from both M and L categories – they could not be classified to any category, however, because the deviations permitted in the regulation of the Ministry of Agriculture and Rural Development of August 5, 2003 concerning market quality of hen eggs are much greater [Regulation of the Ministry…., 2003b]. In all the cases presented in Table 1 no statistically significant (p=0.05) difference was found between conventional and organic eggs.

Another important indicator of egg quality is the height, stability and colour of air cell. In organic eggs, the size of air cell varied from 2 to 5 mm (mean 3.6±1.1 mm), whereas in conventional eggs the mean air cell size varied from 2 to 7 mm (mean 4.3±0.9 mm). In this case a statistically significant difference (F=12.027; p=0.05) was detected between both types of eggs. Generally, conventional eggs had much greater air cells than the organic ones. Considering the parameters of air cell, as much as 32% of organic eggs can be considered extra-fresh, in which air cell did not exceed 4 mm, whereas these conditions were fulfilled by only 18% of conventional eggs. Height and index of dense white and flattening and index of yolk were also determined (Table 2).

It is accepted that the lesser the surface of egg white dense and the more its height, the better is the egg. The height of egg white dense in fresh eggs should not be less than 0.5 cm. The value of egg white dense index for fresh consumer eggs should not be lower than 0.06-0.07 and for freshly laid eggs - lower than 0.09-0.12. An additional parameter describing the quality of egg is flattening and index of yolk. The height of yolk over 1.6 cm, yolk index not lower than 0.30 and its spherical shape characterize a fresh egg.

TABLE 2. Height and index of egg white dense and flattening and index of yolk (degrees of freedom: k_1=1; k_2=18).

Raising method/parameter		White height (cm)	White index	Yolk height (cm)	Yolk index
Conventionally fed hens	$\overline{x}$ ± SD	0.39 ± 0.07	0.11 ± 0.03	1.66 ± 0.10	0.41 ± 0.03
	range	0.29 – 0.57	0.07 – 0.19	1.43 – 1.86	0.35 – 0.46
Organically fed hens	$\overline{x}$ ± SD	0.72 ± 0.17	0.38 ± 0.16	1.85 ± 0.13	0.46 ± 0.04
	range	0.30 – 1.04	0.14 – 0.73	1.63 – 2.17	0.39 – 0.55
F value			105.954*		26.820*

*Significant at probability level p=0.05; $\overline{x}$ – mean; SD – standard deviation

TABLE 3. Active acidity of white and yolk (degrees of freedom: k_1=1; k_2=18).

Raising method/parameter		pH of white	pH of yolk
Conventionally fed hens	$\overline{x}$ ± SD	9.25 ± 0.26	6.65 ± 0.15
	range	8.30 – 8.81	6.36 – 6.96
Organically fed hens	$\overline{x}$ ± SD	9.11 ± 0.20	6.79 ± 0.14
	range	8.81 – 9.44	6.62 – 7.13
F value		3.118	5.330*

*Significant at probability level p=0.05; $\overline{x}$ – mean; SD – standard deviation

Among examined organic eggs, only 3% had lower than recommended dense white height, but it concerned as much as 93% of eggs originating from the traditional farm. Index of egg white dense showed similar proportions and tendencies. In organic eggs not a single value of this parameter was lower than recommended, whereas in almost 58% of conventional eggs dense white index was lower than 0.12.

Considering flattening and index of yolk, similar relations were observed. Among organic eggs, 38% were characterised by yolk index below 0.45 and in no instances was it lower than 0.3. On the other hand, 88% of conventional eggs had yolk index value below 0.45. The height of yolk in the examined eggs was also very different, from 1.43 cm in conventional eggs to 2.17 cm in organic eggs. In 3% of organic eggs and 38% of conventional eggs the observed value was lower than the recommended 1.6 cm. One-way analysis of variance showed statistically significant (p=0.05) differences for all parameters presented in Table 2. It means that the raising method may have a significant influence on the quality of examined eggs.

Another important parameters that may serve for commodity assessment of eggs are pH of white and yolk (Table 3).

The pH of white in a freshly laid egg is about 7.9. In the period of a few days, due to CO_2 release, it rises rapidly to 9.2-9.3 and does not change after reaching the value of 9.7. The pH of yolk in turn is about 6.0 directly after laying and changes with time to 6.7-6.9.

Mean active acidity of yolk and white of the examined eggs laid by hens bred with a free-run method was pH=6.8 and pH=9.1, respectively. For the eggs originating from conventional raising it was pH=6.6 and pH=9.25, respectively. The statistical analysis performed (p=0.05) showed a significant influence of hen raising method on the value of pH of yolk.

CONCLUSIONS

1. Hen raising method had a statistically significant influence on white index, yolk index and pH of yolk. The respective average values for organic eggs were 0.38, 0.46, 6.79 and for conventional eggs – 0.11, 0.41, and 6.65.
2. 64% of eggs from organic raising, while only 38% of eggs from conventional raising were classified as class A.

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WPŁYW SPOSOBU CHOWU NA JAKOŚĆ JAJ KURZYCH

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Celem pracy było dokonanie oceny jakości dostępnych na rynku Trójmiasta jaj kurzych, pochodzących z chowu konwencjonalnego oraz ekologicznego. Dokonano oznaczeń parametrów wymaganych rozporządzeniem MRiRW z dnia 29 grudnia 2003 r. w sprawie metod analiz jaj kurzych oraz oznaczono wagowy udział poszczególnych składników jaja, ich pH, stanu i indeksu białka gęstego, spłaszczenia i indeksu żółtka. Wśród badanych jaj pochodzących z chowu konwencjonalnego 38% jaj zaklasyfikowano jako jaja klasy A i 60% jako jaja klasy B oraz 2% jaja klasy C. Wśród jaj ekologicznych odnotowano odwrotne proporcje. Dominowały jaja klasy A - 64%, natomiast jaja klasy B stanowiły 32% ogólnej liczby badanych jaj, a jaja klasy C - 4%. Wielkość komory powietrznej w jajach ekologicznych wahała się w granicach od 2 do 5 mm natomiast w jajach konwencjonalnych średnia wielkość komory wynosiła 4,3 ± 0,9 mm. W przypadku tego parametru stwierdzono statystycznie istotne różnice pomiędzy poszczególnymi rodzajami jaj. Badane jaja różniły się masą oraz udziałem procentowym poszczególnych składników. Średnia kwasowość czynna żółtka i białka badanych jaj pochodzących od kur hodowanych metodą wolnowybiegową wynosiła odpowiednio pH = 6,8 i pH = 9,1. natomiast jaj pozyskiwanych z chowu konwencjonalnego, odpowiednio pH = 6,6 i pH = 9,25. Średni indeks białka gęstego wynosił 0,38 dla jaj ekologicznych oraz 0,11 dla jaj konwencjonalnych, natomiast indeks żółtka wynosił odpowiednio 0,46 i 0.41.

Sposób hodowli kur ma istotny statystycznie wpływ na indeks białka, żółtka oraz pH żółtka.