Acta Agraria Kaposváriensis (2006) Vol 10 No 2, 199-205
Kaposvári Egyetem, Állattudományi Kar, Kaposvár
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Commercial quality evaluation of different weight grade eggs

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ABSTRACT

In the Republic of Croatia, consumers are offered eggs of extra quality class, and of I and II quality classes, all in different weight grades. Prices of eggs are primarily formed on the basis of market supplies and demands, and secondly by the egg weight. This research was carried out with the aim to evaluate market quality of S, A and B weight grade eggs at our market. The obtained research results will be used to inform consumers on the quality of commercial eggs. Analyzed eggs (n=150) were bought at a family-owned poultry farm. In order to assess quality of eggs, the following were investigated: egg weight, portions of main parts in egg, shell thickness and firmness, albumen height, yolk color, pH of yolk and albumen, HU (Haugh units) and VN (value number) of eggs. It was determined that eggs of the S weight grade had more intensive color of yolk (13.08) than eggs of the A and B weight grades (12.83 and 12.76, respectively), P<0.05. Other investigated traits (portions of main parts in egg, shell thickness and firmness, albumen height, pH of yolk and albumen, HU and VN of eggs) proved no statistically significant differences (P>0.05). Furthermore, there was a percentage of protein and dry matter determined in eggs of different weight grades, on the basis of which the relation between price and quality was postulated.
(Keywords: eggs, market quality, freshness, price, weight grade)

INTRODUCTION

Eggs are an excellent source of protein, vitamins, minerals and high quality fat, such as phospholipids and unsaturated fatty acids (PUFA) (*Seuss-Baum*, 2005). Through feeding regimes it is almost impossible to influence changes in content of total protein and amino acids in eggs. However, through supplementation of different forages in diets fed to laying hens, it is relatively easy to manipulate contents of lipids, fatty acids (*Meluzzi et al.,* 2000; *Kralik et al*., 2005), fat soluble vitamins (*Flachowsky et al*., 2000) and minerals (*Surai*, 2002; *Yaroshenko et al*., 2003). Depending on its weight, an egg provides 4.5–6 g of protein, with the half of that amount being contained in albumen. It also contains 65–75 kcal and 185–215 mg of cholesterol in yolk. If referring to their price, eggs are a cheap foodstuff. When buying eggs, customers often dwell on whether to buy domestic free-range eggs or eggs produced on farms, or eggs that weigh more or less. Science cannot provide a simple answer to these questions, as the purchase of eggs is a matter of customers' personal choice. In the last 5 years, Croatia marks an increase in egg production (*Table 1*). The table shows that only 33% of commercial eggs were produced by industrial farms, and even 67% by family-owned farms. In 2004, there were 801 mil. of eggs produced, out of which 257 mil. on industrial farms and 544 mil. on family-owned farms. If considering yearly consumption of eggs and powder eggs per capita, in the last 5 years some fluctuations were noticed. The highest consumption was marked in 2001

(10.81 kg), while in 2004 it reached only 8.15 kg. Decrease in eggs and powder eggs consumption can be explained by the world-wide occurrence of Avian influenza, and by consumers' awareness on high content of cholesterol in egg yolk and its negative effects on human health (*Maluzzi, et al*., 1995). In the near future, increase of fresh egg consumption will be possible to achieve through production of „functional food", i.e. designed eggs that will significantly differ in their content from currently available commercial eggs.

Table 1

Production and consumption of eggs in Croatia

Year	Egg production (mil. pcs)			Eggs and powder eggs consumption (kg per capita)
	Business entities and industrial farms	Family-owned farms	Total	
2000	272	502	774	9.32
2001	287	500	787	10.81
2002	274	487	761	10.72
2003	292	581	873	8.12
2004	257	544	801	8.15

Source: Croatian Statistical Yearbook, 2005.

According to the Regulations on eggs' and egg products' quality (Croatian Official Journal No. 55/96), in Croatia commercial chicken eggs are divided into 10 weight grades: E less than 45 g; D 45–50 g; C 50–55 g; B 55–60 g; A 60–65 g; S 65–70 g; SU 70–75 g; SV 75–80 g; SZ 80–85 g and SX 85 g and more. Commercial eggs are further divided into 4 quality classes (extra class, I, II and III quality class). It is important to emphasize that eggs of the III quality class are used only in further processing. Differently from our market, European Union market offers since 2003 eggs that are classified into 4 weight grades: S less than 53 g; M 53–63 g; L 63–73 g and XL more than 73 g. Market quality of eggs is determined on the basis of several traits referring to their appearance and inner freshness. The market demands eggs that have clean, firm, unbroken and unwashed shell. Of their inner traits, commercial eggs must have clear and compact albumen, satisfactory color of yolk, HU of at least 70, they should be odor-free and have the air container below 9 mm. As the egg size significantly affects market price of eggs, this research was carried out with the aim to assess quality of eggs in order to provide relevant information to consumers and make their choice in purchasing eggs easier.

MATERIALS AND METHODS

The research focused on eggs of extra quality in different weight grades (S, A, B), all bought on a family-owned farm. A total of 150 eggs were analyzed, of which 50 were of S grade, 70 of A grade and 30 of B grade. Eggs were prepared for marketing (classified and appropriately packaged).

In order to assess the quality of eggs, the following traits were evaluated: weight of eggs and their main parts (g), portions of main parts in egg (%), thickness (mm) and firmness of egg shell (kg/cm^2), albumen height (mm), yolk color, pH of albumen and yolk, HU and VN of eggs. Physical traits of eggs were determined in Egg Multi-Tester EMT 5200 and Eggshell Force Gauge Model II. Weights of egg main parts (albumen, yolk and shell) were measured

by Mettler Toledo PB1502-S scales. Shell thickness was measured by electronic micrometer of the 0.001 mm precision level, in the equatorial zone of egg shell. Percentage of albumen, yolk and shell portion was calculated mathematically out of data obtained by measuring weights of egg main parts in relation to the whole egg. VN was calculated out of refractive index of albumen and yolk (*Janke* and *Jirak*, 1934), applying the following formula: VN=1000 x (refractive index of yolk – refractive index of albumen). Protein and dry matter contents were determined on samples of each weight grade group according to the *Lowry* method (1951), in the UV/VIS JENWAY 6305 spectrophotometer. Data on protein content were further used in evaluation of different weight grade eggs. Research results were obtained by applying arithmetic mean ($\bar{x}$), standard deviation (s), standard error of arithmetic mean ($s_{\bar{x}}$) and coefficient of variance (Cv%), and processed in ANOVA. Differences among different weight grade eggs were determined by the t-test at the significance level of 5% ($P<0.05$) in the software Statistica 7.1 (StatSoft, Inc. 1984–2005).

RESULTS AND DISCUSSION

The poultry industry pays great attention to production technology and high quality products. Contemporary consumers are well informed and know that quality of production is directly related to quality of commercial products. As large supermarkets are being supplied with eggs from numerous small farms, it is of use to be aware of the quality of eggs. *Table 2* presents quality traits of eggs of S, A and B weight grades. If considering the egg appearance, i.e. form index, shell firmness and thickness, no statistically significant differences ($P>0.05$) were determined among investigated egg groups. The highest form index value was obtained in the S weight grade eggs (78.27), followed by eggs of A (77.79) and B (77.21) weight grade. These results correspond with the results obtained by *Casiraghi et al*. (2005) and *Lukić et al*. (2004). Obtained results were as expected, as egg groups were formed on the basis of weight grades, so the highest form index was expected for eggs of the S grade. If comparing results on the egg shell thickness stated by *Casiraghi et al*. (2005) (Small=0.4 mm; Medium=0.42 mm; Large=0.42 mm and Extra Large=0.41 mm), obtained data in our research are lower (B=0.367 mm; A=0.371 mm; S=0.369 mm), however, they are in accordance with results published by *Lukić et al.* (2004) and *Škrbić et al*. (2004). Egg shell firmness was similar in all investigated eggs (S=3.59 kg/cm^2; A=3.54 kg/cm^2; B=3.40 kg/cm^2). Referring to the egg freshness trait, statistically significant difference ($P<0.05$) was determined only for egg yolk color of the S weight grade in comparison to the A and B weight grade eggs (S=13.08; A=12.83; B=12.76). In his research, *Hernandez* (2005) found out that consumers preferred eggs of intensive yolk color. This especially refers to Germans, as they consider a quality egg yolk to have the color intensity between 12 and 14. Following that fact, eggs analyzed in our research are satisfactory for the European market with respect to their yolk color. *However*, *Škrbić et al*. (2004) and *Lukić et al*. (2004) in their researches into the quality of commercial eggs obtained lower values for yolk color (9.21–10.25). Other indicators of egg freshness: albumen height, HU, pH of yolk and albumen, and VN did not exhibit statistically significant differences ($P>0.05$). Similar values referring to albumen height (S=7.88 mm; B=7.77 mm) and HU (S=86.7; B=87.84) were determined in eggs of S and B groups, while eggs of the A group had slightly lower values of that trait (7.35 mm; 84.36). The value referring to pH of yolk in all analyzed eggs was 6.07, while the slight difference was determined in pH of albumen (S=8.45, A=8.49, and B=8.42). Similar VN was obtained from eggs of S and A weight grade (62.47 and 62.62, respectively), while eggs of the B grade have slightly lower value (61.47). These results are in accordance with results obtained by *Kralik* (1976), who determined the average VN of 2-day old eggs to be 63.14. Obtained values of investigated traits indicate that the analyzed eggs were of extra

quality. Portions of albumen, yolk and shell (%) in eggs of different weight grades are shown in the *Figure 1*. Higher portions of albumen (S=62.79%; A=62.81%; B=62.74) and yolk (S=25.4%; A=25.17%; B=25.17) were obtained in eggs of the S and A weight grades, while the B grade eggs had higher portion of shell (S=11.81%; A=11.66%; B=12.09%). Stated differences among groups were not statistically significant (P>0.05).

Table 2

Quality traits of eggs

Indicator	Statistical parameter	S	A	B	P-value
Egg weight, g	$\bar{x}$	66.81[a]	62.46[b]	58.06[c]	<0.001
	s	1.38	1.58	1.10	
	s $\bar{x}$	0.19	0.19	0.20	
	Cv%	2.07	2.53	1.89	
Form index	$\bar{x}$	78.27	77.79	77.21	0.315
	s	4.29	2.111	2.25	
	s $\bar{x}$	0.61	0.25	0.41	
	Cv%	5.48	2.71	2.92	
Yolk color	$\bar{x}$	13.08[a]	12.83[b]	12.76[b]	0.022
	s	0.49	0.65	0.43	
	s $\bar{x}$	0.07	0.08	0.08	
	Cv%	3.73	5.07	3.37	
Albumen height, mm	$\bar{x}$	7.88	7.35	7.77	0.082
	s	1.37	1.34	1.36	
	s $\bar{x}$	0.19	0.16	0.25	
	Cv%	17.33	18.23	17.51	
Shell firmness (kg/cm^2)	$\bar{x}$	3.59	3.54	3.40	0.442
	s	0.57	0.67	0.75	
	s $\bar{x}$	0.08	0.08	0.14	
	Cv%	15.77	18.85	22.03	
Shell thickness, mm	$\bar{x}$	0.369	0.371	0.367	0.677
	s	0.02	0.02	0.02	
	s $\bar{x}$	0.003	0.002	0.004	
	Cv%	5.15	5.56	5.81	
HU	$\bar{x}$	86.7	84.36	87.84	0.148
	s	9.43	9.08	8.07	
	s $\bar{x}$	1.33	1.07	1.47	
	Cv%	10.87	10.76	9.19	
Albumen, pH	$\bar{x}$	8.45	8.49	8.42	0.226
	s	0.19	0.22	0.15	
	s $\bar{x}$	0.03	0.03	0.03	
	Cv%	2.31	2.59	1.78	
Yolk, pH	$\bar{x}$	6.07	6.07	6.07	0.879
	s	0.07	0.08	0.06	
	s $\bar{x}$	0.01	0.01	0.01	
	Cv%	1.18	1.38	0.94	
Value number (VN)	$\bar{x}$	62.47	62.62	61.47	0.089
	s	2.71	2.51	1.71	
	s $\bar{x}$	0.38	0.30	0.31	
	Cv%	4.34	4.01	2.78	

a, b, c : P<0.05

Figure 1

Portions of main parts in eggs

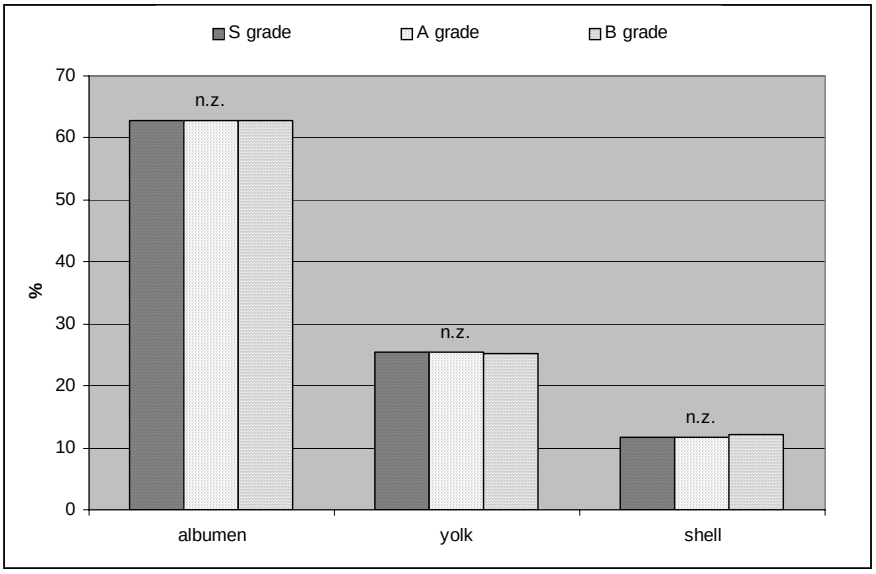

Table 3 presents an overview of prices per one egg, its edible part, protein and dry matter content, all depending on particular weight grade. It is obvious that the price is increased proportionally to the egg weight (S=0.135 €; A=0.122 €; B=0.108 €), however, edible part of egg, protein and dry matter are the cheapest in eggs of B weight grade. For example, for 100 g of protein in the S grade eggs, a consumer will pay 0.24 € more than for the same amount of protein in eggs of the B weight grade.

Table 3

Mean prices (€) of different weight grades

Weight grades of eggs	Price per egg	Price per 100 g of edible part	Price per 100 g of protein	Price per 100 g of dry matter
S	0.135	0.23	1.96	2.83
A	0.122	0.22	1.83	2.50
B	0.108	0.19	1.72	1.86

CONCLUSION

It is to conclude that B grade eggs have the most favorable pH value of albumen and the highest HU, and are the cheapest source of animal protein if respecting their price and protein content in yolk and albumen.

This research can be of use for consumers in their selection of different weight grade eggs, as it provides an insight into which eggs on our market are the cheapest and of the best quality.

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