

Heterosis in *Fayoumi* strain incrossing

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Summary

Many experiments have proved the superiority of hybrids resulting from incrossing of inbred lines, which have been utilized commercially in poultry production. The aim of this experiment was to study the effect of incrossing inbred lines of *Fayoumi* chickens upon their combinability. The results can be summarized as follows:

The fertility percentage was 96.7 in $L_{25} \times L_{50}$ incross comparing with 92.9 in outbred control.

Some incrosses ($L_{25} \times L_{37.5}$) secured considerable positive effect on hatchability which reached 143.7 % in relation to the control.

At 16 weeks of age, the viability percentage of the control chicks was 67.5, while it reached 84.6 in $L_{25} \times L_{37.5}$ by incrossing.

The heavier incross $L_{25} \times L_{37.5}$ had body weight equal to 118, 112 and 103 % in relation to the control at 4, 8 and 16 weeks of age, respectively. Heterosis in body weight became less obvious as chicks advanced in age and alleles responsible for early growth rate showed a great response to incrossbreeding.

Incrossbreeding improved feed utilization of *Fayoumi* chicks.

These results show the possibility for improving the native breed by incrossing and detecting the most efficient incrossbreds.

Introduction

Superior vigor of hybrids resulting from inbred line crosses has been utilized commercially in the production of chickens for both meat and eggs. Most of the studies dealing with incrossing showed that heterosis produced considerable positive effect on economical characters in chickens.

RIZK (1967) working on *Fayoumi* incrosses reported that incrossing increased hatchability. Similar findings on feed efficiency, body weight and viability in other breeds were reported for instance by MARSHALL and QUISENBERRY (1959) and COLE and HUTT (1962).

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Material and methods

The main objective of the present investigation was to study the effect of incrossing on some economic traits in *Fayoumi* chicks. Full-sib, half-sib and first cousin matings were used to get different inbreeding intensities. *Fayoumi* sires and dams were mated in family pens supplied with trap nests, and pedigree chicks were used to consist different inbred lines during the experimental period (i.e. 1971-1975).

The data were collected by using 15 females mated to 2 sires for each type of cross. Thus 18 sires and 135 dams were used in this experiment, giving 769 offspring. For the « control » group 205 individuals were obtained. The experiment was carried out during february 1975 and 4 hatches were available. All the chicks were reared in batteries in the same conditions using a diet of a standard type.

The control chicks (outbreds) were resulted randomly from a flock mating system. Three inbred lines (having inbreeding coefficients 25, 37,5 and 50 %) had been incrossed in all possible combinations.

Results were subjected to statistical analysis using the method of analysis of variance (SNEDECOR, 1959).

Results and discussion

Effect of incrossing on fertility

Data in Table I summarize the effect of incrossing on fertility of *Fayoumi* chicks. The fertility percentage in the control chicks was 92,9, while it was improved in L25 × L50 incross and reached 96.7. The reciprocal incross (L50 × L25) had the lowest fertility percentage (69.4 %). Moreover, all the incrosses having L25 as a male had the highest fertility percentages, while their reciprocal incrosses had the poorest percentages. These results suggest a possible effects of the inbreeding coefficient of the male line on fertility.

TABLE I

Effect of incrossing on fertility percentage
Effet de la consanguinité suivie de croisement sur le pourcentage de fertilité

Incrosses	Fertility (%)	As percentage of control
Control	92.9	100.0
L25.0 × L37.5	90.1	96.9
L37.5 × L25.0	82.5	88.8
L25.0 × L50.0	96.7	104.1
L50 × L25	69.4	74.7
L37.5 × L50	84.5	90.9
L50 × L37.5	80.0	86.1

Effect of incrossing on hatchability

Hatchability of *Fayoumi* chicks resulting from incrosses showed considerable hybrid vigor. Most of the incrosses had higher hatchability percentage than the control chicks (Table 2). The incross L25 × L37.5 gave the most positive effect on hatchability, which reached 143.7 % in relation to the control. COLE and HUTT (1962), and RIZK (1967) proved this positive effect on hatchability.

TABLE 2

Effect of incrossing on hatchability percentage
Effet de la consanguinité suivie de croisement sur le pourcentage d'éclosion

Incrosses	Hatchability (%)	As percentage of control
Control	55.2	100.0
L25 × L37.5	79.3 (*)	143.7
L37.5 × L25	49.4	89.5
L25 × L50	64.7	117.2
L50 × L25	73.5 (*)	133.2
L37.5 × L50	57.6	104.3
L50 × L37.5	73.7 (*)	133.5

(*) $P < .05$ — significantly superior to control.

Effect of incrossing on viability

Table 3 presents hybrid vigor in viability of the *Fayoumi* chicks at different ages. Early viability (i.e. from 0-4 weeks) was improved in some incrosses, where it reached 93.8 % in L25 × L37.5 compared to 88.0 % in the control. No significant differences were secured among all the means of this early period.

At 8 weeks of age, the viability percentage of the control chicks was 74.4, while it was 92.3 and 86.4 in L25 × L37.5 and L50 × L37.5, respectively. Although there was a marked difference between the incrosses and the control, yet it was statistically not significant. This may be due to the small number of replicates.

At 16 weeks of age, the viability percentage of the control chicks was 67.5 and this figure is low comparing with the figures given in standard breeds. This revealed its lack of genetic potentiality concerning high viability. However, some incrosses gave desirable results and viability percentage reached 84.6 at 16 weeks of age (L25 × L37.5). This figure was equal to 125.3 % in relation to the control and such increasing in some incrossbreds could not be ignored. Similar results were obtained by BRILES and KRUEGER (1955). These results gave the possibility for improving the native breed from the viewpoint of the viability by detecting the most efficient incrossbreds.

TABLE 3
Effect of increasing on viability at different ages
Effet de la consanguinité suivie de croisement sur la viabilité à différents âges

Incrosses	0—4		0—8		0—12		0—16 weeks	
	Viability (%)	As % of control						
Control	88.0	100.0	74.4	100.0	69.2	100.0	67.5	100.0
L25 × L37.5	93.8	106.6	92.3	124.1	89.2	128.9	84.6	125.3
L37.5 × L25	84.5	96.0	69.0	92.7	60.7	87.7	56.3	83.4
L25 × L50	87.9	99.9	77.3	99.9	72.7	105.1	69.7	103.3
L50 × L25	85.2	96.8	70.4	94.6	62.9	90.9	59.3	87.9
L37.5 × L50	90.6	102.9	79.2	106.5	73.6	106.3	67.9	100.6
L50 × L37.5	93.2	105.9	86.4	113.9	84.7	122.4	76.3	113.0

TABLE 4
Effect of incrossing on body weight (in grams) of both sexes (unweighted means) at different ages
Effet de la consanguinité suivie de croisement sur le poids corporel des deux sexes (moyennes non pondérées) à différents âges

Incroses	0		4		8		12		16 weeks	
	Mean	AS % of control	Mean	As % of control						
Control	27.3	100	102	100	260	100	463	100	657	100
L25 × L37.5	25.2	92	121	119	290	112	485	105	679	103
L37.5 × L25	26.0	95	109	107	283	109	469	101	656	100
L25 × L50	25.7	94	105	103	278	107	472	102	645	98
L50 × L25	26.1	96	113	111	266	102	491	106	664	101
L37.5 × L50	25.6	94	93	91	252	97	462	100	653	99
L50 × L37.5	27.1	99	102	100	278	107	483	104	672	102

Effect of incrossing on body weight

Meat production of chickens is considered as a short way to solve the meat shortage in some countries. Hybrid vigor in body weight is widely used in broiler industry and almost all the broilers produced now are hybrids. Table 4 presents body weight of incrossbred chicks in different systems of mating.

At hatching day, almost all the incrossbred chicks were lighter than the control ones. The unweighted mean of both sexes of the control chicks was 27.3 grams and it was 25.2-27.1 grams in the incrossbreds. This may be due to maternal effect, where chick weight is largely affected by egg weight and all the inbred dams were lighter than their corresponding controls.

At 4 weeks of age, hybrid vigor became obvious and some incrosses were heavier than the control. It was noticed that the body weight mean of both sexes of control chicks was 102 grams while it was 121 grams in L25 × L37.5 incross. In other words, this incross had body weight equal to 119 % in relation to the control one.

At 8 weeks of age, the mean of body weight was 260 grams in the control while it varied from 252 to 290 grams in the incrossbreds. The heavier incross (*i.e.* L25 × L37.5) had body weight equal to 112 % in relation to the control chicks. The same trend was also observed in body weight at 12 weeks of age.

At 16 weeks of age, the body weight mean was 657 grams in the control and varied from 645 to 679 grams in the incrossbreds. Although most of the incrossbreds were heavier than the control chicks, yet the differences among these means were not significant.

To summarize the effect of incrossing on body weight, it was noticed that heterosis in crossbred *Fayoumi* became less obvious as chicks advanced in age and it was more pronounced during the early period when the growth rate was high. On other words, alleles responsible for early growth rate (during broiler age) showed a great response to incrossbreeding.

TABLE 5

*Effect of incrossing on feed efficiency**Effet de la consanguinité suivie de croisement sur le rendement alimentaire*

Incrosses	Intervals in weeks						
	0-2	0-4	0-6	0-8	0-10	0-12	0-16
Control	3.00	3.25	5.30	6.15	6.65	7.54	9.31
L25 × L37.5	2.30	2.60	4.15	5.00	5.62	6.61	8.07
L37.5 × L25	2.50	2.80	4.55	5.35	6.22	7.38	8.91
L25 × L50	2.90	3.25	4.80	5.65	6.49	7.54	8.85
L50 × L25	2.80	3.10	5.00	5.70	6.21	7.11	8.63
L37.5 × L50	3.40	3.70	5.70	7.60	7.81	8.73	10.11
L50 × L37.5	2.90	3.20	4.90	5.70	6.33	7.24	8.94

Effect of incrossing on feed efficiency

Modern trends in poultry production have clearly emphasized the need for research on the efficiency of feed utilization in chickens where feed cost is the largest single item of total cost. At 8 weeks of age, feed efficiency of the incross L25 × L37.5 was 5.000, while it was 6.15 in the control chicks (Table 5). Most of the incrossbreds (except L37.5 × L50.0) showed better feed efficiency than controls. Similar results were reported by MARSHALL and QUISENBERRY (1959).

At 16 weeks of age, feed utilization was less efficient and this way be due to low growth rate of the chicks at this older age (*). Units of feed required to produce one unit of gain were 9.31 in the control and varied from 8.07 to 10.11 in the incrossbreds. L25 × L37.5 was the most efficient incross and its feed efficiency was 8.07. These results showed that it was possible to reduce the amount of feed required per unit of gain by incrossing and detecting the most efficient incrosses.

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Résumé*Hétérosis dans des croisements de lignées consanguines de Fayoumi*

Le but de cette expérience était d'étudier l'effet du croisement de lignées consanguines de *Fayoumi* sur leur aptitude à se combiner. Les résultats peuvent être résumés comme suit :

Le pourcentage de fertilité était 96,7 dans le croisement L25 × L50 comparé à 92,9 chez le témoin non consanguin.

Certains croisements (L25 × L37,5) avaient un effet positif considérable sur le taux d'éclosion, l'améliorant de 43,7 % par rapport au témoin.

A 16 semaines d'âge, le pourcentage de viabilité du témoin était 67,5, alors qu'il atteignait 84,6 dans le croisement L25 × L37,5.

Le croisement le plus lourd (L25 × L37,5) avait un poids corporel égal à 118,112 et 103 p. 100 du témoin respectivement à 4, 8 et 16 semaines d'âge. L'hétérosis pour le poids corporel était moins marqué à mesure que les poulets avançaient en âge.

Le croisement améliorait le rendement alimentaire des poussins *Fayoumi*.

Ces résultats montrent la possibilité d'améliorer cette race locale par consanguinité et croisement, et de déceler les croisements les plus efficaces.

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(*) The growth rate of *Fayoumi* strains is relatively very low in comparison with commercial standards (this being due partly at least to the hot climatic conditions). Thus the marketing age is often 16 to 20 weeks of age.