التطور التناسلى والنضج الجنسى فى أناث دقى ٤

١ ـ تأثير بعض الاضافات الغذائية

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الملخص

أجريت ثلاث تجارب ـ اثنتان منها لدراسة تأثير اضافة مخلوط الزنك والمنجنيز والنحاس أو اليود لعلائق كتاكيت دقى ـ ٤ عادية النمو (عمر ٨ أسابيع) على تطور الأعضاء التناسلية وكذلك النضج الجنسى فى الأناث ، أما التجربة الثالثة فقد أجريت لدراسة تأثير اضافة اليود لعلائق كتاكيت متأخرة النمو (من نفس النوع والعمر والجنس) على تطور جهازها التناسلى وكذلك على نضجها الجنسى .

ولقد أتضح من النتائج أن الاضافات فى التجربتين الأولتين لم تظهر أى تحسن فى الصفات المدروسة فى الأناث ، على أن أضافة اليود فى التجربة الثالثة قد أدت الى تطور أحسن للأعضاء التناسلية فى الأناث بطيئة النمو عند عمر ٢٤ أسبوع وكذلك الى تبكير بسيط فى العمر عند النضج الجنسى .

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REPRODUCTIVE PERFORMANCE AND SEXUAL MATURITY OF DOKKI-4 PULLETS

I.—Effect of Certain Feed Microadditives

(With five tables)

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SUMMARY

Three experiments were conducted to investigate the effect of Zn, Mn, Cu and I_2 supplements on the development of reproductive organs and sexual maturity of Dokki-4 pullets. It was detected in Experiment I (+ Zn, Mn and Cu) and in Experiment II (+I_2), that the additives did not improve the studied criteria in the normally-grown chicks. However, in Experiment III the iodine additives stimulated the reprodutive development of the subnormally-grown pullets and resulted, to some extent, in an earlier sexual maturity.

INTRODUCTION

Any nutritional deficiency, particularly of certain vitamins and minerals may retard both growth and sexual maturity of chicks (BELL and FREEMAN, 1971). The trace elements are important for increasing the reproductive activity of poultry. Zinc, manganese, copper and iodine are known to be beneficial for stimulating the reproductive development which leads to the earliness of sexual maturity (BLAMBERG, BLACKWOOD, SUPPLEE and COMPS 1960 ; KIENHOLZ, TURK, SUNDE and HOEKSTRA 1961 ; TAKINSON, BRADLY, COUCH and QUISENBERRY, 1967 and UNDERWOOD, 1971), and increasing of egg production (GALLUP and NORRIS, 1939 b ; OLOUFA, 1954 ; SHERBINA, 1962 ; BIRD, O'DELL and SAVAGE, 1963, MITSIK, 1964 ; TURK, 1964 and 1965). In spite of the markedly important role of these trace elements on reproduction, only few or rare investigations have been carried out on our local chickens. Therefore, it was meaningful to conduct three experiments to study the effect of Zn, Mn, Cu and I_2 additives on the reproductive performance and sexual maturity of Dokki-4 pullets.

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MATERIALS AND METHODS

Nine hundreds and fifty one-day old Dokki-4 chicks were maintained in floor brooders and fed a practical ration for a period of 8 weeks. Thereafter, female chicks were separated, weighed and classified according to their live body weight into two categories. Chicks of the first category ; with average body weight of 300 grams ; were considered as normally grown. They were divided into two main divisions with which experiments I and II were carried out respectively. Chicks of the second category , with average body weight of 200 grams , were considered as subnormally grown.

Experiment I : This experiment was carried out with 200 pullets which were randomly divided into two groups : A and B (100 pullet each). Group A (control) received a basal ration containing 12 ppm Zn, 48 ppm Mn and 4.8 ppm Cu. While group B. was fed the same basal ration, supplemented with 25 ppm Zn, 25 ppm Mn and 2.5 ppm Cu in the forms of Zn SO_4 7 H_2O, $MnSO_4$.7 H_2O and $CuSO_4$.5 H_2O.

Experiment II . This experiment included 131 pullets which were divided at random into three groups : C, D and E. Group C (control) received the same basal ration, containing 279 ppb iodine. Whereas group D and E were fed the basal ration plus iodine additives (Lugol's solution) at the levels of 400 and 800 ppb. respectively. Lugol's solution was prepared by dissolving 5 gm. elemental iodine + 10 gm. potassium iodide in 100 ml distilled water. To avoid the problem of iodine unstability, the Lugol's solution was added and mixed with rations weekly.

Experiment III : This experiment was conducted with 79 pullets which were divided randomly into three groups : F, G and H. Group F (control) received the same basal ration used in experiments I and II, while the ration of groups G and H were supplemented with 0.4 mg iodine (lugol's solution) and 115 mg desiccated thryoid per kg respectively. The amount of thyroid tissue provides 400 ppb iodine, since the dry gland contains 0.346% iodine (SAUCHELLI, 1969). The composition of the basal ration used in these experiments is shown in Table I. Pullets of the differnet groups were individually weighed every two weeks.

At 12, 16, 20 and 24 weeks of age in experiment I and at the latter three ages in experiments II and III, variable numbers (2-6) from each group were randomly chosen and slaughtered. The reproductive organs, pituitary, adrenals and paired thyroid glands were removed and weighed. The number and size of ova and length of the oviduct were taken. The developed follicles were divided according to their diameter (BELLARIS, 1964). Before slaughtering the dimensions of comb and wattles were also taken.

TABLE 1 : Composition of the basal ration

Ingredient	%
Maize	50
Wheat bran	24
Decorticated Cottonseed meal	10
Horse beans	5
Protelan	5
Blood meal	3
Limestone	2.5
Common salt	0.5
Vitamin Premix (A + D_3)*	0.1
Calculated analyses**	
Crude protein %	17.56
Metabolizable energy, Kcal/kg	2714
C/P ratio	154

*Vitamin premix contained 5000 I.U. vit. A and 500 I.U. vit. D_3 per gram.

**Calculated analyses : Values were calculated according to EWING (1963).

At 24 weeks of age, the remainder number of pullets in each group were moved to laying houses provided with sufficient trap nests. The eggs were collected and recorded until all pullets reached their sexual maturity. The age at the first oviposition for every pullet was recorded as a criterion for determining sexual maturity.

Iodine was determined in the ovary and in the basal ration after, BARAKAT, SHEHAB and IBRAHIM (1968). Also, their zinc and copper contents were determined according to TAWTSIN (1968), while their manganese content was determined after, ALIKAIEV, PETOKHOVA, KHALENOVA and VIDOVA (1967)

The obtained data were examined by statistical analyses including comparisons of means using (t) test as outlined in SNEDECOR and COCHRAN (1967). The correlation coefficients between body weight and the studied criteria in the different groups were also calculated.

RESULTS

Ovary : The supplementation of trace elements (Zn + Mn + Cu) did not improve either the ovarian weight or the number of developed follicles (Tables 2 and 5).

Enriching the ration of normally growing pullets with iodine additives, to provide 679 ppb, resulted in a certain increase in the ovarian weight and to a decrease in the follicles number at 24 weeks of age. However, a level of 1079 ppb caused an obvious decrease in the ovary weight and follicles number at 20 weeks of age. The percentage of large follicles (over 9 mm) at 24 weeks of age was slightly higher at the level of 679 ppb than those at 279 and 1079 ppb I_2 (Table 5).

Increasing the iodine level in the ration of subnormally-growing pullets to 679 ppb, using Lugol's solution or desiccated thryoid, led to an increase in the ovary weight especially at 20 weeks of age (Table 4). It can be noticed from the same table that the addition, in form of thyroid tissue, was more effective than in the form of Lugol's solution. The follicles number showed a certain increase at the age of 20 and 24 weeks due to the supplementation of both iodine sources. Then, it could be summarized that, the level of 679 ppb iodine in the diet had a highly stimulative effect on both ovarian growth and follicles number of the subnormally-growing pullets than on those of the normally growing ones.

The concentrations of Zn, Mn and Cu in the ovary of the control group pullets at the age of 24 weeks were (on dry matter basis) : 9.53, 9.27 and 27.44 ppm, respectively. However, they were 31.15, 10.42 and 23.10 ppm, in the same order in the treated group. In Experiment, II, the concentrations of iodine in the ovary at the same age were 429, 473 and 763 ppb in groups C, D and E respectively. While in Experiment III, the iodine concentrations in the ovary at 24 weeks age were 831, 331 and 475 ppb for groups F, G and H respectively.

Oviduct : The data presented in Tables 2 and 5 show that the oviduct weight and length decreased at 24 weeks of age due to the supplementation of Zn, Mn and Cu. Also, elevating the iodine level in the ration of normally-growing pullets to guarantee 679 and 1079 ppb led to a marked decrease in the weight and length of this reproductive organ as compared with the control group at the age of 24 weeks. However, increasing the iodine content of the ration, fed to subnormally-growing chicks, to 679 ppb by adding Lugol's solution or desiccated thyroid resulted in an obvious increase in the oviduct length at 20 and 24 weeks of age (Table 5).

TABLE 2. Effect of Zn, Mn and Cu additives on the different studied criteria in Exp. i

Criteria	Age in weeks 12		16		20		24	
	A*	B*	A	B	A	B	A	B
No. of pullets	100	91	97	85	94	83	60	60
No. of slaughtered pullets	3	3	3	3	5	5	5	5
Live body weight (g)	488	539	882	833	1124	1124	1263	1202
Ovary weight (g)	0.21	0.29	0.37	0.36	0.78	0.75	16.03	10.87
Ovary weight (g/100 g. B. W.)	0.043	0.045	0.042	0.043	0.069	0.067	1.270	0.905
Oviduct weight (g)	0.11	0.20	0.24	0.22	0.86	0.76	21.01	15.62
Oviduct weight (g/100 g.B.W.)	0.023	0.031	0.027	0.026	0.077	0.068	1.664	1.301
Weight of pituitary (mg)	9.5	9.1	5.5	8.6	7.0	6.1	26.2	18.0
Weight of pituitary (mg/100 g)	1.947	1.423	0.623	1.032	0.623	0.543	2.075	1.499
Weight of paired thyroid (mg)	59.5	102.1	86.5	115.2	102.3	131.8	119.2	99.1
Weight of paired thyroid (mg/100 g)	12.19	19.96	9.80	13.83	9.10	11.73	9.44	8.25
Weight of adrenals (mg)	76.1	73.2	75.4	89.3	102.0	54.7	109.1	181.8
Weight of adrenals (mg/100 g)	15.59	11.44	8.55	10.72	9.08	4.87	8.64	15.14
Comb length (cm)	1.8	2.3	2.4	2.4	2.8	2.9	4.6	4.2
Comb height (cm)	0.5	0.9	0.6	0.7	0.8	1.1	1.8	1.7
Wattles length (cm)	1.2	1.6	1.6	1.4	1.8	2.1	2.3	2.6
Wattles width (cm)	0.2	0.6	0.9	0.7	1.0	0.7	2.1	2.1

* Groups of Exp. I.

TABLE 3. **Effect of iodine additives on the different studied criteria in Exp. II (Normally-growing pullets).**

Criteria	Age in weeks								
	16			20			24		
	C*	D*	E*	C	D	E	C	D	E
No. of pullets	48	34	49	46	32	47	43	22	35
No. of slaughtered pullets	2	2	2	3	3	3	6	6	6
Live body weight (g)	804	858	764	987	1260	1183	1207	1204	1098
Ovary weight (g)	0.37	0.45	0.35	1.12	0.75	0.48	7.04	9.37	5.57
Ovary weight (g/100 g B.W.)	0.046	0.052	0.046	0.114	0.056	0.043	0.583	0.778	0.507
Oviduct weight (g)	0.27	0.30	0.36	5.04	1.34	1.00	15.53	11.58	8.69
Oviduct weight (g/100 g)	0.034	0.035	0.047	0.051	0.106	0.089	1.288	0.962	0.791
Weight of pituitary (gm)	8.6	11.5	4.4	8.5	11.2	9.0	8.5	10.3	9.3
Weight of pituitary (mg/100 g)	1.070	1.340	0.576	0.861	0.889	0.805	0.724	0.855	0.847
Weight of paired thyroid (mg)	70.3	67.3	63.9	76.3	123.8	99.3	108.5	105.3	84.5
Weight of paired thyroid (mg/100 g)	8.744	7.844	8.364	7.730	9.825	8.880	8.992	8.744	7.694
Weight of adrenals (mg)	—	—	—	—	—	—	118.3	178.3	113.5
Weight of adrenals (mg/100 g)	—	—	—	—	—	—	9.804	14.807	10.33
Comb length (cm)	2.4	2.2	2.3	3.4	3.3	3.0	3.4	3.8	3.4
Comb height (cm)	0.9	0.6	0.6	1.4	1.4	1.4	1.5	1.5	1.4
Wattles length (cm)	1.6	1.6	1.6	2.2	2.1	1.9	2.5	1.0	2.1
Wattles width (cm)	0.9	0.6	0.9	1.2	1.2	1.0	2.1	2.3	1.4

* Groups of Exp. II.

TABLE 4. Effects of iodine additives on the different studied criteria in Exp. III (Subnormally growing pullets)

Criteria	Age in weeks								
	16			20			24		
	F*	G*	H*	F	G	H	F	G	H
No. of pullets	26	22	31	24	17	29	17	17	26
No. of slaughtered pullets	2	2	2	3	3	3	6	6	6
Live body weight (g)	819	812	899	1067	1138	1118	1100	1480	1438
Ovary weight (g)	0.45	0.58	0.58	1.44	8.92	10.07	27.26	30.29	28.70
Ovary weight (g/100 g B.W.)	0.055	0.071	0.065	0.135	0.784	0.901	2.478	2.046	1.995
Oviduct weight (g)	0.24	0.20	0.21	4.35	10.43	10.89	23.59	25.64	31.57
Oviduct weight (g/100 g)	0.029	0.025	0.023	0.408	0.916	0.982	2.145	1.732	2.195
Weight of pituitary (mg)	—	—	—	7.0	11.3	10.2	8.1	10.6	9.6
Weight of pituitary (mg/100)	—	—	—	0.656	0.993	0.862	0.736	0.716	0.668
Weight of paired thyroid (mg)	62.0	62.3	71.5	128.8	138.8	96.2	67.9	109.3	80.1
Weight of paired thyroid (mg/100 g)	0.757	0.769	8.038	12.075	12.282	8.102	6.173	7.384	5.569
Weight of adrenals (mg)	—	—	—	—	—	—	125.3	143.3	154.8
Weight of adrenals (mg/100 g)	—	—	—	—	—	—	11.39	9.68	10.76
Comb length (cm)	2.5	2.1	1.7	3.1	3.5	3.3	4.4	4.3	4.8
Comb height (cm)	0.9	0.8	1.3	1.4	1.5	1.7	1.9	2.3	2.5
Wattles length (cm)	1.6	1.7	1.9	2.2	1.8	1.8	1.9	2.3	2.3
Wattles width (cm)	1.0	1.0	1.1	1.5	1.6	1.5	1.9	2.4	2.6

* Groups of Exp. III.

TABLE 5. Number of ovarian follicles and oviduct length at 20 and 24 weeks of age in the different experiments.

Age (weeks)	Criteria	Exp. I		Exp. II		Exp. III			
		A	B	C	D	E	F	G	H
20	No. of follicles	2.0	2.6	7.0	2.0	3.0	7.4	11.6	16.1
	Small (< 3 mm)	2.0	2.6	4.0	2.0	3.0	6.7	8.0	12.7
	Medium (< 6 mm)	—	—	3.0	—	—	0.7	2.3	1.7
	Large (< 9 mm)	—	—	—	—	—	—	1.3	1.7
	Length of oviduct (mm)	—	—	—	—	—	18.9	24.0	33.2
24	No. of follicles	20.0	19.2	17.5	13.5	17.9	24.6	25.3	29.3
	Small (< 3 mm)	14.3	13.2	15.0	11.2	16.5	15.3	19.1	21.0
	Medium (< 6 mm)	2.7	4.7	1.7	0.8	0.7	5.8	2.2	3.8
	Large (< 9 mm)	3.0	1.3	0.8	1.0	0.7	3.5	4.0	4.5
	Length of oviduct (cm)	31.7	30.3	29.4	21.5	24.7	28.8	40.8	46.5

Pituitary, adrenals and thyroids weight : The average weight of these endocrine glands in the control and treated groups show conflicting results (Tables 2-4). However, the adrenals weight in group B increased than its control ($P < 0.05$).

Comb and wattles : A fluctuated trend was obtained due to the effect of (Zn Mn + Cu) or I_2 supplements on the growth of comb and wattles of the normally-growing pullets (Tables 2-4). Supplying the ration with Lugol's solution or desiccated thyroid to provide a level of 679 ppb had a better developmental effect on comb and wattles of the subnormally-growing females at 20 and 24 weeks of age.

Age at sexual maturity : The results presented in Table 5 show that the average age of sexual maturity was approximately similar for group A (control) and group b (+ Zn, Mn and Cu). However, the commencement of laying in group B was at 170-180 days, which was 10-20 days earlier than the control.

Elevating the iodine content of the rations fed to the normally-growing pullets from 279 to 679 or 1079 ppb, led to a slightly delaying of sexual maturity (Table 6). Nevertheless, supplying the rations of subnormally-growing pullets with Lugol's solution or desiccated thyroid to provide an iodine level of 679 ppb, had resulted— to some extent in an earlier sexual maturity. The pullets had also a narrow range of variation in the age of sexual maturity as compared with those of the normally-growing. It is noteworthy to mention that the correlation coefficients between body weight and the different studied criteria in all groups were found to be insignificant.

DISCUSSION

From the mentioned findings it could be detected that supplying the diet of the growing female chick with zinc, copper and manganese had no synergetic effect on the development of their reproductive organs till 24 weeks of age, albeit a certain percent of these pullets began to lay 10-20 days earlier than their controls. It seems that the amounts of these trace elements which existed in the basal ration (48 ppm Mn, 12 ppm Zn and 4.8 ppm Cu) were adequate for the development of the reproductive system. These levels are similar to those recommended by INSKO, LYONS and MARTIN (1938) and GALLUP and NORRIS (1939 a) (35-60 ppm Mn), ZEIGLER, LEACH and NORRIS (1938) (15-20 ppm Zn) and HILL and MATRONE (1961)

and UNDERWOOD (1971) (4-5 ppm Cu). Our results indicated that the Zn concentration in the ovary of the treated pullets (group B) was 31.2 ppm versus 9.5 ppm for their controls. This may explain the earlier commencement of laying by a certain percent of the treated pullets, since zinc is involved in the production and function of gonadotrophic and sex hormones (MILLAR, FISCHER, ELOCATE, MAWSON, 1960 and UNDERWOOD, 1971).

In spite of increasing the ovarian weight at the level of 679 ppb iodine in the ration of the normally-growing pullets, it seemed not advisable to elevate the iodine content in the diet either to 679 or 1079 ppb. These levels resulted in a decrease in the weight and length of the oviduct at 24 weeks of age, and delayed- to some extent-the sexual maturity when compared with a level of 279 ppb. So the latter level may be more appropriate for the development of the reproductive system of the normally-growing pullets till 24 weeks of age. These results are in partial agreement with those of GODFREY, CARRICK and QUACKENBUSH (1933) ; CREEK, PARKER, HAUGE, ANDREWS and CARRICK (1957) and WILGUS, GASSNER, RATTON and HARSHFIELD (1953) who recommended iodine levels for the growing chick ranging from 300-440 ppb. The NATIONAL RESEARCH COUNCIL, (1966) also suggested the level of 350 ppb iodine in the diet of the chick.

Nevertheless, the iodine additives, specially in the form of desiccated thyroid providing a level of 679 ppb in the ration, had more pronounced stimulative effect on the development of the reproductive organs of the subnormally-growing pullets and shortened the ti merequired to be sexully matured. The iodine additives here had also a promoting effect on the liver body weight (Unpublished data). The benifical effects of the iodine additives on the reproductive system of the subnormally-growing female chicks may be explained through two means : a) This element may act directly on the ovary and other reproductive organs ; or b) It may act indirectly by increasing the activity of the thyroid gland or promoting the growth of the whole body. A functional relationship between thyroid and ovary reported by BLANQUET, STOLL, MARAUD, MAUNIERET and MEYNIEL (1957) and ROCHE, MICHEL and VOLPERT (1959) whose results indicated a competition between thyroid and ovary for available iodine. Also, a normal thyroid function is essential for either growth or normal development of reproductive organs both in male and female (GLAZNER and SCHAFFNER, 1949 ; PITT-RIVERS and TATA 1959 ; SINGH, REINEKE and RINGER (1968), and UNDERWOOD 1971).

So, it seems reasonable to come to the following conclusions : 1- The levels of 37 ppm Zn, 73 ppm Mn., 7.3 ppm Cu., and 679 or 1079 ppb I_2 were not better for the development of reproductive system of the normally-growing Dokki-4 pullets than those of 12 ppm Zn, 48 ppm Mn, 4.8 ppm Cu and 279 ppb I_2. 2- Supplying the ration of the subnormally-growing female chicks with iodine additives to provide 679 ppb improved the reproductive development and slightly shortened the time needed to be sexually matured. The supplementation was more effective in the form of desiccated thyroid than in the form of elemental iodine or iodine salts. Therefore, it may be a point of application since very wide variation exist between the individuals of the local strains of chickens; to supply the rations of the weak individuals of the batch with iodine.

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