

AN INVESTIGATION ON THE INTERACTION
AMONG OXYTETRACYCLINE, DIETARY
CALCIUM AND SODIUM SULFATE IN
CHICK RATION

By

* E.M. OMAR, O.E. MOHAMED, G.A.R. KAMAR
AND M.A. SOLIMAN

This experiment included 246 one-day old Fayoumi chicks divided into 5 groups containing 47-51 chick each. Oxytetracycline (OTC) was added to drinking water at the level of 100 ppm. Calcium was fed at two levels of 1.01% (gp. 1, 2 and 3) and 1.73% (gp. 4 and 5). Sodium sulfate was added at the level of 1.50 and 2.30% to rations fed to groups 3 and 5 respectively. This experiment lasted until the chicks were 10 weeks old. Chicks were offered food and water *ad libitum*.

Results of this experiment indicated that adding the OTC at the level of 100 ppm in drinking water of chicks fed a ration containing 1% Ca produced no growth response over the control but was effective in reducing the mortality rate to some extent. Adding 1.50% Na_2SO_4 to a ration having the same composition resulted in significant growth stimulation ($P < 0.05$) and lowered the mortality to an appreciable extent. Also the Na_2SO_4 produced good feed efficiency. The effect of Na_2SO_4 in increasing the absorption of OTC from the intestine is discussed. Chicks fed rations containing 1.73% Ca with or without added Na_2SO_4 and supplemented with OTC in their water showed no growth stimulation and had high mortality and poor feed efficiency.

As early as 1946, it was reported that antibiotics in small amounts stimulated the growth of chicks (Evans, 1960). Chlortetracycline (CTC) is effective in controlling certain infectious diseases and in stimulating growth of animals when added to their feeds and drinking water (Jukes, 1955). Calcium has been reported to lower the effect of antibiotics by reducing their absorption from the intestines (Kiser, 1957). Therefore, in order to obtain maximum benefit of the antibiotic added to the feed, calcium level of the feed should be reduced. However, reducing Ca level affects bone formation and development and consequently the growth of the bird.

Pensack (1963), introduced the use of sulfate ion to chick diets. The sulfate ion lowers the inhibitory effect of Ca on the absorption of antibiotics from the intestine. He recommended the addition of sodium sulfate to poultry rations to increase the absorption of CTC. Gale and Baughn (1965), confirmed Pensack's observation and reported that the addition of 1.5% sodium sulfate to chick diets containing CTC increased CTC blood level about 1.35 times as compared to the group supplemented with CTC but without sodium sulfate.

* Animal Production Department, Faculty of Agriculture, Cairo University.

In U.A.R., Gihad (1959), using turkeys reported that feeding antibiotics at levels up to 50 ppm produced slight increase in body weight at 16 weeks of age. He observed no difference in mortality rate or feed efficiency due to feeding antibiotics.

This experiment was carried out to investigate the effect of adding water soluble oxytetracycline (OTC) on the growth and performance of Fayoumi chicks as affected by different Ca and sodium sulfate levels.

Material and Methods

Two hundred Forty six, 1-day old Fayoumi chicks were used in this experiment. Chicks were divided into 5 experimental groups as follows : group 1 : 51, group 2 : 50, group 3 : 49, group 4 : 47 and group 5 : 49 chicks were wingbanded at 1-day old and vaccinated intraocularly against New Castle. The composition of the basal ration is indicated in Table 1.

TABLE 1.—COMPOSITION OF THE BASAL RATION

Ingredient	%
Yellow corn, ground	49.3
Decorticated cotton meal	25.0
Wheat bran	10.0
Skim milk	7.5
Fish meal	7.5
Na Cl	0.5
Vitamin A ₃ D ₁ mixture	0.2
Total	100.0
Calcium	0.73
Phosphorus, total	0.902
Phosphorus, inorganic	0.492

(1) Vitamin A-D³ mixture supplied 5000 I.U. vitamin A and 1000 I.U. vitamin D³ per 1.0 Kilogram of ration.

As can be seen from this table, the ration can not be considered economical since it contained 15% animal protein. The inclusion of such high percentage of animal protein was practiced to satisfy the phosphorus requirements (total and inorganic) without the need to add mineral source of P to the ration. Calcium level was raised by adding Ca CO₃. Water soluble OTC was added to drinking water every day at the level of 100 ppm. Table 2 shows the experimental design. Chicks were weighed at biweekly intervals and at the end of the experiment i.e. 10 weeks. Records were kept of feed consumption and the mortality during the experimental period (1 day — 10 weeks of age). Water and feed were offered *ad libitum*. Data were statistically analyzed using the analysis of variance as outlined by Snedecor (1959).

TABLE 2.—EXPERIMENTAL DESIGN

Item	Group				
	1	2	3	4	5
<i>Addition to drinking water :</i>					
Oxytetracycline (ppm)	0.00	100	100	100	100
<i>Additions to ration :</i>					
Ca CO ₃ (%)	0.70	0.70	0.70	2.50	2.50
Na ₂ SO ₄ (%)	—	—	1.50	—	2.30
Calculated Ca level (%)	1.01	1.01	1.01	1.73	1.73
Calculated P level (%)	0.90	0.90	0.90	0.90	0.90

Results and Discussion

Figure 1 shows that chicks of group 3 had the highest average body weight during the entire experimental period. However, chicks of group 4 had the lowest average body weight during the entire experimental duration. The average body weight of the other three groups was intermediate between these two groups. Table 3 shows the final average body weight of the different groups as follows

TABLE 3.—AVERAGE BODY WEIGHT, MORTALITY RATE AND FEED EFFICIENCY OF THE EXPERIMENTAL GROUPS

Item	Group				
	1	2	3	4	5
Average final body weight, g	535.1	533.4	576.8	501.0	517.1
S ₂	18.9	15.4	15.9	20.6	13.7
Mortality rate	22.00	14.00	10.20	27.66	26.53
Feed efficiency ¹	4.92	4.36	3.93	5.64	5.32

1. Defined as Kilograms of feed required to produce 1.0 kilogram body gain.

+ 15.9, group 4 : 501.0 + 20.6 and group 5 : 517.1 = 13.7 grams. Applying the analysis of variance (F test) on the final average body weight of the experimental groups revealed significant difference due to treatment ($P < 0.05$) as follows :
as follows :

Source of variation	DF	SS	MS	F
Among treatments	4	104863	26215.0	2.75-
Error	192	1832594	9544.8	
Total	196	1937457		

* $P < 0.05$

** $P < 0.01$

The 4 degrees of freedom of treatment were partitioned one degree at a time as follows :

Source of variation	DF	SS	MS	F
OTC vs. no OTC	1	686	686	0.07
High vs. low Ca	1	63405	63405	66.42**
Within low Ca	1	40405	40405	4.23*
Within high Ca	1	367	367	0.04

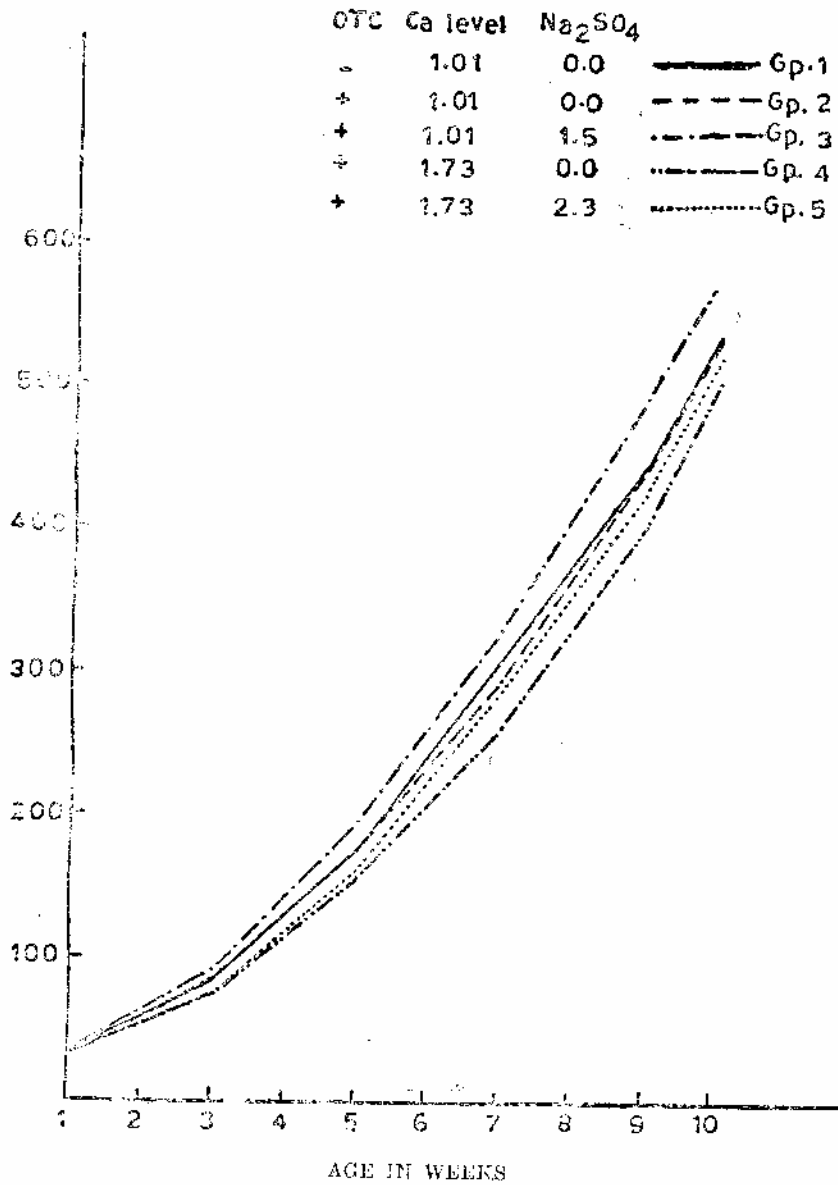


FIG. 1.--Average Body Weight of Fayoumi Chicks as Affected by OTC, Ca and Na SO levels

Comparing the average body weight of group 1, which had no OTC, with the average body weight of the other 4 groups, which were provided with OTC in their drinking water, showed insignificant difference. However, comparing the average body weight of groups 2 and 3 with that of groups 4 and 5 showed highly significant difference ($P < 0.01$). This clearly indicates that on the low Ca level (1.01%) the chick made better growth than on the high Ca level diet. This implies that the chick in the high Ca groups did not make full use of the antibiotic due to its reduced absorption in the intestine. Group 3 had significantly higher ($P = 0.05$) average body weight than group 2. The two groups were similar in dietary Ca (being 1.01%) and the OTC level in water but they differed with respect to the inclusion of Na_2SO_4 (Table 2). Chicks of group 3 were fed 1.5% sodium sulfate in the diet while group 2 did not. Thus the Na_2SO_4 here helped the chicks of group 3 in achieving better absorption of the OTC from the intestine. These results are in accordance with those of Pensack, 1963 and Gale and Baughn (1965).

The average body weight of group 4 was not significantly different from that of group 5. This indicates that rations having high Ca levels (1.73%) will interfere with OTC absorption from the intestines regardless of adding Na_2SO_4 to the diet at the level of 2.3%.

Therefore, it may be concluded that adding OTC will not improve growth of chicks if the ration is containing 1.0% Ca level. Gihad (1959), arrived at similar conclusions in turkeys where he reported that feeding antibiotics at levels up to 50 ppm produced no significant increase in body weight. The ration used by Gihad probably had higher level than 1.0%. For best results and maximum benefit of OTC, addition of Na_2SO_4 at the level of 1.5% is recommended provided the Ca level of the ration is in the vicinity of 1.0%.

Mortality Rate :

Table 3 shows that group 3 had the lowest mortality followed by group 2 while groups 1, 4 and 5 suffered almost similar mortality rates. This indicates that the group which had the maximum absorption of OTC from the intestines showed the lowest mortality. One explanation forwarded to explain the mechanisms of action of antibiotics is through depressing the number and growth of pathogens, thereby being unable to manifest their injury to the bird (Evans, 1960). Comparing the mortality rate of group 2 with that of group 4 shows that the latter is double that of the former. In group 4 the Ca level was 1.73 as compared to 1.01% for group 2, but other factors being similar. The high Ca level interfered with the absorption of almost all the OTC from the intestines. This explains the observation that group 4 suffered similar mortality to group 1 (no OTC). However, the 1.0% Ca level (group 2) apparently did not interfere with the absorption of all the OTC from the intestines. Therefore, some OTC were absorbed and manifested their effect in counteracting pathogens with the result that mortality was reduced and approached that of group 3.

Feed efficiency :

From Table 3 it may be seen that feed efficiency was improved in the group fed the 1.5% Na_2SO_4 . The lowest feed efficiency was encountered in group 4 which was fed the high Ca without Na_2SO_4 . This shows that OTC improves feed efficiency when its absorption from the intestines is increased.

REFERENCES

- EVANS, R.E., 1960.—Rations for livestock. *Bulletin No. 48. Ministry of Agriculture Fisheries and Food.* Her Majesty's Stationary Office, London.
- GALE, G.O., AND BAUGHN, C.O., 1965.—The effect of sodium sulfate in diets containing chlor-tetracycline hydrochloride on chicks infected with *mycoplasma gallisepticum*. *Poultry Sci.*, 44 : 342-344.
- GIHAD, E.A., 1959.—The effect of feeding antibiotics on growing and laying turkeys. *M.Sc. Thesis, Faculty of Agric., Cairo University.*
- JUKES, T.H., 1955.—Antibiotics in nutrition. *Antibiotics Monographs No. 4. Medical Encyclopedia, Inc.*
- KISRB, J.S., (1957).—Enhancement of therapeutic efficacy of antibiotics. *U.S. Patent, No. 2806789.*
- PENSACK, J.M., 1963.—A new approach to increase antibiotic efficacy. *Proceedings of the 18th Annual Texas Nutrition conference.*
- SNEDECOR, G.W. 1959.—Statistical Methods Fifth Edition. The Iowa State College Press, Ames, Iowa, U.S.A.

دراسة العلاقة بين الأوكسييتتراسيكلين ومستويات الكلسيوم وكبريتات الصوديوم في علائق الكتنايت

× عصمت محمد عمر - أسامة عز الدين محمد - جمال عبد الرحمن قمر -

محمد عادل سليمان

الملخص

شملت هذه الدراسة ٢٤٦ كتكوت فيومى عمر يوم وقسمت هذه الكتنايت الى خمس مجاميع تحتوى كل منها على ٤٧ - ٥١ كتكوت . اضيف الأوكسييتتراسيكلين الى ماء الشرب بنسبة ١٠٠ جزء في المليون وكان مستوى الكلسيوم في عليقة المجاميع ١ ، ٢ ، ٣ ، ٤ هو ١٠٠٪ بينما في علائق المجاميع ٤ ، ٥ هو ١٧٣٪ . اضيفت كبريتات الصوديوم الى عليقة المجاميع ٣ ، ٥ بنسبة ١٥٠ ، ٣٠٠٪ على التوالي . استمرت التجربة حتى عمر ١٠ أسابيع وكانت الكتنايت تفضى حتى الشبع وكان المساء أمام الكتنايت في جميع الأوقات .

تدل نتائج هذه التجربة ان اضافة الأوكسييتتراسيكلين للماء يعدل ١٠٠ جزء في المليون وعندما كانت العليقة تحتوى على ١٪ كلسيوم لم ينتج عن هذه المعاملة اى زيادة جوهريية في النمو الا ان نسبة الوفيات كانت اقل من مجموعة المقارنة والتي لم تعط المضاد الحيوى . ولاحظ كذلك اضافة كبريتات الصوديوم بنسبة ١٥٠٪ لنفس العليقة السابقة وبنفس مستوى المضاد الحيوى نتج عنه زيادة ملحوظة في نمو الكتنايت حيث كانت احسن في نموها من اى مجموعة اخرى في التجربة وفاقته عن نمو المجموعة السابقة على مستوى احتمال ٥٪ . كما لوحظ ان معدل الاستفادة من الفذاء في هذه المجموعة كان هو احسن معدل وانخفضت نسبة الوفيات الى النصف بمقارنتها بمجموعة المقارنة وقد عزيت هذه التأثيرات الى دور كبريتات الصوديوم في تحسين امتصاص الأوكسييتتراسيكلين من الامعاء . أما المجاميع التى غذيت على مستوى كلسيوم ١٧٣٪ سواء كانت علائقها تحتوى على كبريتات صوديوم أم لا فان نموها كان اقل من مجموعة المقارنة وكانت نسبة الوفيات بها مرتفعة ومعدل الاستفادة من الفذاء منخفض .

× قسم الانتاج الحيوانى « فرع تغذية الحيوان » بكلية الزراعة - جامعة القاهرة - بالجيزة