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Studies on some Economical Traits in Fayoumi and its Crosses along with Semen Evaluation

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A TOTAL of 136 layers at age of one year old from Fayoumi breed were artificially inseminated with Fayoumi, Plymouth Rock and Rhode Island Red cocks. Each male was mated to a certain group of Fayoumi females to represent a family. The collected eggs were incubated within 10 hatches to study fertility, hatchability, hatching weight and malpositions. Besides the cocks were examined for semen evaluation. The data revealed significant difference between Fayoumi and its crosses on the abovementioned characters. Fertility, hatchability and hatching weight were significantly correlated with semen characteristics and prediction equations were proposed for evaluation. It is concluded that the mating of Plymouth male to Fayoumi female seems to be more effective for improving the said economical traits.

The commercial breeding of any economically important species, including poultry is directed toward three broad objectives. The first one is increased product output per animal, the second is increased efficiency of production and the third is improved quality of an existing product. In poultry the improvement of fertility, hatchability, growth rate, body conformation, egg and meat yield, feed conversion, egg and meat quality and viablilty are all facets of the abovementioned objectives.

Fertility is determined by the ability of the male and the female when mated together, produce offsprings. Occasionally, many females are sterile even with good males, however, the male plays the principal part in fertility than female (Munro, 1946).

Hatchability is determined by very large numbers of genes (Byerly *et al.* 1934) and could be improved by selective breeding (Wilson and Johanson, 1946). There is always correlation between the variation in fertility and hatchability (Hays, 1951). Several investigators (Hafez and Kamar, 1955: Ragab *et al.*, 1956; Amer *et al.*, 1957; El-Ayadi and ElIbiary, 1957; Kicka *et al* ., 1977) were concerned about the effect of breed, strain, crossbreeding and environmental factors on fertility, embryonic mortality and hatchabililty. Other workers directed their efforts on the improvement of the fertilizing capacity of the cocks through semen examination and/or the correlation between semen characteristics and incubation quality (Kamar, 1960 ; Brown and Graham, 1971 ; Soller and Rappaport, 1971 ; Dubey *et al.*; 1977 and Khalifa, 1977).

The present work was planned to study the possibility of improving fertility, hatchability and hatching weight in Fayoumi through different types of mating by applying artificial insemination. Besides the correlations between semen characteristics with fertility and hatchability were also considered.

Material and Methods

A total of 136 layers at age of one year old from Fayoumi (F) breed were artificially inseminated with males from Fayoumi (F), Plymouth Rock (P) and Rhode Island Red (R). Each male within breed mated to a certain group of Fayoumi females to represent family (Table 1). The hens were weekly inseminated with 0.05 cc for 14 weeks. The eggs were daily collected from each family, weighed and recorded for the shape index after 4 weeks from the first insemination. From January 31, 1981 to April 5, 1981 ten hatches with a total of 2191 colllected eggs (Table 2) were used. The eggs from each hatch were incubated in a forced draft incubator, where fertility, embryonic mortality, hatchability and hatching weight were calculated. The eggs which did not hatch were considered as dead and were classified to 6 types of malpositions as follows :

1. The head is burried between thighs
2. Head in the narrow end of the egg.
3. Head is bent to the left side.
4. Beak is not directed toward the air cell.
5. Feets are over the head.
6. Beak is above the right wing.

TABLE 1. **The number of the Fayoumi females for the different families.**

Mating		The serial number of the male							Total
Male	Female	1	2	3	4	5	6	7	
Fayoumi . .	Fayoumi (FF)	6	6	5	10	6	6	6	45
Plymouth . .	Fayoumi (PF)	12	12	11	13	8	——	——	56
Rhode . . .	Fayoumi (RF)	10	7	9	9	——	——	——	35

TABLE 2. Information about experimental eggs.

Classification	Egg set	Fertile eggs	Egg weight, g mean±S.E	Shape index% mean+S.E
FF	680	503	40.9 ± 0.28	76.1 ± 0.26
PF	884	651	40.4 ± 0.28	75.7 ± 0.23
RF	627	449	41.6 ± 0.29	75.9 ± 0.24

TABLE 3. Mean ± S.E of fertility percentage in Fayoumi and its crosses.

Item		♂Fayoumi x ♀Fayoumi (FF)	♂Plymouth x ♀Fayoumi (PF)	♂Rhole x ♀Fayouim (RF)
Overall mean		74.0 ± 1.8	73.6 ± 1.9	71.6 ± 2.6
Date	Hatch no.			
31/1/81	1	73.4 ± 5.9 a	53.3 ± 7.1^{c}	53.9 ± 9.9^{b}
7/2	2	73.9 ± 5.7 a	60.2 ± 7.3^{b,c}	72.2 ± 6.5^{a,b}
13/2	3	72.0 ± 5.2 a	72.5 ± 7.4^{a,b}	73.3 ± 8.8^{a,b}
19/2	4	68.3 ± 6.4 a	76.7 ± 7.3^{a,b}	75.6 ± 9.0^{a}
26/2	5	74.4 ± 6.6 a	77.9 ± 9.1^{a,b}	66.0 ± 10.0^{a,b}
6/3	6	75.8 ± 4.5 a	75.7 ± 6.0^{a,b}	72.1 ± 6.8^{a,b}
13/3	7	75.3 ± 5.4 a	70.1 ± 7.6^{a,b}	81.5 ± 7.3^{a}
21/3	8	83.5 ± 4.3 a	82.5 ± 3.6^{a}	78.8 ± 6.0^{a}
27/3	9	67.7 ± 6.3 a	80.4 ± 5.0^{a}	80.7 ± 7.2^{a}
5/4	10	72.9 ± 6.3 a	80.0 ± 4.8^{a}	61.4 ± 9.4^{a,b}
Family(between males)				
1		69.5 ± 4.4b,c	69.9 ± 3.7^{b}	72.3 ± 4.9^{a,b}
2		66.1 ± 6.4b,c	70.3 ± 4.1^{b}	60.8 ± 5.7^{b}
3		58.6 ± 5.1c	73.8 ± 5.1^{b}	79.8 ± 5.5^{a}
4		84.7 ± 3.3a	89.5 ± 3.4^{a}	73.5 ± 4.5^{a,b}
5		85.0 ± 3.1a	67.2 ± 4.8^{b}	
6		76.0 ± 4.5a,b		
7		68.7 ± 5.4b,c		

Means within a column within a item followed by the same letter do not differ significantly from each other, otherwise they differ significantly at 0.05

From each male, two ejaculates of the semen were collected. Semen characteristics were examined for each ejaculate including volume to the nearest 0 01 cc, motility rating as explained by Kamar (1960), scheme of classification and concentration were maesured according to Smith and Mayer (1955), live percentages and abnormalities as described by Kamar (1959) and the pH.

Results and Discussion

Fertility

Table 3 shows the fertility percentages for the 10 hatches and for the different families. On the averages, the data revealed insignificant difference between the different types of mating. Howewer, both FF (74.0 %) and pF (73.6 %) had higher fertility percentage than the RF (71.6 %). Therefore, crossbreeding did not improve the fertility in Fayoumi. In fact, Fayoumi breed showed higher fertility than its two crosses. In this respect, previous reports (Ragab *et al.*, 1965 ; Kicka *et al.*, 1977) showed that Fayoumi exceeded the Rhodes in fertility. Nordskog and Phillips (1960) concluded that fertility is an inherited character and that crossing had an effect on its expression.

The effect of hatches and/or the families on the fertility percentages is shown in Table 3. In FF and RF no significant differences were observed between hatches (Table 4),while significant difference was observed in PF. On the other hand,there was gradual increase in the fertility percentage with advancement of the hatches (Table 3). This is an indication that month of the year seems to have an effect on this phenomenon. This observation is in agreement with previous reports (Amer *et al* .,1957; El-Ayadi and El-Ibiary, 1957). Also, it seems that the ambient temperature during February to April is suitable for the higher fertility. In this respect, Hafez and Kamar (1955) pointed out that Fayoumi eggs have the maximum percentage of fertility in Aprli.

TABLE 4. Significance of hatches, families annd interaction in Fayoumi and its crosses.

Effect	Fertility %			Hatchability			Hatching		weight
	FF	PF	RF	FF	PF	RF	FF	PF	RF
Weeks (W)	NS	**	NS	NS	NS	**	**	**	**
Families (F)	**	**	NS	NS	**	**	**	**	**
W x F	NS	**	NS	NS	NS	**	NS	**	**

NS not significant
** significant at 0.01

With respect to the differences between families, significant difference in FF and PF was observed (Table 4), while insignificant difference was observed in RF. The observed significant difference between families in FF and PF is due to the male effect. Semen characteristics were found to be different either between breeds and /or between families (males for each group) as shown in Table 5. For each group, the families which exceed their overall mean in fertility percentage (Table 3)were found to have high semen quality of their males than the other males (Table 5).

TABLE 5. Semen characteristics in Fayoumi (F), Plymouth (P) andRdode (R).

Item	Male (family no.)							Mean±SE
	1	2	3	4	5	6	7	
Volume, cc								
F	0.24	0.30	0.21	0.35	0.27	0.26	0.21	0.26±0.02
P	0.42	0.50	0.85	0.80	0 55			0.62±0.06
R	0.40	0.45	0.45	0.60				0.48±0.03
Concen-tration								
F	1.06	1.56	1.36	2.01	1.65	1.51	1.33	1.50±0.11
P	0.82	1.40	2.28	1.67	1.75			1.58±0.16
R	1.85	1.11	1.79	1.05				1.45±0.16
Motility								
F	6.50	7.00	6.00	7.00	8.00	6.50	5.00	6.60±0.33
P	6.50	7.00	9.50	8.00	7.00			7.60±0.43
R	7.00	5.00	7.00	5.50				6.13±0.52
Live %								
F	89.00	84.00	87.50	94.00	88.00	89.50	90.00	88.90±1.10
P	88.00	89.10	97.00	95.00	92.00			92.20±1.30
R	85.50	84.00	86.50	87.50				85.90±1.10
Total abnormalities %								
F	22.00	17.00	16.50	9.50	16.00	16.50	36.00	19.10±2.00
P	13.00	8.50	5.50	8.00	6.50			8.30±1.10
R	11.00	11.00	8.00	11.50				10.40±0.71
pH								
F	7.00	7.25	6.25	7.50	6.50	6.60	6.20	6.70±0.15
P	7.30	7.40	8.00	7.40				7.50±0.11
R	7.20	6.90	7.40	7.20				7.20±0.09

The correlations and the regressions of the different semen characteristics with egg fertility are shown in Table 6. The observed significant difference in FF andtPF (Table 3) coincides with the significant correlations between all the semen characteristics under study in FF with egg fertility. However, only volume and live % in PF were significant (Table 6). The correlation values

in this study are different in magnitude than other values reported by different investigators (Shaffner and Andrews, 1948 ; Allen and Champion, 1955 ; Mccartney, 1956 ; Kamar, 1960 ; Brown and Graham, 1971). It should be noted that the results in Tables 5 and 6 are preliminary data to improve fertility in Fayoumi by family selection, or the lead to this improvement in PF when inbreeding practiced on long run future taking into consideration that the males were selected on the basis of semen evaluation. It is interesting to mention that the domestic hen maintain fertility for long periods after a single mating or artificial insemination. Physiological conditions in the female reproductive tract are optimal for the survival of the sperms. As a matter of fact, each semen character has its particular influence on fertility. Semen characters are so closely interrelated and therefore, it is difficult to study the effect of each character separately.

TABLE 6. **Correlations and regressions between semen characteristics (X) and fertility in Fayoumi and its crosses.**

Item		N	Intercept	Regression	Correlation
Volume, cc	FF	69	40.05	123.45	0.467**
	PF	49	55.39	29.10	0.331*
	RF	40			0.085
Concentrat.	FF	69	40.24	21.61	0.485**
	PF	49			0.140
	RF	40			0.180
Motility	FF	69	30.41	6.41	0.453**
	PF	49			0.185
	RF	40			0.287**
Live %	FF	69	—72.96	1.64	0.374**
	PF	49	—41.18	1.24	0.286*
	RF	40	—33.01	.69	0.343*
Total abnormalities	FF	69	79.97	—0.40	—0.252*
	PF	49			—0.098
	RF	40			—0.271
pH	FF	69	26.84	6.79	0.272*
	PF	49			0.048
	RF	40	21.90	4.06	0.376*

** Significant at 0.01
* Significant at 0.05

Hatchability and hatching weight

Table 7 shows the overall mean of hatchability in PF (75.0%) which was significantly higher than both FF (66.9%) and RF (65.3%) as shown in Table 4. On the other hand, the overall mean of the hatching weight in PF and RF(Table8) were significantly higher than the FF(Table4). These finding are in agreement with previous reports(Ragab *et al.*, 1955, 1956; Khalil and El-Ibiary, 1963 and Ragab *et al.*, 1965). Therefore, a better combining ability for having higher hatchability and hatching weight is between the Plymouth Rock males and Fayoumi females in comparison with Rhode Island and/or Fayoumi males.

This is characterized by the significant correlations between all the semen characters of the Plymouth cocks with hatchability as shown in Table 9. The hatchability in PF had clear family significant difference, while no significant difference between hatches was observed (Table 4). Semen characteristics of Plymouth cocks were of higher values than either Fayoumi or Rhodes (Table 5). There was no significant difference in hatchability between hatches or families in FF (Table 4). However, the correlations between semen characteristics were sigificant with hatchability (Table 9) except for live %. Meanwhile, hatchability was significantly different between hatches and between families in RF (Tables 7 and 4) and the correlations between all the semen characters and hatchability were significant as shown in Table 9.

TABLE 7. **Mean ± S.E. of hatchability percentage in Fayoumi and its crosses.**

Item		♂ Fayoumi × ♀ Fayoumi (FF)	♂ Plymouth × ♀ Fayoumi (PF)	♂ Rhode × ♀ Fayoumi (RF)
Overall mean . .		66.9 + 2.4	75.0 ± 2.2	65.3 ± 1.5
Date	Hatch no.			
31/1/81	1	65.6 ± 9.1^{a}	77.2 ± 7.5^{a,b}	50.0 ± 0.5^{e}
7/2	2	63.7 ± 7.9^{a}	72.1 ± 7.0^{a,b}	75.7 ± 8.1^{a,b}
13/2	3	57.6 ± 8.3^{a}	76.7 ± 7.8$^{a\ b}$	56.4 ± 10.1^{d,e}
19/2	4	70.8 ± 5.7^{a}	86.6 ± 5.5^{a}	64.7 ± 8.3^{c,d}
26/2	5	56.2 ± 8.5^{a}	80.9 ± 5.9^{a,b}	66.5 ± 9.9^{c,d}
6/3	6	72.5 ± 7.6^{a}	70.4 ± 8.4^{a,b}	71.1 ± 8.3^{a,b}
13/3	7	69.2 ± 8.6^{a}	67.4 ± 7.2^{a,b}	60.8 ± 10.4^{d}
21/3	8	76.1 ± 6.2^{a}	78.5 ± 4.7^{a,b}	77.7 ± 6.8^{a}
27/3	9	69.6 ± 9.3^{a}	76.7 ± 5.5^{a,b}	63.1 ± 8.6^{c,d}
5/4	10	65.4 ± 7.6^{a}	63 3 ± 7.2^{a}	58.4 ± 9.5^{d,e}
Family(between males)				
1		66.9 ± 6.3^{a}	83.5 ± 3.4^{a}	68.7 ± 6.0^{a}
2		65.7 ± 6.8^{a}	80.7 ± 5.1^{a}	51.4 ± 4.6
3		59.9 ± 7.1^{a}	59.5 ± 4.8	73.4 ± 7.0a
4		73.2 ± 5.2^{a}	75.9 ± 5.4^{a}	72.5 ± 5.5a
5		69.4 ± 6.9^{a}	73.8 ± 5.4^{a}	
6		71.1 ± 6.3^{a}		
7		50.4 ± 5.7^{a}		

Means within a column within a item followed by the same letter do not differ significantly from each other, otherwise they do differ significantly at 0.05

Hatching weight (Table 8) was significantly different (Table 4) either between hatches or between families in FF, PF and RF. On the other hand, hatchability (Table 7) and hatching weight (Table 8) seem to be higher during the late of February up to April. This observation coincides with the fertility (Table 3).

TABLE 8. **Mean + S.E. of hatching weight, g in Fayoumi and its crosses.**

Item		♂—Fayoumi × ♀ Fayoumi (FF)	♂—Plymouth × ♀ Fayoumi (PF)	♂—Rhode × ♀ Fayoumi (RF)
overall mean . . .		28.8 ± 0.29	29.7 ± 0.35	29.9 ± 0.16
Date Hatch no.				
31/1/81	1	$27.7 \pm 0.61^{d,e}$	28.1 ± 0.55^{d}	$30.6 \pm 0.69^{a,b,c}$
7/2	2	28.2 ± 0.50^{d}	$29.7 \pm 0.41^{a,b,c}$	28.4 ± 0.48^{b}
13/2	3	26.4 ± 0.67	$28.9 \pm 0.56^{c,d}$	$29.4 \pm 0.70^{c,d}$
19/2	4	27.1 ± 0.39^{e}	$29.7 \pm 0.52^{a,b,c}$	$29.4 \pm 0.63^{c,d}$
26/2	5	29.2 ± 0.61^{c}	$29.0 \pm 0.38^{b,c,d}$	$29.7 \pm 0.58^{b,c}$
6/3	6	30.9 ± 0.57^{a}	30.2 ± 0.49^{a}	$30.6 \pm 0.47^{a,b}$
13/3	7	30.5 ± 0.50^{a}	$30.1 \pm 0.33^{a,b}$	31.2 ± 0.48^{a}
21/3	8	$29.8 \pm 0.33^{b,c}$	30.2 ± 0.29^{a}	$30.5 \pm 0.43^{a,b,c}$
27/3	9	$30.4 \pm 0.42^{a,b}$	$30.0 \pm 0.19^{a,b}$	$30.2 \pm 0.38^{a,b,c}$
5/4	10	29.3 ± 0.42^{c}	$29.5 \pm 0.57^{a,bc,}$	$29.7 \pm 0.33^{b,c}$
Family(between males)				
1		29.9 ± 0.31^{a}	29.8 ± 0.23^{b}	29.7 ± 0.26^{b}
2		$28.2 \pm 2.00^{b,c}$	30.7 ± 0.55^{a}	30.9 ± 0.33^{a}
3		27.2 ± 2.17^{c}	28.7 ± 0.34^{c}	30.7 ± 0.32^{a}
4		$29.2 \pm 0.40^{a,b}$	$30.0 \pm 0.30^{a,b}$	29.2 ± 0.32^{b}
5		$28.9 \pm 0.32^{a,b}$	28.1 ± 0.27^{c}	
6		$28.8 \pm 0.37^{a,b}$		
7		27.0 ± 0.49^{c}		

Means within a column within anitem followed by the same letter do not differ significantly from each other, otherwise they do differ significantly at 0.05

TABLE 9. Correlations and regressions between semen characteristics (×) and hatchability in Fayoumi and its crosses.

Item		N	Intercept	Regression	Correlation
Volume, cc	FF	69	27.31	141.65	0.409**
	PF	49	96.26	—33.37	—0.365**
	RF	40			
Concentration	FF	69	39.59	16.74	0.112 0.286*
	PF	49	97.60	—14.07	—0.433**
	RF	40	47.27	12.63	0.315*
Motility	FF	69	9.79	8.34	0.449**
	PF	49	128.99	— 6.94	—0.459**
	RF	40	21.27	7.23	0.433**
Live %	FF	69			0.100
	PF	49	244.34	— 1.83	—0.405**
	RF	40	—425.33	5.72	0.496**
Total abnormalities	FF	69	81.38	— 0.90	—0.429**
	PF	49	55.92	—2.35	0.387**
	RF	40			—0.274
pH	FF	69	—13.86	11.65	0.356**
	PF	49	270.16	——26.10	——0.458**
	RF	40	—310.06	52.44	0.575**

** Significant at 0.01
* Significant at 0.05

Different types of malpositions

The distribution of embryonic malpositions is shown in Table 10. The importance of this study was considered as one of the features common to the failure of the fertile eggs to hatch. Asmundson and Lorenz(1957 and Robertson (1961) reported that the failure to hatch may be attributed to the abnormal

position in the shell. The effect of particular type of malpositions on reducing hatchability depends upon the extent to which the lethal and the frequency with which it occurs. In this study, the most frequent malpositions was type no. 4 (beak is not directed toward the air cell) for RF followed by FF and the least in PF. However, this type is considered not lethal as Waters (1935) and Byerly and Olsen (1936) pointed out that this type is a little deviation from normal.

With respect to the other different malpositions, Asmundson and Lorenz (1957) and Purohit *et al.* (1974) considered these types to be lethal, while others (Waters, 1935;Robertson, 1961; Talmodge, 1977) stated that these types are not lethal. This contradiction leads to mention that the frequency of total malposition is more efficient in this manner. On the basis of the foregoing consideration it would appear that the RF and th highest values followed by FF and the least in PF. However, these values (Table 10) were less than 30-69% as reported by Asmundson (1938) and Amer (1962). In general it could be recommended that the mating Plymouth male with Fayoumi females is preferable for improving the economical traits under study.

TABLE 10. **Distribution of embryonic malpositions.**

Malposition	♂—Fayoumi ♀Fayoumi	♂—Plymouth ♀Fayoumi	♂—Rhode ♀Fayoumi
1 total no.	23	10	16
%	13.9	6.1	10.3
2 total no.	13	28	9
%	7.8	17.2	5.8
3 total no.	1	2	8
	0.6	1.2	5.1
4 total no.	23	20	23
%	13.9	12.3	14.7
5 total no.	12	17	16
%	7.2	10.4	10.3
6 total no.	11	5	6
%	6.6	3.1	3.8
total no.	83	82	78
%	50.0	50.3	50.0
Total embryonic mortality	166	163	156
Frequency of malposition % fertil eggs	16.5	12.6	17.4

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دراسات على بعض الصفات الاقتصادية فى الفيومى وخليطه وارتباطها بصفات السائل المنوى للديوك المستخدمة فى التلقيح

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استخدمت فى هذا البحث ١٣٦ دجاجة بياضة فيومى قسمت الى ثلاثة مجاميع وتم التلقيح صناعيا فى المجموعة الاولى لديوك من الفيومى (٧ عائلات) ، وفى المجموعة الثانية لديوك من البليموث (٥ عائلات) وفى المجموعة الثالثة لديوك من الرود ايلند (٤ عائلات) وقد جمع البيض فرديا فى كل عائلة ليتم تفريخه على ١٠ دفعات فى الفترة من شهر يناير سنة ١٩٨١ الى شهر ابريل سنة ١٩٨١ ـ وكانت الصفات الاقتصادية المدروسة هى نسبة الخصوبة والاوضاع الشاذه للجنين ونسبة الفقس ووزن الكتكوت عند الفقس ـ كما جمع السائل المنوى لكل ديك مرتين لدراسة صفات السائل المنوى لكل نوع وارتباطها بالصفات الاقتصادية سابقة الذكر ـ وكان أهم النتائج المتحصل عليها كما يلى :

١ ـ متوسط وزن الكتكوت عند الفقس للخليط أعلا من الفيومى فى حين كانت نسبة الفقس لخليط البليموث اعلا من المجاميع الاخرى هذا ولا توجد اختلافات معنوية فى نسبة الخصوبة بين المجاميع الثلاثة وان كان الفيومى أعلاها فى المتوسط .

٢ ـ وجدت اختلافات معنوية بين الدفعات المختلفة للتفريخ فى نسبة الخصوبة لخليط البليموث ، فى نسبة الفقس لخليط الرود ، وفى الخليط عموما فى وزن الكتكوت عند الفقس وكانت الصفات السابقة بصفة عامة اعلاها فى الدفعات الاخيرة (شهرى مارس وابريل) .

٣ ـ توجد اختلافات مؤكدة بين العائلات فى كل مجموعة فى صفه وزن الكتكوت عند الفقس ، وفى نسبة الخصوبة بين عائلات الفيومى وخليطه من البليموث فى حين كانت نسبة الفقس من الخليط فقط معنوية ـ وجميع هذه الاختلافات بين العائلات ترجع الى اختلاف صفات السائل المنوى لكل نوع .

٤ ـ يوجد ارتباط بين صفات السائل المنوى وكل من صفتى الخصب أو الفقس لكل نوع .

٥ ـ كان خليط البليموث أقل فى عدد معظم أنواع الأجنة ذات الأوضاع الشاذة عن المجاميع الأخرى .

توصى هذه الدراسة بالتوسع فى خلط ديوك البليموث بالاناث الفيومى لتحسين الصفات الاقتصادية تحت الدراسة .