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Studies on Physical Properties of Blood and Egg Production in Turkey.

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TWENTY-SIX HENS and ten toms Medium-weight broad-breasted white studler turkeys, and also the same numbers of native broad-breasted Bronze turkeys were used in this experiment to study the relationship between physical properties of blood and egg production.

There were low and negative phenotypic correlation between hematocrit value and egg number, weight and mass in bronze poults, but they were low and positive in studler poults.

For both breeds, there were low and positive correlations between both of blood hemoglobin and mean corpuscular hemoglobin concentration (MCHC) and each of the economic characters studied.

There were high and negative correlations between sedimentation rate either after one or two hours and each of the economic characters studied in both breeds.

Phynotypic correlations between specific gravity and each of economic characters were all negative and the magnitude of the correlations was higher for Bronze than for studler.

Physical Properties of Blood

1. *Hematocrit Value*

Corpuscular volume (Hematocrit) is influenced by age, hormones, number, size and shape of cells. Until sexual maturity there appears to be no significant difference in the counts of erythrocytes and little variation due to age (Domm and Taber, 1946, and Newell and Shaffner, 1950). The number of erythrocytes in hens is greater in the fall than in the winter and spring, when rate of laying is usually higher (Domm and Taber, 1946). Vogel (1961) showed higher erythrocytes volumes for males and females in winter. (Values for cell volume in percentage are shown in Bronze turkey at nine months old and for adult by Hunsaker (1969) were 35·4 and 33·5.Chickens raised at ambient temperatures of 10, 21 and 32·2°C had higher hematocrits than those raised at lower temperature of 7·2° (Kubena, *et al.*, 1971).

Changes in packed cell volume were positively correlated with changes in hemoglobin content (Hunsaker *et al.*, 1964).

2. *Blood Hemoglobin*

Wolternik *et al.* (1947) found that hemoglobin values for normal white Holland turkeys at 28, 32 and 40 weeks of age were 10·82, 11·27 and 12·17 grams in 100 ml. respectively. Chickens showed seasonal variation in hemoglo bin levels according to Olson (1937), tending to be higher during the winter months than during the summer months.

Hemoglobin levels were definitely influenced in pullets by egg production. Ramsay and Campbell (1954) and Tanaka and Rosenberg (1954) observed that laying hens had much lower hemoglobin levels than non-laying hens. Tanaka and Rosenberg (1954) and Hunsaker *et al.*, (1964) showed that hemoglobin levels decreased sharply as egg production increased. On the other hand, Jaffe (1960) reported no difference in hemoglobin of laying and non-laying birds. Mean while, Harmon (1936) observed that good producers contained higher hemoglobin levels than poor producers.

3. *Mean Corpuscular Hemoglobin Concentration (MCHC)*

The mean corpuscular hemoglobin concentrations (MCHC) expresses the mean content of hemoglobin in g/100 ml. of erythrocytes. Bell *et al.*, (1964) found that MCHC in Brown Leghorns at the end of laying were 30-31 g/100 ml. and the values around the return to laying were 40-41 g/100 ml.

4. *Sedimentation Rate*

Gray *et al.*, (1954) reported that sedimentation rates range from 0·5 to 9·0 mm/hour, with most values falling between 1·5 and 4. Sturkie and Textor (1960) showed that sedimentation rate increased significantly as hematocrits decreased. Also, changes in sedimentation rate were negatively correlated with changes in packed cell volume (Hunsaker *et al.*, 1964).

5. *Specific Gravity of Blood*

The specific gravity of whole blood was 1·044 in female chicken (Medway and Kare, 1959) and 1·052in female goose (Hunsaker *et al.*, 1964). The specific gravity of the whole bloood did not change with age (Medway and Kare, 1959). Hunsaker *et al.*, (1964) found that changes in whole blood specific gravity of goose were positively correlated with changes in packed cell volume.

Egg production

Whitson *et al.*, (1944) reported that egg production per hen from beginning January 15 to May 31 for Belsville small-type white, white Holland, Standard bred Bronze and Broad Brested Bronze were 62,63,76 and 59 eggs respectively. Shoffner *et al.*, (1962 , and Thomason *et al.*, (1972) suggested that egg production decreased as seasonal temperatures increased during the breeding season.

Thomason *et al.*, (1972) showed that in large White turkey females, eggs weights were significantly higher for eggs taken from birds in 12.8 and 21.1 °C temperature environments than those in the 29.4°C pens. On the other hand, Rosenberg and Tanaka (1951) showed that no differences in egg weight due to differences in temperature throughout the laying year.

Material and Methods

This work was carried out at the Poultry Research Center, Animal Production Department, Faculty of Agriculture, Cairo University.

Twenty-six hens and ten toms 28-weeks-old, Medium-weight Broad-Breasted White Studler turkeys, and also the same numbers native Broad-Breasted Bronze turkeys were used in this experiments which started in May 15, (1982) and lasted untill May, (1983). The purpose of this experiments was to study the relationship between egg production and some physical properties of blood as affected by breed and age.

During the experimental period, the birds were fed a turkey breeder ration containing 16.4% crude protein and 2900 kcal/kgME.

At 32-week-old the birds were exposed abruptly to 17 hr of light daily : 8 hr of natural light plus 9 hr of artificial light of 2 feet candle by using incandescent bulbs.

The experiments lasted until the hens reached 48-week-old.

The hens were trapnested and the eggs were pedigreed. The egg weight was recorded daily to the nearest gram. Egg production and egg mass were counted.

Blood samples were collected immediately from the wing vein by a syringe at 4 weeks intervals from 28 to 48 weeks of age. About 3 ml of blood from each hen were placed in heparanizect test tube. Hematocrit vaue, Hemoglobin content Mean corpuscular hemoglobin concentration, specific gravity of whole blood, and sedimentation rate after one and two hours were measured in individual samples.

Statistical analysis was carried out according to Steel and Torrie (1960), and phenotypic correlations were computed between physical properties of blood and between physical properties and economic characteristics.

Results and Discussion

Physical Properties of Blood

1) *Hematocrit Value*

Generally, the hematocrit value in Bronze was lower than that in studler (Table 1). The differences due to breed were significant (Table 2). The heamatocrit value in Bronze decreased gradually from 28 weeks until 40 weeks of age in March (Peak of production) then increased markedly. The highest value was observed at 48 weeks of age (Table 1 and Fig 1) meanwhile in Studler, the hematocrit value decreased markedly with age, till 36th week in late February, then a steep increase was observed up to 44 weeks of age and slightly decreased after wards.

It was observed that the reduction in hematocrit value occurred during the period of sexual maturity which is occompanied by higher level of gonadal hormones. Taber *et al.*, (1941) found that estrogens tended to depress erythrocytes numbers.

TABLE 1. **Average hematocrit value, blood hemoglobin and mean corpuscular hemoglobin conceatration (MCHC) for Bronze (B) and Studler (S) during the different periods.**

Period (week)	Hematocrit value (%)		Hemoglobin (gm/100 ml)		MCHC (%)	
	B	S	B	S	B	S
28—32	33.3^{abc}	33.8^{abc}	11.6^{bcd}	12.0^{cb}	34.9^{bcd}	35.5^{c}
32—36	32.0^{cd}	31.7^{b}	11.2^{bcd}	12.3^{c}	35.2^{cd}	38.7^{b}
36—40	31.5^{b}	34.8^{ab}	12.1^{bc}	12.0^{cd}	38.7^{b}	34.5^{c}
40—44	33.8^{ab}	34.8^{a}	12.1^{b}	16.3^{a}	35.8^{c}	46.9^{a}
44—48	34.6^{a}	34.2^{cab}	15.8^{a}	13.3^{b}	45.7^{a}	93.0^{b}

* Values in the same column followed by the same letter are not significantly different) $P < (0.05)$ from each other.

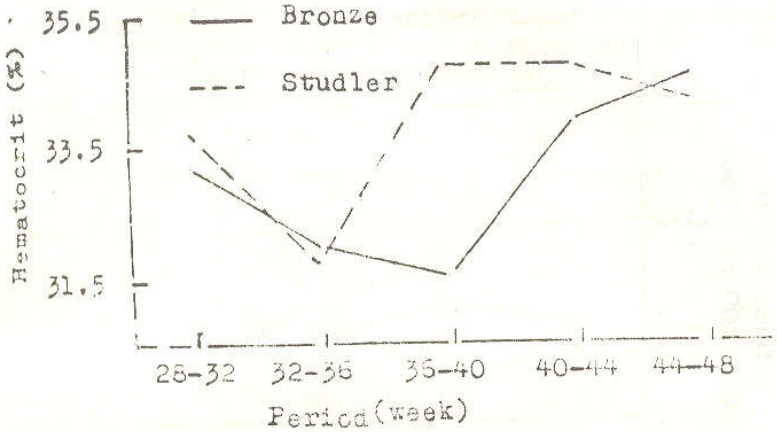

Fig. 1 Average hematocrit value for Bronze (B) and Studler (S) during the different periods.

2. *Blood Hemoglobin*

Table 1 and Fig 2 showed that the level of hemoglobin in blood of studler hens was higher than that in Bronze. The differences between breeds in blood hemoglobin were significant (Table 2).

In Bronze, the hemoglobin content increased gradually with the advancement of age (Table 1 and Fig 2), while in Studler the hemoglobin content has a fluctuating trend with age. The highest value was attained at 40-44 weeks of age in April. The differences in blood hemoglobin were significant (Table 2). Hemoglobin levels are definitely influnced by age, gonadal activity and intensity of production. Tanaka and Rosenberg (1955) suggested that, the balance between androgens and estrogens determines the hemoglobin level in chickens. Taber *et al.*, (1941) found that estrogens tended to depress erythrocyte count, and there was a close positive association between erythrocyte count and hemoglobin level. There was a significant negative association between intensity of production and hemoglobin content, which is in agreement with the reports of Maugham (1935) and Harmon (1936). Tanaka and Rosenberg, (1954) reported that laying chickens had lower hemoglobin levels than non-laying birds from the same hatch, and hemoglobin level varied significantly within individuals being higher during periods of pause and partial molt than during egg production.

3. *Mean Corpuscular Hemoglobin Concentration (MCHC)*

The mean corpuscular hemoglobin concentration in Bronze was lower than that in Studler, but the differences due to breed were not significant (Table 2). Comparing between the different ages it was found that MCHC in Bronze and Studler had similar trends to those of blood hemoglobin, but with little fluctuations (Table 1 and Fig 3). The differences due to age were significant (Table 2). The factors affecting hemoglobin content exert the same effect on MCHC Sturkie, 1965).

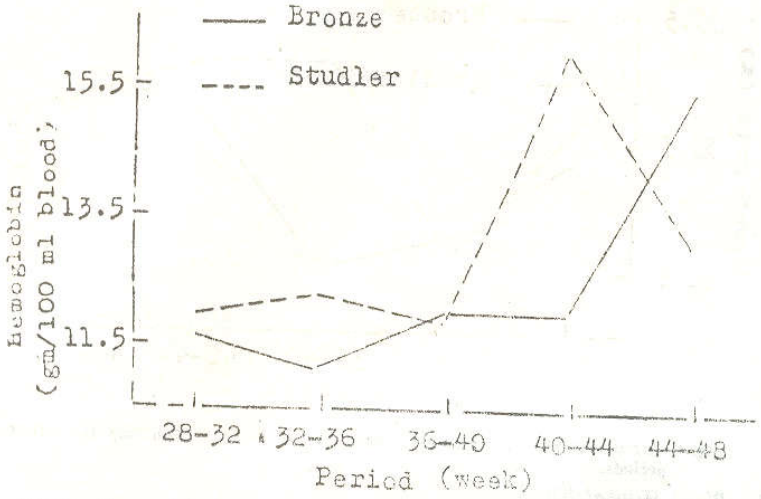

Fig. 2 : Average blood hemoglobin for Bronze (B) and Studler (S)during the different periods.

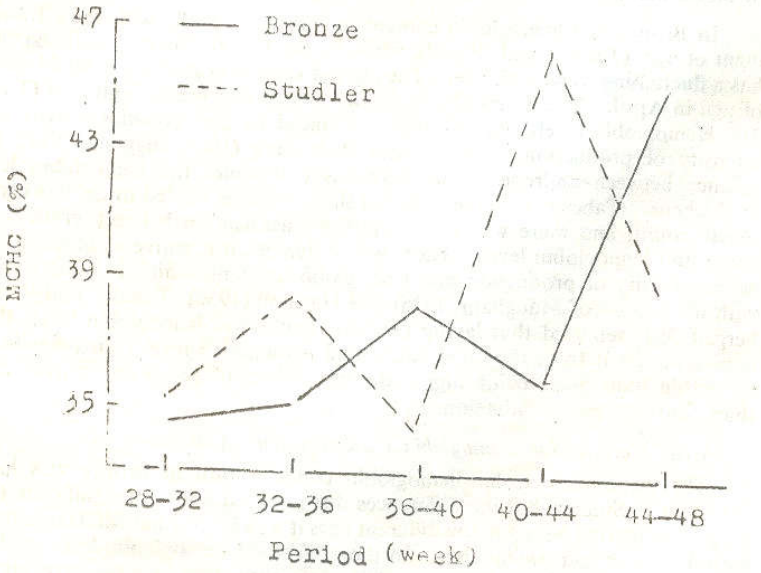

Fig. 3 : Average mean corpuscular hemoglobin concentration for Bronze (B) and Studler (S) during the different periods.

TABLE 2. **Analysis of variance of hematocrit value, blood hemoglobin, mean corpuscular hemoglobin concentration, sedimentation rate and specific gravity of blood for Bronze and Studler during the experimental period.**

Items	S.V.	d.f.	S.S.	M.S.
Hematocrit	Bet. Breeds	1	17.71	17.71*
	Bet. ages	4	81.91	20.48*
	Error	254	876.89	3.45
Hemoglobin	Bet. Breeds	1	24.55	24.55*
	Bet. ages	4	391.74	97.94*
	Error	254	786.97	3.10
Mean curpuscular Hemoglobin concentration	Bet. Breeds	1	48.42	48.42^{NS}
	Bet. ages	4	2087.29	521.82*
	Error	254	5754.37	22.66
Sedimentation hour (one hour)	Bet. Breeds	1	0.02	0.02^{NS}
	Bet. ages	4	63.48	15.87*
	Error	254	81.63	0.32
Sedimentation rate (two hours)	Bet. Breeds	1	4.77	4.77*
	Bet. ages	4	78.48	19.62*
	Error	254	74.73	0.29
Specific gravity	Bet. Breeds	1	0.01	0.01*
	Bet. ages	4	0.00012	0.00003^{NS}
	Error	25	0.21	0.0008

NS = Not significant
* = Significant ($P < 0.05$)

4) *Sedimentation Rate*

In general, the sedimentation rate after one hour or two hours in Bronze were higher than that in studler (Table 3 and Fig 4 and 5). Only the differences in sedimentation rate after two hours between breeds were significant Table 2). The difference between the two breeds was high in the first period (28-32 weeks age), then it decreased after that, when sedimentation rate was measured after one and two hours.

The sedimentation rate after one or two hours decreased gradually as age increased in both breeds (Table 3 and Fig 4 and 5). The decrease in sedimentation rate was higher after the first period than after other periods when it was measured after one hour in Bronze. Age had a significant effect on sedimentation rate either after one or two hours (Table 2). The results obtained agree with Gilbert (1968) who added that the sedimentation rate in females is throught to be related to the level of lipid content of their plasma. Thus as the hen matures the sedimentation rate rises.

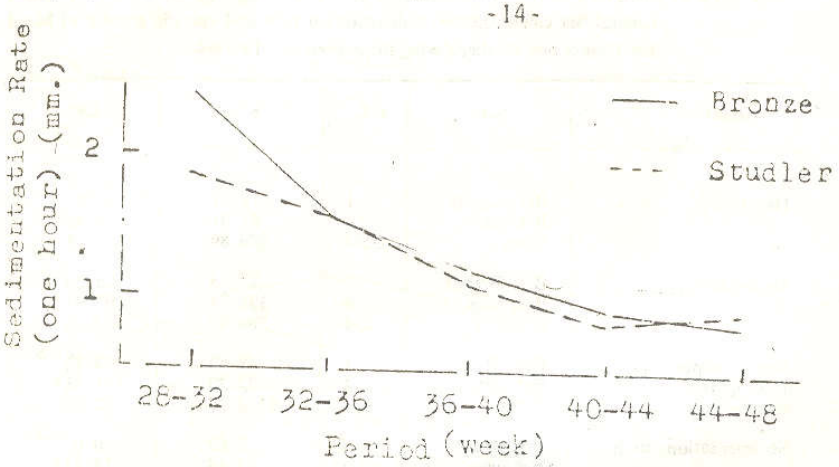

Fig. 4 Average sedimentation rate after one hour for Bronze (B) and studler (S) during the different periods.

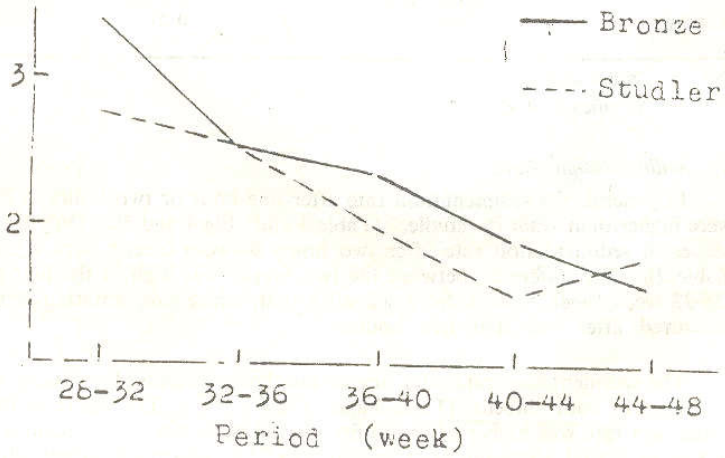

Fig. 5 Average sedimentation rate after two hours for Bronze (B) and Studler (S) during the different periods.

TABLE 3. Average sedimentation rate after one and two hours and specific gravity of blood for Bronze (B) and Studler (S) during the different periods.

Period (weekd)	Sedimentation rate (mm)				Slecific gravity	
	one hour		two hours			
	B	S	B	S	B	S
28—32	2.5^{a}	1.9^{a}	3.5^{a}	2.8^{a}	1.048^{a}	1.050^{a}
32—36	1.6^{b}	1.6^{a}	2.6^{b}	2.6^{a}	1.047^{ab}	1.047^{bcd}
36—40	1.2^{c}	1.1^{b}	2.4^{b}	2.0^{b}	1.046^{abcd}	1.049^{ab}
40—44	0.9^{cd}	0.8^{abc}	1.9^{c}	1.5^{c}	1.047^{abc}	1.049^{abc}
44—48	0.8^{d}	0.9^{abc}	1.6^{d}	1.8^{b}	1.047^{abcd}	1.047^{abcd}

*Values in the same column followed by the same letter are not significantly different ($P<0.05$) from each other.

5. *Specific Gravity of Blood*

In general, the specific gravity in Bronze was lower than that in studler (Table 3 and Fig 6). The differences between breeds were significant (Table 2).

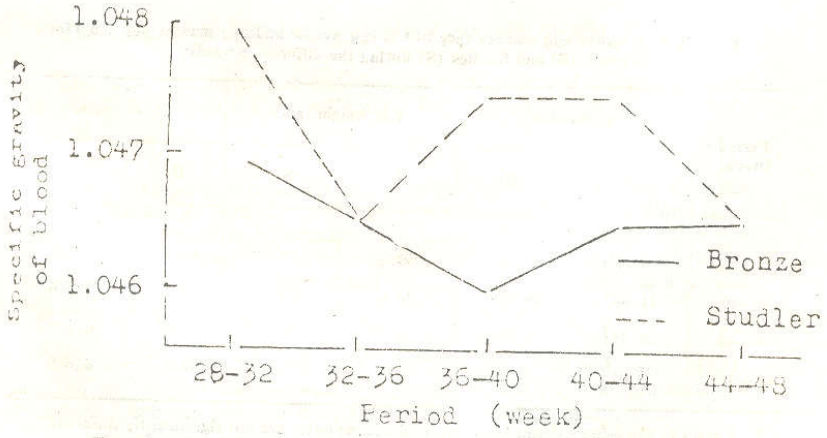

Fig. 6 Average specific gravity of blood for Bronze (B) and Studler (S) during the different periods.

The specific gravity decreased with age in the two breeds (Table 3 and Figure 6), but the differences due to age were not significant (Table 2). Medway and Kare (1959)found that the specific gravity of whole blood shows only minor changes with age.

Economic Characteristics

1. *Egg Number*

Egg number in Bronze was higher than that in Studler in all periods of experiment (Table 4). The differences in egg number due to breed were significant (Table 5). Whitson *et al.*, (1944) observed clear differences in egg production among four of the more common varieties of turkeys, Beltsville small-type white, white Holland, Standardbred Bronze and Broad-Brested Bronze. Asmundson (1938) from an investigation of a complex of characters affecting egg production in turkeys reported that those characters were probably influenced by a number of genes just as chickens.

In both breeds included in the study the egg number increased enormously as age increased, reaching a maximum value at 40 weeks of age in March, and decreased gradually there after with the advance of age (Table 4 and Fig. 7) The differences in egg number due to age were significant (Table 5). Results show that egg production decreases as seasonal temperature increases during the breeding season. Similar results were observed by Shoffner *et al.*, (1962). Thyroid activity has been shown to be closely related to egg production. It is well known that the gland activity decreases with the increase of inveron mental temp., (sturkie, 1965).

TABLE 4. A verage egg number (per hen), egg weight and egg mass (per hen) for Bronzet (B) and Studles (S) during the different periods·

Period (week)	Egg number		Egg weight (gm)		Egg mass (gm)	
	B	S	B	S	B	S
32—36	6.15^{c}	2.70^{d}	69.5^{c}	72.1^{abc}	46.3^{b}	200.1^{b}
36—40	11.65^{a}	10.60^{a}	74.6^{a}	$75\ 0^{a}$	896.1^{a}	792.6^{a}
40—44	10.65^{b}	8.85^{b}	74.5^{ab}	75.5^{ab}	$793p7^{a}$	658.5^{a}
44—48	6.61^{c}	5.81^{c}	73.7^{ab}	73.2^{abc}	487.1^{b}	424.9^{c}

* Values in the same column followed by the same letter are not significantly different ($P < 0.05$) from each other.

TABLE 5. Analysis of variance of egg number (per hen) egg weight, and egg mass (per hen) , (economic characteristics) for Bronze and Studler during the experimental period.

Items	S.V.	d.f.	S.S.	M.S.
Egg number . .	Bet. Breeds	1	1492.35	1492.35*
	Bet. ages	3	2744.75	914.92*
	Error	203	166.33	0.82
Egg weight . . .	Bet. Breeds	1	20.74	20.74^{NS}
	Bet. ages	3	498.83	166.28*
	Error	203	10959.40	54.00
Egg mass . . .	Bet. Breeds	1	878670.01	878670.01*
	Bet. ages	3	8607712.38	2869237.40*
	Error	203	5906693.10	29097.01

MS = Not significant

* = Significant ($P < 0.05$) t

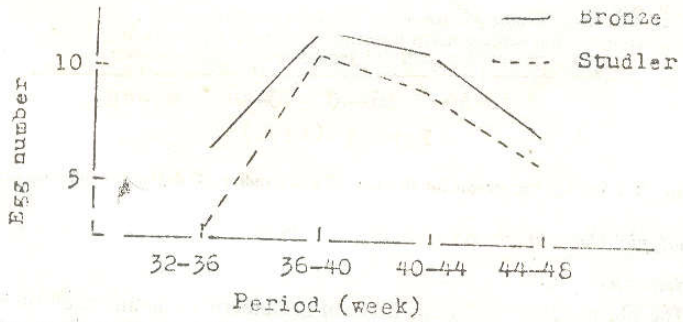

Fig. 7 Average egg number (per hen) for Bronze (B) and Studler (S) during the different periods.

Egg Weight

In general, the egg weight in Bronze was lower than that in studler in young birds till 40 weeks of age (Table 4 and Fig 8), though differences were not significant (Table 5). The egg weight increased as age increased. reaching the peak at 40 weeks of age in Bronze and at 40 one in studler in March and decreased slightly afterwards (Table 4 and Fig 8). Age exerted a significant effect on egg weight of turkey (Table 5).

The results indicate that egg weight tended to increase as the breeding season progressed. Thomason *et al.*, (1972) suggested that constant high air temperature reduced egg weight below the maximum. Huston *et al.*, (1957) attributed the lower egg weight of birds exposed to high environmental temperature to the lower feed consumed by such birds than those held at moderate temperature.

3. *Egg Mass*

The egg mass was higher in Bronze than in studler (Table 4 and Figure 9). The increase was mainely due to the high egg production in Bronze.The differences in egg mass due to breed were significant (Table 5).

Egg mass increased as age increased reaching a maximum value at 40 weeks of age in March and decreased gradually thereafter following egg number (Table 4 and Figure 9). Differences in egg mass due to age were statistically significant (Table 5).

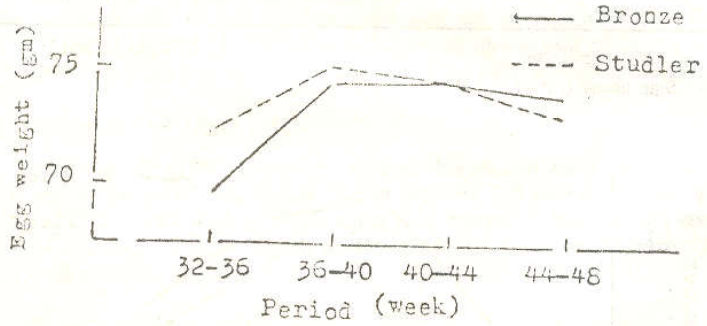

Fig. 8 : Average egg weight for Bronze (B) and Studler (S) during the different periods.

Phemotypic Correlations between Physical Properties of Blood

1. *Hematocrit value*

The phenotypic correlations between hematocrit value and each of blood hemoglobin, mean corpuscular hemoglobin concentration and specific gravity of whole blood, were all positive in the two breeds (Table 6). Previous data (Hunsaker *et al.*, 1964) showed that changes in packed cell volume were positively correlated with changes in hemoglobin content and whole blood specific gravity. However, correlations between hematocrit and sedimentation rate either after one or two hours were negative. The magnitude of the correlations was higher for studler than for Bronze. These result agree with those found by Hunsaker *et al.*, (1964). They showed that sedimentation rates were negatively correlated with packed cell volume

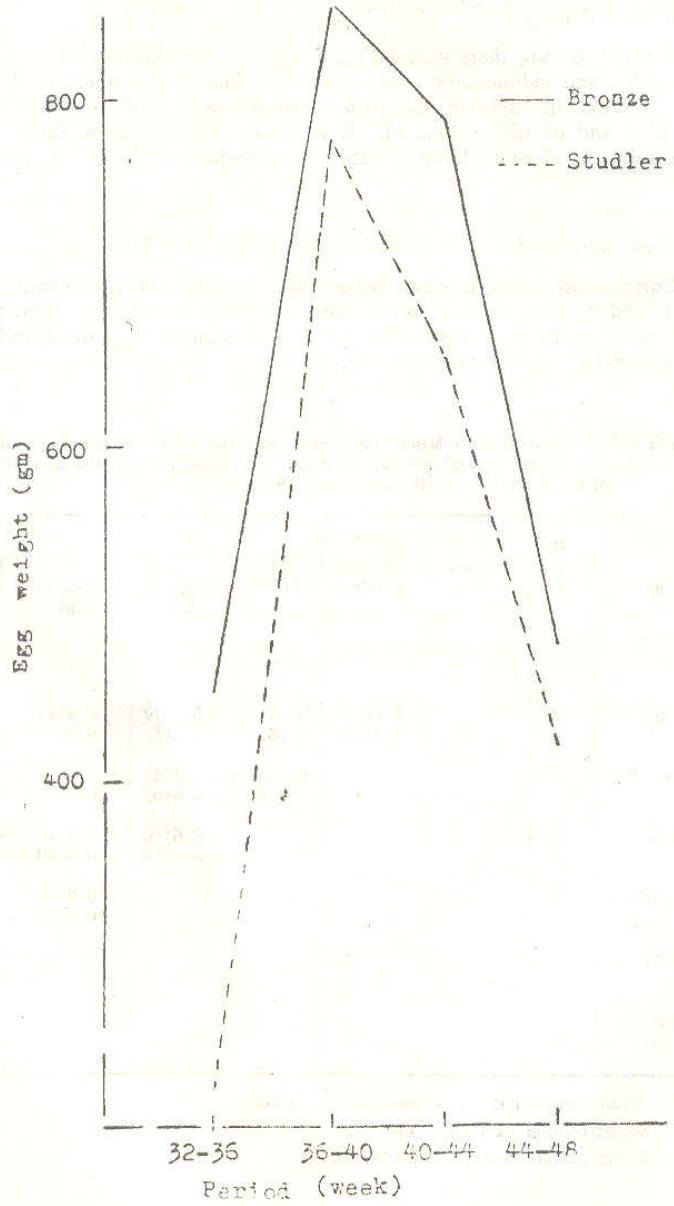

Fig. 9 Average egg mass (per hen) for Bronze (B) and Studler (S) during the different periods.

2. *Blood hemoglobin*

For both breeds, there were high and negative correlations between blood hemoglobin and sedimentation rate either after one or two hours, while those between blood hemoglobin and mean corpuscular hemoglobin concentration were high and positive (Table 6). It was also indicated from Table 6 that the correlations of hemoglobin content with specific gravity were low and negative.

3. *Mean corpuscular hemoglobin concentration (MCHC)*

Correlations between mean corpuscular hemoglobin concentration and each of sedimentation rate after one and two hours and specific gravity were all negative in the two breeds (Table 6). The magnitude of the correlations was higher for Bronze than for Studler.

TABLE 6. **Phenotypic correlations between hematocrit value, blood hemoglobin, mean corpuscular hemoglobin concentration, sedimentation rate and specific gravity of blood for Bronze (B) and Studler (S) polts.**

Item	Breed	Hema-tocrit	Hemo-globin	1 MCHC	2 SR (1h)	3 SR (2h)	Specific gravity
Hematocrit	B		0.6955	0.4910	—0.2639	—0.4145	0.04980
	S		0.4108	0.1625	—0.6113	—0.6734	0.5212
Hemoglobin	B			0.9673	—0.5783	—0.6816	—0.955
				0.9662	—0.6803	—0.7672	—0.0347
MCHC[1]	B				—0.6110	—0.6814	—0.2966
	S				—0.5710	—0.6460	—0.1200
SR (1h)[2]	B					0.9819	0.6668
	S					0.9872	0.2683
SR (2h)[3]	B						0.5317
	S						0.1433
Specific Gravity	B						
	S						

1 = Mean corpuscular hemoglobin concentration.
2 = Sedimentation rate after one hour.
3 = Sedimentation rate after two hours.

4. *Sedimentation rate*

In both Bronze and studler breeds, there were very high and positive correlations between the estimates of sedimentation rate recorded after one hour and those recorded after two hours (Table 6). The correlations between sedimentation rate either recorded after one hour or two hours and specific gravity were all positive. The magnitude of the correlations was higher for Bronze than for Studler.

Phynotypic Correlations Between Blood Physical Properties and Economic Characteristics

1. *Hematocrit value*

In Bronze poults, phenotypic correlations between hematocrit value and each of the economic characters studied were all low and negative (Table 7). However, in Studler poults there were positive correlations between hematocrit value and economic characters studied.

It may be due to the higher egg production of Bronze than that of studler.

TABLE 7. **Phenotypic correlations between blood physical properties and economic characterististics for Bronze (B) and Studler (S) poults.**

Items	Breed	Egg number	Egg mass	Egg weight
Hematocrit	B	—0.2519	—0.2498	—0.0930
	S	0.6491	0.6485	0.0573
Hemoglobin	B	0.0819	0.0810	0.3122
	S	0.4238	0.4203	0.3710
MCHC-[1]	B	0.1953	0.1937	0.4107
	S	0.2794	0.2756	0.3936
SR (Ih)[2]	B	—0.8185	—0.8155	—0.9137
	S	—0.8464	—0.8405	—0.7722
SR (2h)[3]	B—	—0.6964	—0.6952	—0.8590
	S	—0.8314	—0.8262	—0.6929
Specific gravity	B	—0.8944	—0.8929	—0.8054
	S	—0.0104	—0.0025	—0.6425

1 = Mean corpuscular hemoglobin concentration
2 = Sedimentation rate after one hour
3 = Sedimentation rate after two hours

2. *Hemoglobin*

For both breeds, there were low and positive correlations between blood hemoglobin and each of the economic characters studied (Table 7). Earlier published data by Tanaka and Rosenberg (1954) found negative correlation between hemoglobin level and intensity of egg production in chicken hens. They indicated that good producers have lower hemoglobin levels than poor producers. Hunsaker *et al.* (1964) found that hemoglobin levels decreased sharply as egg production increased.

3. *Mean corpuscular hemoglobin concentartion (MCHC)* :

The correlations seemed to be similar to those calculated for blood hemoglobin (Table 7).

4. *Sedimention rate*

In both Bronze and Studler poults, there were high and negative correlations between sedimentation rate either after one or two hours and each of the economic characters studied (Table 7).

5. *Specific gravity*

Phynotypic correltions between specific gravity and each of economic charters were all negative (Table 7). The magnitude of the correlations was clearly higher for Bronze than for Studler.

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دراسة بعض الخواص الطبيعية للدم وانتاج البيض فى الدجاج الرومى

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استخدم فى هذا البحث ستة وعشرون دجاجة ، وعشر ديوك رومى من نوعى ستودلر وبرونز • لدراسة العلاقة بين الخواص الطبيعية للدم وانتاج البيض •

وقد وجد أن هناك ارتباط سالب منخفض بين نسبة المكونات الخلوية للدم وكل من انتاج البيض ، ووزن البيضة وكتلة البيض فى نوع البرونز • ولكن هذه العلاقة كانت موجبة ومنخفضة فى نوع ستودلر •

فى كل من النوعين كان معامل الارتباط موجب ومنخفض بين كل من كمية هيموجلوبين الدم ومتوسط تركيز الهيموجلوبين فى الكرات من جهة وكل من الصفات الاقتصادية المدروسة للبيض من جهة أخرى •

كان معامل الارتباط سالب بدرجة كبيرة بين سرعة الترسيب بعد ساعة وساعتين وكل من الصفات الاقتصادية للبيض •

وقد ظهر أن معامل الارتباط بين الكثافة النوعية للدم وكل من الخواص الاقتصادية للبيض كانت كلها سالبة • وكانت مقادير معامل الارتباط أكبر فى نوع البرونز عنها فى نوع ستودلر •