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The Effect of Egg Laying Cycle on Egg Quality

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16 Fayoumi and 13 White Plymouth Rock pullets were available during the first year of laying. Fayoumi pullets produced 4332 eggs which comprised 935, 668, 356, 127, 53, 21, and 12 clutches of one, 2, 3, 4, 5, 6 and 7 eggs laying cycles respectively. Plymouth Rock pullets produced 2767 eggs having 887, 499, 191, 41, 19, 6, and 2 clutches of one, 2, 3, 4, 5, 6 and 7 eggs laying cycles respectively. The different egg quality characters were studied.

Egg weight and other egg quality values increased during winter and spring months and decreased during hot summer months. The first egg in cycles of 2 eggs had thicker shell than the second egg. "Haugh" unit values of albumen quality increased with the advancement of the position of the egg in the clutch. No clear trend could be detected with respect to the position of the egg in the cycle and yolk index and yolk colour. The plymouth eggs were almost of higher "Haugh" unit values of albumen quality than the Fayoumi. Fayoumi birds gave darker yolks of higher yolk index than the Plymouth ones. Also, Fayoumi eggs were of thicker shells than the Plymouth.

The height of Ablumen is the most accurate criterion for its quality (Wilgus and Wagenen, 1936). The height of thick albumen was low during the period from the months of fall to summer (Raffa, 1963). However, Funk *et al.* (1958) found that the height of thick albumen declined from October until November. On the other hand, Hauter *et al.* (1936) found that the highest albumen quality was observed in the period between fall months "November" and spring months "March". The lowest quality was during the period from spring months "March" until the end of summer.

Funk *et al.* (1958) reported that albumen height is low during the first six to seven months of the first laying year. While it was observed by Pope *et al.* (1960) that this occurred only during the first two months of the first laying year.

The "Haugh" unit, measured by albumen height and egg weight is another means for estimating albumen quality (Haught, 1937). It ranged from 37 to 90 for one day eggs (Pfost, 1960). The maximum was reached at the beginning of laying year (El-Gammal, 1965). The "Haugh"unit attained its maximum value at March and then decreased to the lowest value at August (Brant, *et al.*, 1953). However, Hicks *et al.* (1961)found that "Haught" unit was low during the period from December to June.

Albumen quality was affected by high temperature over 90 F° (Huston and Garmen, 1961). While Huston (1958) reported that albumen quality was not affected by temperature differences.

The larger chicken eggs within the same breed were better in their "Haugh" unit and contain larger amount of albumen than small eggs(Skala and Millo, 1962). There is negative correlation between albumen quality and egg production (Johnson and Merrit, 1955 and Pope *et al.*, 1960). Meanwhile, Jeffry (1941) found that low egg production of the individual birds tended to be associated with higher albumen index. Huston (1958) , reported that albumen quality declined with the age of the bird.

Yolk quality is estimated in terms of its color. The yolk color and carotenoids present in egg yolk depend on the carotenoids in the diet and consequently on the amount of carotenoid pigments consumed by birds (El-Gammal, 1965). There is a clear seasonal variation in the yolk color. Thus, at the beginning of the laying year (autumn), yolk color is of a relatively faded shade, then becomes more yellowish during winter, and ligher at the end of the spring and early summer (Hauter *et al.*, 1936 and El-Gammal, 1965). On the other hand, Parker *et al.* (1962) found no definite seasonal trend in yolk color eggs laid by birds on a uniform ration and held in confinement. The environmental temperature is responsible for much of the variability of yolk color (El-Gammal, 1965).

Yolk index is also a common and simple method to determine yolk quality. The yolk index was found to be about 0.436 in native eggs, 0.498 in S.C. White Leghorn (Saxena *et al.*, 1963) and 46.93, 47.43 and 46.44 percent in White Leghorn, White Plymouth Rock and New Hampshire respectively (El-Gammal 1965).

Yolk index is low during the period of hot weather elapsing from March until the end of summer months (Hauter *et al.* 1936 and El-Gammal 1965). The maximum index was observed in January and October (El-Gammal 1965). El-Gammal (1965) added that high yolk index was observed when the pullets began their laying year.

Shell thickenss in the two-egg laying cycle is higher in the second egg than in the first one. In cycles of 3 or more eggs, the shells of the first and last eggs are thicker than those in between (Taylor and Lerner , 1939). Shells are very thin during spring and summer (Quinn, 1963) and they become uniform.

in winter (Romanoff and Romanoff, 1949) or in fall (Baskett *et al.*, 1937). Shell thickness increases with the increase of light received by birds (Sieger and Beane, 1964) and decreases with the increase in air temperature over 90°F (Mueller, and Amejcua,1959).

Material and Methods

Sixteen Fayoumi pullets of six months of age and thirteen White Plymouth Rock hens of eight months of age were used in this study. All the birds were kept for the whole first year of laying, during which, they were treated, managed and fed alike. Egg quality, including, egg weight, albumen hight, "Haugh" unit, yolk index, yolk colour and shell thickness was tested for all the eggs produced, summing up 4322 Fayoumi eggs and 2767 White Plymouth Rock eggs. The height of thick albumen was measured by using a tripod micrometer to the nearest one hundredth of Millimeter. Eggweight and albumen height were used to calculate the "Haugh" unit for each individual egg according to (Haugh, 1937). The yolk index is the percent ratio of the yolk height to width. Yolk colour was estimated by using a colour chart containing 12 shades. Shell thickness was estimated on the membraneless shells.

Results and Discussion

Shell thickness

In all cycles studied, the Fayoumi eggs had thicker shell than the White Plymouth Rock eggs. The yearly average of shell thickness in Fayoumi was 0.01267 inch and in Plymouth Rock was 0.01177 inch (Table 1). The differences between the two breeds in all cycles were highly significant.

Shell thickness of the first egg in a cycle did not follow a uniform trend with the increase in clutch length. However, shell thickness of the second, third, fourth, fifth and sixth eggs decreased with the increase in clutch length. Some exceptions were obseerved in the long cycles of five, six and seven eggs (Tables 2 to 8).

In both breeds the first egg in two egg laying cycles had thicker shell than the second one. The first and last egg in three or more egg laying cycles had thicker shell than the intermediate eggs in the same cycle while the first egg was thicker than the last one.

Statistical analyses showed no significant differences in shell thickness of different egg positions in clutch except in the four egg laying cycles where high significance occurred.

TABLE 1. Monthly and breed differences in egg quality of Fayoumi and Plymouth Rock

Breed	January	February	March	Apri	May	June	July	August	Septe-mber	October	Nove-mber	Dece-mber	Average
Fayoumi													
Shell thickness	13.57	13.77	13.23	12.68	12.09	12.08	11.98	12.36	12.63	12.75	12.39	12.56	12.67
Haugh unit . .	91.08	86.26	84.81	81.62	81.62	78.81	78.33	81.37	81.99	78.46	79.33	87.17	82.67
Yolk index. . .	51.26	52.13	51.03	49.11	47.54	48.04	49.71	48.78	42.47	50.94	52.79	54.28	49.84
Yolk color . .	7.41	7.35	7.05	7.33	7.15	6.42	6.19	6.66	6.93	6.48	6.71	6.42	6.84
Plymouth Rock													
Shell thickness	13.18	12.82	12.31	11.34	11.39	11.30	11.27	11.52	11.02	11.84	12.06	11.21	11.77
Haugh unit . .	92.05	88.98	87.35	86.57	85.73	80.32	82.38	84.42	80.36	77.39	83.13	88.00	84.72
Yolk index . .	51.49	51.99	51.59	48.94	45.83	47.79	48.97	48.97	49.37	50.13	53.04	53.50	50.13
Yolk color . .	7.20	6.79	6.51	6.62	6.36	4.29	4.29	4.17	4.45	4.10	4.29	4.43	5.12

The thicker shell of the first egg in the clutch may be due to the effect of the preceding pause which permitted longer time for calcium deposition. The thicker shell of the last egg in the cycle may be because the last egg spends longer time in the uterus than the preceding eggs (Berg, 1945). The added time involved in the formation of the last egg of the clutch is spent in shell deposition and not in albumen formation as egg size decrease with each succeeding egg in a clutch. The previous trends were obvious whenever the rate of egg production was high and the prevailing weather was favourable, especially in short cycles. The thicker shells in all cycles studied were obse rved during the winter season. The thinner shells were observed during the summer except in the six egg laying cycles in both breeds and the one egg layingcycles in the Plymouth Rock where the thinner shells occurred during the autumn. In the two egg laying cycles in the Plymouth Rock the lowest shell thickness was noticed during the spring season.

The differences between seasons in shell thickness of all cycles studied were highly significant . An exception to that was the only significant differences between seasons in the three egg laying cycles.

TABLE 2. One egg laying cycles : Seasonal variations in egg quality of the Fayoumi and the White Plymouth Rock breeds.

Seasons	Fayoumi				Plymouth Rock			
	Shell thickness	Haugh unit	Yolk index	Yolk Color	Shell thickness	Haugh unit	Yolk inder	Yolk Color
Winter. . .	13.02	87.33	52.88	6.91	12.55	92.33	52.80	6.17
Spring . .	13.09	85.67	49.84	7.04	11.49	89.67	47.23	6.65
Summer . .	11.63	81.17	52.71	6.22	11.31	87.00	48.54	4.59
Autumn . .	12.06	81.00	51.97	6.42	11.07	86.17	51.35	4.47
Average . .	12.45	83.79	51.85	6.65	11.61	88.79	49.98	5.47

F. values	S.T	H.U.	Y.I.	Y.C.
Between breeds	19.8623**	405.1864**	7.2159*	24.071**
Between seasons	10.8248**	143.7868**	6.5284*	9.5712**

TABLE 3. Two egg laying cycles : Seasonal variations in egg quality of the Fayoumi and the White Plymouth Rock breeds.

Seasons	Successive eggs	Fayoumi				Plymouth Rock			
		Shell thickness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Winter.	1	13.74	81.00	53.78	7.07	13.22	93.50	52.59	7.23
	2	13.53	89.00	52.63	6.96	13.09	93.50	52.30	7.09
Average . . .	—	13.64	85.00	53.21	7.02	13.16	93.50	52.45	6.66
Spring	1	13.42	84.00	51.51	7.28	12.24	88.67	50.52	6.49
	2	13.27	85.66	49.10	7.28	11.61	89.67	49.03	6.46
Summer	1	12.53	80.00	49.72	6.47	11.93	82.67	48.51	4.33
	2	12.82	82.00	49.54	6.50	12.14	86.50	48.83	4.36
Average . . .	—	12.68	81.00	49.59	6.49	12.04	84.59	48.67	4.35
Autumn . . .	1	13.02	76.83	50.77	6.70	12.08	81.50	51.51	4.22
	2	21 70	78 67	50 83	6.65	11.96	81.17	50.59	4.30
Average . . .	—	12.86	77.75	50.80	6.68	12.02	81.34	51.05	4.26
Annual average		13.13	82.15	50.97	6.99	12.28	87.15	50.49	5.68
F. values		.S.T **	.H.U**	.Y.I	.Y.C				
Between breeds		35.6746	241.7348	2.9412	23.1153**				
Between seasons		11.2206**	18.1015**	23.9220**	9.4799**				
Between eggs in clutch		0.8671	4.8902	7.0588*	0.0068				

TABLE 4. Three egg laying cycles : Seasonal variations in egg quality of the Fayoumi and the White Plymouth Rock breeds

Seasons	Successive eggs	Fayoumi				Plymouth			
		Shell thickness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Winter.	1	13.49	88.33	52.30	7.39	13.68	64.83	51.77	4.12
	2	13.62	88.67	53.07	7.28	12.97	61.17	71.70	4.78
	3	13.64	88.00	52.86	7.25	13.50	62.67	51.04	4.47
Average . . .	—	13.58	88..33	52.65	7.31	13.38	62.89	51.50	4.55
Spring	1	13.00	80.33	50.25	6.84	12.34	86.33	48.87	6.71
	2	12.43	83.33	49.15	7.26	11.71	87.83	48.97	6.62
	3	12.96	82.00	48.90	5.89	11.93	89.33	49.24	6.64
Avevage	—	12.79	18.89	49.43	66.6	11.99	87.83	49.03	6.66
Summer	1	12.69	76.67	49.72	6.66	11.70	83.17	48.38	4.28
	2	12.08	78.67	49.26	6.10	11.40	83.33	48.80	4.05
	3	12.10	81.00	45.91	6.18	11.52	84.83	49.52	3.69
Average . . .	—	12.29	78.78	48.29	6.31	11.54	83.78	49.90	4.01
Autumn	1	12.51	81.50	52.20	7.35	11.05	70.75	48.81	4.03
	2	12.65	79.00	51.27	6.98	11.48	76.25	49.44	3.85
	3	12.46	78.00	51.04	7.21	11.81	76.00	48.52	3.99
Average . . .	—	12.54	79.50	51.50	7.18	11.78	74.33	48.92	3.96
Annual average.		12.80	82.13	50.47	6.87	12.17	77.21	49.59	4.79
F. values									
Between breeds		6.4545*	1.9538	2.5409	40.9983**				
Between seasons		7.8208**	1.5904	10.1285**	3.8697*				
Between eggs in clutch		0.8281	0.0023	1.2155	0.1677				

TABLE 5. Four egg laying cycles : Seasonal variations in egg quality of the Fayoumi and the White Plymouth Rock breeds

Seasons	Successive eggs	Fayoumi				Plymouth Rock			
		Shell thickness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Winter.	1	14.15	86.00	51.05	7.12	12.94	92.50	51.85	7.27
	2	13.68	80.00	51.21	7.15	12.25	92.50	51.85	6.90
	3	13.54	88.50	51.17	7.26	11.95	91.00	50.74	7.10
	4	13.88	88.50	52.43	7.23	12.55	91.75	52.13	7.00
Average . . .	—	13.18	85.75	51.47	7.19	12.42	91.94	51.64	7.07
Spring	1	13.00	81.00	48.28	7.27	12.34	83.33	50.45	6.57
	2	12.33	83.00	49.50	7.28	11.63	85.17	49.35	6.52
	3	12.59	82.67	48.87	7.34	10.79	89.67	49.78	6.49
	4	13.01	83.67	48.55	7.31	11.45	86.33	49.09	6.50
Average . . .	. . . . .	12.73	82.59	48.80	7.30	11.59	86.13	49.67	6.52

TABLE 5. (*cont.*)

Seasons	Successive eggs	Fayoumi				Plymoutp Rock			
		Shell thick ness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Summer	1	12.18	75.33	49.65	6.78	11.25	91.50	51.87	3.00
	2	11.85	78.67	49.69	6.67	10.88	87.25	52.36	3.00
	3	11.80	78.67	49.89	6.66	10.38	91.00	50.37	3.50
	4	11.99	80.33	49.90	6.35	10.75	90.00	50.19	3.50
Average		11.96	78.25	49.58	6.62	10.82	89.94	51.19	3.25
Autumn	1	13.00	83.33	51.33	6.47	12.00	70.00	52.50	3.00
	2	13 13	81.33	50.88	6.59	11.00	81.50	48.29	4.00
	3	13.14	78.67	51.43	6.53	12.00	81.00	49.49	5.00
	4	13.08	79.00	52.74	6.69	11.50	82.00	48.75	5.00
Average	—	13 13	80.58	51.59	6.57	11.63	78.63	49.76	4.25
Annual average.		12.91	81.29	50.36	6.92	11.62	86.66	50.57	5.27
F. values									
Between breeds		998.3280**	12.1196**	0.3422	43.4943**				
Between seasons		303.2830**	0.7293	5.3085**	11.06564				
Between eggs in clutch		37.2910	6.6688	0.4716	0.2541				

TABLE 6. Five egg laying cycles : Seasonal variations in egg quality of the Fayoumi and the White Plymouth Rock breeds.

Seasons	Successive eggs	Fayoumi				Plymouth Rock			
		Shell thikness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Winter	1	13.93	89.50	62.29	6.87	13.42	85.50	51.22	6.17
	2	13.62	88.75	52.47	7.02	13.42	96.00	52.15	6.25
	3	13.87	92.50	51.77	7.13	12.92	93.75	51.63	6.31
	4	13.39	89.75	51 17	7.08	12.09	91.75	49.84	6.92
	5	13.82	91.00	50.32	6.93	11.50	91.25	52.70	6.84
Average	—	13.73	90.30	51.62	7.01	12.67	91.65	51.51	6.49
Spring	1	12.78	77.83	48.87	6.99	12.46	82.50	49.83	6.53
	2	12.21	82.50	48.34	7.11	12.13	84.50	48.69	6.61
	3	12.10	84.00	50.07	7.30	11.87	86.00	48.21	6.79
	4	12.40	77.33	51.29	7.23	11.54	89.75	49.19	6.89
	5	13.03	81.33	50.42	7.01	12.42	86.25	47.78	6.67
Average	—	12.50	80.59	49.79	7.13	12.08	85.80	48.74	6.69
Summer	1	12.17	77.00	47.30	6.00	12.21	73.00	49.19	4.00
	2	12.03	79.50	46.85	5.89	10.67	75.63	49.25	4.42
	3	12.44	74.00	48.41	6.08	10.92	78.50	46.82	4.67
	4	12.00	77.33	47.94	6.22	11.08	73.67	46.26	3.92
	5	12.11	81.83	48.47	6.17	11.17	75.33	49.99	3.67
Average	—	12.15	77.93	47.79	6.07	11.21	75.27	48.30	4.14
Autumn	1	—	—	—	—	12.00	67.50	50.51	5.00
	2	—	—	—	—	11.00	80.00	49.92	5.00
	3	—	—	—	—	10.50	73.50	50.26	5.00
	4	—	—	—	—	11.00	70.50	44.63	6.0
	5	—	—	—	—	11.00	60.50	47.25	6.00
Average	—	—	—	—	—	11.10	70.40	48.51	4.80
Annual average.		12.79	82.94	49.74	6.74	11.77	80.78	49.27	5.53

F. values	S.T.	H.U.	Y.I.	Y.C.
Between breeds	23.0777**	0.2309	0.6036	32.5466**
Between seasons	27.6622**	0.3270	3.4383	47.3939**
Between eggs in clutch	2.0764	0.2896	0.6228	4.2284*

TABLE 7. Six egg laying cycles ; Seasonal variations in egg quality of the Fayoumi and the White Plymouth Rock Breeds.

Seasons	Successive eggs	Fayoumi				Plymouth Rock			
		Shell thickness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Winter	1	13.90	86.00	52.99	7.50	13.50	77.00	56.67	6.00
	2	13.25	91.50	53.28	7.75	12.00	84.00	57.30	6.60
	3	13.15	91.00	54.75	8.10	12.45	83.00	58.11	7.00
	4	13.20	92.50	52.88	7.75	12.50	84.00	54.74	7.00
	5	13.30	88.00	50.14	7.69	12.00	81.00	54.32	6.10
	6	13.65	89.75	51.55	7.75	13.50	80 50	55.14	6.00
Average	—	13.41	89.79	52.59	7.76	12.66	81.58	56.05	6.46
Spring	1	12.39	83.50	49.30	7.45	12.13	76.25	52.05	5.25
	2	12.18	80.68	48.09	8.00	11.75	77.50	53.13	6.00
	3	12.01	85.00	48.58	8.00	11.00	76.50	50.00	6.00
	4	11.76	83.17	48.02	8.00	10.75	77.50	49.55	7.75
	5	12.10	84 33	46.92	7 50	21 00	79 00	51.39	6.20
	6	12.00	83.89	45.89	7.45	10.89	81.20	49.10	5.19
Average	—	12.15	83.14	48.09	7.83	11.27	78.88	51.25	5.89
Summer	1	13.00	85.00	51.62	8.00	11.50	65.25	48.07	35.0
	2	14.00	83.00	46.05	8.00	10.50	96.00	43.95	4.00
	3	13.50	76.00	47.36	7.50	11.00	76.25	44.41	4.00
	4	13.50	78.00	46.00	7.50	10.75	72.50	46.59	4.50
	5	13.00	92.00	45.28	7.50	9.75	76.00	45.05	3.50
	6	13.00	81.50	45.79	6.50	12.00	67.25	43.33	2.50
Average	—	13.33	82.58	47.02	7.43	10 92	71.04	45.23	3.67
Autumn	1	12.50	79.00	49.50	7.50	—	—	—	—
	2	12.00	80.50	51.03	7.50	—	—	—	—
	3	11.50	89.00	32.41	7.50	—	—	—	—
	4	12.00	87.50	050.51	7.50	—	—	—	—
	5	12.00	87.00	51.03	7.00	—	—	—	—
	6	12.10	86.00	50.18	7.00	—	—	—	—
Average	. . . . .	12.02	84.83	50.76	7.33	—	—	—	—
Annual average	. . . . .	12.73	85.09	49.52	7.59	11.62	77.17	50 84	5.34
F. value									
Between breeds		22.5463**	46.1886**	6.3868*	22.3158*				
Between seasons		6.8794**	23.2418**	56.7247**	4.2002*				
Between eggs in clutch		0.2564	1.0122	1.0498	0.2994				

TABLE 8. Seven egg laying cycles : Seasomal variations in egg quality of the Fayoumi and the White Plymouth Rock.

Seasons	Successive eggs	Fayoumi				Plymouth Rock			
		Shell thickness	Haugh unit	Yolk index	Yolk color	Shell thickness	Haugh unit	Yolk index	Yolk color
Winter	1	14.75	88.50	49.80	7.00	13.25	79.00	49.77	6.00
	2	13.75	85.50	51.03	7.75	12.50	82.00	47.69	6.75
	3	13.00	88.50	50.79	7.75	13.25	79.00	49.88	6.50
	4	12.59	90.50	48.41	7.25	13.25	82.00	48.05	6.75
	5	13.00	85.00	49.08	7.50	13.00	83.50	48.60	7.00
	6	13.25	85.25	49.50	7.50	12.75	80.50	49.11	7.25
	7	13.50	86.25	48.97	7.75	80.25	49.29	7.29	7.00
Average		13.41	87.07	49.65	7.50	13.04	80.89	48.91	7.40
Spring	1	12.46	82.16	49.26	7.69	—	—	—	—
	2	12.10	83.33	49.61	7.77	—	—	—	—
	3	11.89	80.33	49.46	7.43	—	—	—	—
	4	12.14	81.50	48.00	7.27	—	—	—	—
	5	11.52	82.66	47.22	7.46	—	—	—	—
	6	11.88	82.16	47.41	7.32	—	—	—	—
	7	12.57	83.50	47.19	7.63	—	—	—	—
Average		12.08	82.21	48.31	7.51	—	—	—	—
Summer	1—7	—	—	—	—	—	—	—	—
Autumn	1—7	—	—	—	—	—	—	—	—

The increase in air temperature during hot summer months reduced the feed consumption and consequently the calcium intake in the diet by the hen. Therefore the calcium level in the blood decreased and calcium deposition was affected. Similar conclusions were reported by Warren (1949). Meanwhile, the increase in shell thickness during winter may be due to the derease in egg production during winter months.

Funk *et al.* (1958), Hicks *et al.* (1961) , Quinn (1963) and EL-Gammal (1965) found that shell thickness decreased during summer months and became uniform during winter months.

Haught unit

Tables 1-8 show that the Plymouth Rock eggs had higher "Haugh" unit values than the Fayoumi eggs in the one ,two, three and four egg laying cycles. However, the Fayoumi eggs had the higher "Haugh" unit in the five, six and seven egg laying cycles. The differences between the two breeds in the cycles of one, two, three and five eggs were highly significant. The yearly average of "Haugh" units in the Plymouth Rock was 84.72 and in the Fayoumi was 82.77 Barker and Curtis (1958) related this difference between breeds to genetical differences in physiological factors affecting internal egg quality.

The "Haugh" unit value of different eggs in a clutch tended to decrease with the increase in clutch length. In both breeds the "Haugh" unit increased as the position of the egg advanced in clutch, except in seven egg laying cycles when the values did not follow a regular trend as the position of the egg progressed in the clutch. No significant differences was found in "Haugh" unit between eggs in clutch of all cycles studied. The increase in "Haugh" unit values with the advance of the egg in the clutch may be due to the increase in thick albumen height, as a result to the decrease in albumen weight with the progress of the egg in the clutch. Albumen quality as measured by "Haugh" unit value showed more clear seasonal variation in the case of long cycles than in short cycles. The higher "Haugh" unit values for all cycles of both breeds were observed during winter seasons . Only in the three egg laying cycles in the Plymouth Rock ,the higher value was observed during the spring. The lowest "Haught " unit for cycles of three, four, five and six eggs in Fayoumi and six eggs in Plymouth were observed during summer. Meanwhile, the lowest values for cycles of one and two eggs in both breeds and three, four and five egg laying cycles in Plymouth occurred during autumn. The differences between seasons in "Haugh" units were highly significant in the one, two and five egg laying cycles. But no significant differences were observed in other cycles.

Yolk index

The Fayoumi eggs had relatively higher yolk index value than the Plymouth eggs in the one, two, three and five egg laying cycles. Meanwhile, the Plymouth Rock had relatively higher values in the four, six and seven eggs laying cycles. The differences between the two breeds were significant in the case of the one

and six egg laying cycles only. In general, the yearly average of yolk index in the Fayoumi was 49.84 percent and in the Plymouth Rock was 50.13 percent.

Yolk index of the first, second and third egg in the Fayoumi and first,second, third and fourth egg in the Plymouth followed irregular trend with the increase in clutch length. Meanwhile, yolk index in the fourth, fifth and sixth eggs in Fayoumi and fifth egg in Plymouth Rock decreased as the clutch length increased. However, the yolk index of the sixth egg in the Plymouth Rock increased with the increase in clutch length.

No clear trend can be detected with respect to the position of the egg in the clutch and yolk index . The only exception from that trend was the decrease in yolk index value of the second egg than the first one in the two egg laying cycles of both breeds. Statistical analyses showed no significant differences in yolk index value between different eggs in clutch except in the two egg laying cycles where the difference was significant.

The higher yolk index values in all cycles studied occurred during winter season. The lowest yolk index values for the two, three, five and six egg laying cycles in both breeds and the four egg laying cycels in the Fayoumi were observed during summer season. Meanwhile, the lowest values occurred during autumn in the one egg laying cycles in the Fayoumi and four egg layin cycles in the Plymouth rock. Highly significant differences were observed between seasons in yolk index of all cycles except in the five egg laying cycles where no significant difference was found.

High temperature weakens the vitellin membrance, this resulted in the passage of more water from albumen to the yolk which leads to the reduction of the height and the increase in the diameter of the yolk and consequently decreases yolk index. Also, Hauter *et al.* (1936) and El-Gammal (1965), reported that yolk index increased during winter months and decreased during summer months.

Yolk color

The Fayoumi eggs had darker yellowish yolks than that of the White Plymouth Rock eggs. The yearly average of yolk color in the Fayoumi was 6.84 and in the Plymouth Rock was 5.32. The differences between the two breeds in all cycles were highly significant. These differences may be due to two main factors : (*a*) The concentration of the pigments in the small yolk size of the Fayoumi; (*b*) some genetical differences betweent the two breeds in pigment deposition.

In both breeds, yolk color became darker with the increase in clutch length until the four egg laying cycles, then followed an irregular trend. No definite trend in yolk color can be detected with respect to the position of the egg in a cycle. While the first egg in clutch was darker than the last egg in most cases.

Statistical analyses showed no significant differences in yolk color between different eggs according to their position in the clutch except in the five egg laying cycles where it was significant. The yolk color became fainter with the

advance of the position of the egg in the cycle. This could be attributed to the decrease of pigment.

The darker yellowish yolk for the one, two, four, five and six egg laying cycles in the Fayoumi and one, three and five egg laying cycles in the Plymouth Rock were observed during spring season. While this was noticed during winter season in the two, four and six egg laying cycles in the Plymouth Rock and the three egg laying cycles in the Fayoumi. The lowest egg yolk color in the one, three and five egg laying cycles in the Fayoumi and one, five and six egg laying cycles in the Plymouth Rock were observed during the summer season. Meanwhile, this occurred during the autumn season for the two , four and six egg laying cycles in the Fayoumi and the two, three and four egg laying cycles in the Plymouth Rock.

Analyses of variance showed higher significant differences between seasons in the one, two , four and five egg laying cycles and significant in the three and six egg laying cycles. Yolk color was affected by air temperature and the availability of the green feed. The absence of green fodder and the increase in air temperature during summer months reduced yolk color. Similar findings were found by Hauter *et al.* (1936) and El-Gammal (1965).

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تأثير دورة وضع البيض على مكونات وصفات البيضة

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فحصت فى هذه التجربة ٤٣٣٢ بيضة فيومى تتكون من ٩٣٥و٦٦٨و٣٥٦ و١٢٧و٥٣و٢١و١٢ سلسلة وضع بيض من دورات احادية وثنائية ثلاثية ورابعية خماسية وسداسية وسباعية على التوالى . وكذلك فحصت ٢٧٦٧ بيضة بليموث ابيض تتكون من ٨٨٧و٤٩٩و١٩١و٤١و١٩و٦و٢ سلسلة وضع بيض من دورات احادية وثنائية وثلاثية ورباعية وخماسية وسداسية وسباعية على التوالى . ودرس فيها مختلف صفات البيضة .

وقد زاد متوسط وزن البيضة وصفات الجودة فى البيضة فى الشتاء والربيع وانخفضت فى الصيف ، وكان سمك القشرة فى أول بيضة فى الدورة الثنائية اسمك من أى بيضة أخرى . وترتفع صفات الجودة فى البياض كلما زاد ترتيب البيضة فى السلسلة . وكانت صفات البياض الجيدة فى البليموث أكبر منها فى الفيومى واعطت الدجاجات الفيومى بيض لون صفاره أغمق من البليموث وكذلك كان بيض الفيومى ذى قشرة أسمك من البليموث .