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Yolk Color Parameters In Eggs Of Atak-S Parents

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Abstract
The present study was conducted to determine the color characteristics of egg yolk in the eggs of layers ATAK-S [Barred Rock I (BAR1) and Rhode Island Red I (RIR1)] parents. Twenty five weeks old ATAK-S layer parents were divided into 7 treatment groups of similar mean weight (including 60 female and 10 male) in Agricultural Biotechnology Department, Ahi Evran University. Parents ATAK-S housed were employed a 16:8 hours light: dark photoperiod. Feed and water were given ad libitum. Layers were fed standard layer diet having 17 g crude protein, 3.8 g calcium and 2800 Kcal ME in each kg. Experiment was carried out 48 weeks (between 25 and 72 weeks) and a total of 4032 egg yolks were analyzed. L* a* b* values were measured with photo colorimetric method of the CIELAB system and E (color difference) value, hue, saturation (Chroma), Ho value were calculated. To conclude, overall mean of L*, a*, b*, E, hue, saturation (Chroma) and Ho value were 68.07+0.060, 25.15+0.097, 34.57+0.068, 80.53+0.057, 0.95+0.002, 42.86+0.068 and 53.94+0.129, respectively. This work was supported by the Republic of Turkey Ministry of Food, Agriculture and Livestock, General Directorate of Agricultural Research and Policies. Project Number: TAGEM-15/AR-GE/28.

Keywords: L* a* b* Values, E value, Hue, Saturation, Chroma, Ho value, CIELAB, Yolk Color

INTRODUCTION

Animal proteins are one of the most important needs for the full provide of human health. Nitrogen in protein structure is necessary for important parts of the body such as skin, blood, deoxyribonucleic acid (DNA), enzyme and hormone. Proteins must be converted the amino acids to use in the body. There are 20 known amino acids, which 10 are essential. The animal proteins contain all of the essential amino acids [1], [2]. The most common sources of animal protein are red and white meat, milk and eggs. White meat and eggs are both easy to find and cheap. Egg is rich in nutrient content and the second richest food source after mother's milk. The number of eggs produced in the world in 2016 is approximately 7.9 billion [3]. Total egg production in Turkey in 2017 is approximately 19.3 million [4]. Egg production in the poultry sector in Turkey is continuously increasing. For this reason, Turkey needs to develop its own breeding parents. National projects have been developed to solve the problem of obtaining the imported breeder laying parent of the industry. Therefore, the Poultry Research Institute Directorate (TAEM) brought in 10 poultry lines from Canada (6 brown, 4 white eggs) in 1995 and carried out breeding trials. TAEM has developed hybrid laying hen lines named ATAK, ATAK-S and ATABEY which have the best performance in country conditions. ATAK-S, Barred Rock I (BAR1) and Rhode Island Red I (RIR1) is a hybrid created as a result of hybridization [5], [6], [7] and [8].

The welfare level of society is increasing day by day. Accordingly, the consumption habits are changing rapidly. Egg is an inexpensive, easy and overproduced animal protein source that will meet the daily nutritional needs of the human body. Although eggs are a cheap and nutritious animal protein source, consumers pay attention to the quality criteria of eggs. The first criterion that consumers take into consideration when buying eggs is the size of the egg, while the second criterion is the egg yolk color [9]. For this reason egg yolk color is an important criterion in the egg industry. A special color fan is used in the egg industry to describe egg colors. Roche, called, yolk color fan (RYCF) scale consists of 15 different tones of yellow. The RYCF has distinct yellow tones from light yellow to orange yellow. Egg yellow color is graded by the color matching of egg yolk and RYCF. However, it is not possible to make a complete description of the color by human eyes.

In recent years, methods such as CIELAB have been developed to help determine the precision of more scientific and natural color and to express colors with numerical equivalents. While the Roche fan makes rougher predictions, CIELAB are given results in values of L * (lightness), a * (redness) and b * (yellowness). The CIELAB method L *, a *, and b * values are based on the principle of determining the closest color to the human eye on the coordinate system with the help of values of pigment sensitivity, color tone, color saturation and tone angle. Different color measurement values can be determined with RGB (red, green, blue), Cmy (cyan, magenta and yellow), Cmyk (cyan, magenta, yellow and black), Xyz (coordinate plane), CIE-Lch (light, chroma, hue), Yxy (2D coordinate plane), HunterLab (square root value instead of cubic plane), CIE-Luv (updated version of Xyz), Hsl (hue, saturation, lightness/luminance) and Hsb (Hsv) (hue, saturation, brightness=value) according to the devices and preparation methods used when preparing the color except CIELAB method [10].

MATERIEL and METHOD

The study was carried out at Kırşehir Ahi Evran University, Agricultural Applied and Research Center Directorate's, Full Controlled Egg-Chicken R&D coop. The animal material of the study consisted of a total of 420 ATAK-S parents aged 25 weeks. The study consisted of 60female and 10 male ATAK-S parents of similar weight in 7 differ-

ent sub-coops. The study continued until 72 weeks of age (48 wks.). The layers were fed standard layer diet having 170 g crude protein, 38 g calcium and 2800 Kcal ME in each kg (Table 1). The nutrient content of the standard layer feed is given in Table 1. Animals received feed and water *ad-libitum* throughout the study.

Table 1. Chemical composition and the nutritive value of the experimental basal diet.

Ingredients[1,2]	**Basal Diet (g/kg)**
Yellow Corn	537.739
Soy Bean Meal 46%CP	170.084
Limestone	96.441
Sunflower Meal 36%CP	91.110
Barley 11%CP	30.000
Soy Bean Oil	28.312
Wheat Bran 14%CP	10.000
D-L Methionine 99%	8.139
MCP 22,7 (TIMAB)	5.792
DDGS 27%CP	5.000
FFS 34	5.000
Chicken Feather Flour 56	5.000
Salt	2.756
Ekomix VM Egg	2.000
Sodium Bicarbonat	1.025
Rovabio MAX	1.000
Calsporin	0.600
Chemical (%)	**Composition**[3]
ME, kcal/kg	2800.000
Crude Protein 15.3	17.000
Calcium 3.8	3.800
Available Phosphorus 0.35	3.800
Lysine 0.75	0.685
Methionine 0.35	1.054
Threonine 0.58	0.527
Tryptophan 0.19	0.200

e1-Provided per kilogram of diet: retinyl acetate, 3.1 mg; cholecalciferol, 0.0375 mg; DL-a-tocopheryl acetate, 7.5 mg; thiamin, 0.6 mg; riboflavin, 4.8 mg; pyridoxine hydrochloride, 1.5 mg; cyanocobalamin, 0.009 mg; calcium-D-pantothenate, 7.5 mg; folic acid, 0.15 mg; niacin, 20 mg.

2-Provided per kilogram of diet: copper ($CuSO_4*5H_2O$) 6 mg; iron ($FeSO_4*H_2O$) 60 mg; zinc ($ZnSO_4*H_2O$) 80 mg; manganese ($MnSO_4*H_2O$) 60 mg; selenium ($NaSeO_3$) 0.3 mg; iodine (KI) 0.35 mg.

3-The value of crude protein was analyzed and the value of metabolizable energy (ME) was calculated, others were calculated values.

Between the 25th week and the 72nd week, 12 eggs are randomly collected from 7 sub-coop on the same day of the week. Each week 84 egg yolks were analyzed in Feed Biotechnology Laboratory, Agricultural Biotechnology Department, Agriculture Faculty, Kırşehir Ahi Evran University. Egg yolks were measured three times with the Konica-Minolta CR-410 color meter. L* (lightness), a* (redness) and b* (yellowness) values were measured and their averages were determined.

In the study, L*, a* and b* values were measured in 4032 fertilized ATAK-S egg yolks. E, hue, saturation (Chroma) and H^o index values were calculated using L *, a * and b * values. E value is calculated as the square root of the sum of the squares of L *, a * and b * values ($E = (L^2 + a^2 + b^2)^{1/2}$). The hue value is calculated as the arc tan of the portion of the a* value to the b* value ($\theta = \tan^{-b/a}$). Saturation value is the square root of the sum of the squares of a* and b* values ($(a^2 + b^2)^{1/2}$). H^o index is the degree of $\tan^{-b/a}$ value calculated [11]. The numerical value of egg yolk color was determined by the calculated criteria. Accordingly, the closest color that the human eye can perceive has been tried to be created by calculation.

The data of egg yolk color parameters in randomized designs were analyzed in the GLM procedure in SAS 1996 software [12]. Comparison of average values was ranked by Duncan Multiple Comparison test. The results were calculated as the statistical significances were determined at the level of $P<0.05$.

L*, a*, b*, E, hue, saturation (Chroma) and H^o values of ATAK-S parental egg yolk and RYCF colors were determined using the CIELAB method [13]. ATAK-S parental egg yolk and RYCF colors CIELAB values were converted RGB color method. And then lens color was created using RGB values in Windows 10 Professional paint 3D [14], [15].

RESULTS AND DISCUSSION

When the data of 7 different sub-coops of animals fed with standard laying hens diet were examined, statistical significance was found in L*, a*, Hue, Ho index ($P <0.01$) and b* and E value ($P <0.05$). These differences are thought to be due to differences in the individuals in the poultry and to differences in herd behavior.

Table 2. The egg yolk color measured values

Sub-coops	**L* value**	**a* value**	**b* value**
1	68.06bc	25.87a	34.47bc
2	68.04bc	25.31bc	34.48bc
3	68.08bc	25.08cd	34.42bc
4	67.78c	25.62ab	34.59abc
5	67.78c	25.39abc	34.26c
6	68.64a	24.10e	35.04a
7	68.22b	24.66d	34.85ab
SED	0.05	0.06	0.06
P	***0.0006***	***0.0001***	***0.030***

In the study, averages of measured the L*, a* and b* values of eggs yolk were given in Table 2. In addition, averages of the calculated E, hue, saturation (Chroma) and H^o index values are given in Table 3.

Table 3. The egg yolk color calculated values

Sub-coops	**E value**	**Hue value**	**Saturation**	**H^o Index**
1	80.73ab	0.93d	43.23a	53.28c
2	80.54abc	0.94cd	42.89ab	53.64c
3	80.43bc	0.94c	42.68ab	53.89c
4	80.40bc	0.94cd	43.13ab	53.57c
5	80.20c	0.94cd	42.76ab	53.23c
6	80.89a	0.97a	42.64b	55.38a
7	80.62abc	0.96b	42.80ab	54.75b
SED	0.05	0	0.07	0.08
P	***0.026***	***0.0001***	0.17	***0.0001***

The mean values of egg yolk quality of the ATAK-S parents in Kırşehir conditions were determined as L* 68.07,

a* 25.15, b* 34.57, E value 50.53, hue value 0.95, saturation (Chroma) value 42.86 and Ho index 53.94 respectively (Table 4).

Table 4. Egg Yolk Color Quality Parameter Values

Parameters	n	Min.	Max.	Mean	SEM
L* value	4032	67.33	68.86	68.07	0.060
a* value		23.66	26.96	25.15	0.097
b* value		33.39	35.53	34.57	0.068
E value		79.73	81.26	80.53	0.057
Hue value		0.91	0.98	0.95	0.002
Saturation		41.98	43.88	42.86	0.068
H° Index		52.10	56.02	53.94	0.129

Egg yellow color values are given either as Roche color conversion or as CIELAB values. However, the color values given by the RYCF or CEILAB method can be observed objectively as a result of converting from numbers to RGB values. Egg yellow color varies according to feed manipulation or breeding methods (Table 5). ATAK-S parents' yolk color were identified as egg yolk color bright dark orange (Roche 12-13).

Table 5. Roche egg yolk color fan and ATAK-S eggs yellow mean CIELAB converted to RGB values [14]

Score	L*	a*	b*	R	G	B
1	74.07	-3.34	29.43	196	182	129
2	73.11	-1.93	32.22	196	178	120
3	72.69	-0.71	33.59	199	178	117
4	72.07	0.81	35.05	200	174	112
5	71.06	4.22	36.37	202	169	108
6	69.28	6.16	36.32	200	163	103
7	68.14	8.30	36.64	200	159	99
8	68.72	11.39	37.61	208	159	100
9	67.42	14.21	37.52	207	152	95
10	65.98	17.53	36.27	209	147	96
11	64.02	19.45	34.69	206	140	93
12	61.40	22.63	32.94	201	130	90
ATAK-S	**68.07**	**25.15**	**34.57**	**225**	**147**	**104**
13	60.16	26.78	31.92	203	125	90
14	57.99	29.48	29.79	200	118	88
15	55.43	32.12	27.50	194	108	85

R: Red, G: Green, B: Blue

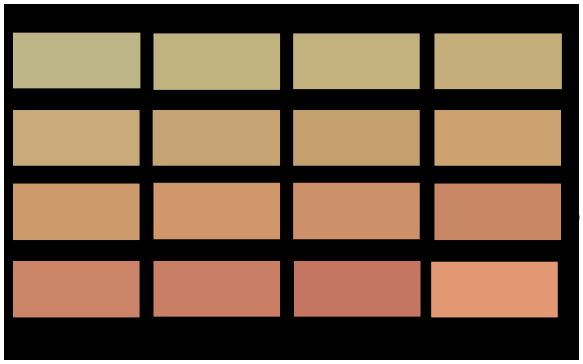

Figure 1. RYCF and ATAK-S parents' egg yolk yellow colors created with Windows 10 Professional Paint 3D

Figure 2. ATAK-S Parents' egg yolk color [15]

CONCLUSION

As a result of no standard has been established for egg yellow belonging to ATAK-S parents. The present study is the quality standard of egg-yellow color of parents of ATAK-S. Further work is needed to establish the quality standard for egg yellow of ATAK-S parents. A similar study can be done in native hybrid hens ATAK and ATABEY parents. These hybrids and ATAK-S parents can be compared in terms of egg yolk color. In addition, more studies are needed to determine the effect and location of egg yolk in the consumer market share.

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