EFFECT OF FEEDING VARIOUS ANTIBIOTICS ON THE HEMORRHAGIC SYNDROME IN POULTRY

by

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INTRODUCTION

The hemorrhagic syndrome in poultry is of importance economically because the consumer tends to discriminate against such birds when they are noticed on the market. Poultry processors are interested in eliminating this condition in broilers which they purchase. The cause of the condition is directed to feed ingredients, and is felt to be a nutritional as well as a physiological problem.

Antibiotics are compounds which have been found to be of benefit as a micro-ingredient in poultry feeds, and their possible influence in causing the hemorrhagic syndrome has been suggested. In certain cases, when the hemorrhage has been attributed to other causes, feeding of antibiotics did not alleviate the condition. Investigations thus far concerning antibiotics and the hemorrhagic syndrome are limited, and further studies needed to be conducted in order to clarify the role of these agents and the syndrome.

Three experiments were conducted in an effort to determine the following: (1) influence of various levels of antibiotics on the hemorrhagic syndrome, (2) compare results of purified vs non purified diets on the hemorrhagic syndrome, using antibiotics as the only variable, (3) effect of using crystalline antibiotics compared with crude feed grade sources of antibiotics in both purified and non purified diets, (4) compare growth of the chickens with different levels of antibiotics in the feed.

REVIEW OF LITERATURE

A hemorrhagic-like condition was reported by McFarlane et al. (1931). It was evidenced by numerous pin point hemorrhages in the kidneys and an excess of water in the ureters and cloaca. The hemorrhages in some cases were peritoneal clots, but more frequently appeared as small blotches along the muscles of the femur and sternum. The condition was noticed in an experiment in which chickens were fed synthetic diets containing various substances as a source of protein. Chicks which were fed fish meal as the protein source grew well but were pale and anemic, later showing the hemorrhagic condition.

Holst and Halbrook (1933) published data concerning a condition in chickens whose symptoms were "scurvy like" in appearance. Frequently hemorrhage around the head, neck, back, ribs, breast and keel occurred. Abdominal hemorrhage and small hemorrhage spots in the muscle of the intestinal wall were also common.

Cook and Scott (1935) using a ration similar to Holst and Halbrook produced the syndrome which is characterized by (a) production of hemorrhages without respect to location, (b) anemia, and (c) prolonged blood clotting time. The control diet which produced no hemorrhage consisted of the following: corn 55 per cent, wheat 20 per cent, skim milk 20 per cent, NaCl .5 per cent, cod liver oil 1 per cent, $Ca_3(PO_4)_2$ 1 per cent, $CaCO_3$ 1 per cent, and dried yeast 1 per cent.

More recently Delaplane and Milliff (1948) reported a hemorrhagic condition associated with feeding sulfaquinoxaline at .05 per cent levels to Rhode Island Red pullets in egg production. Hemorrhages beneath the skin of the legs and in the combs were observed in most birds that died. Davies (1954) reported a hemorrhage condition following sulphonamide treatment. Davies stated that Baker and Jacquette ibid had described hemorrhages in chickens during the growth period with a peak incidence at five to seven weeks. The cause was not determined, but was reported in flocks with no sulfa cocci treatment. Similar conditions occurred in a diet containing trichlorethylene extracted soybean meal, but birds fed other diets of other types of extraction had it also. Hare et al. (1953) fed a corn soybean oil meal ration to day old chicks for six weeks, and observed the hemorrhagic condition had developed. The causative factor was regarded as avitaminosis K, but the relationship of sulphonamide therapy and the "hemorrhagic disease" was uncertain.

Goldhaft and Wernicoff (1954) mentioned that, from the viewpoint of pathologists, it indicates toxicity and appears that birds which eat the most are those most affected.

Griminger et al. (1953) found that chlortetracycline was without effect in decreasing hemorrhages in chickens fed a ration which induced hemorrhages during the third and fourth week. Bernstein and Samberg (1954) directed attention to field cases of vitamin K deficiency in Israel in which intramuscular injection of vitamin K stopped hemorrhagic mortality in chickens which had chlortetracycline and B_{12} at 4 mgs each per kg of feed.

Reynolds et al. (1955) declared that high level oxytetracycline feeds in commercial use do not interfere with normal blood clotting time in the chick.

Griminger et al. (1955), using purified diets and various B_{12} antibiotic supplements, and utilizing Klotogen F in control diets as a comparison for blood clotting times, declared that certain antibiotic supplements were as effective as Klotogen F in promoting normal blood clotting time.

Goldhaft and Wernicoff (1954) fed Leghorn cockerels a control diet containing antibiotics and compared it with diets containing coccidiostats. The per cent incidence of hemorrhage in the control lot was 10 per cent as compared to a maximum of 40 per cent in other lots. The authors proposed the possibility that antibiotics change or reduce the bacterial flora of the intestinal tract and thereby prevent the bacterial utilization or production of vitamin K.

Heuser (1956) mentioned that 100 gms per ton levels of the antibiotics chlortetracycline and oxytetracycline stimulated growth more than low levels, and that high levels also improved feed efficiency. Reynolds et al. (1951) using levels of 2, 5, and 10 gms per ton levels of penicillin and oxytetracycline in broiler rations concluded that 2 gms of oxytetracycline produced the greatest gain in body weight and the most efficient utilization of feed. Elam et al. (1951) found that the feeding of penicillin at 33 mgs/kg levels stimulated the growth of birds fed an all vegetable protein diet. Rizzute and Alford (1956) reported that 10 gms per ton level of bacitracin gave a significant growth response over control birds which received no antibiotics.

MATERIALS AND METHODS

All experiments were conducted at the Poultry Nutrition Laboratory at the College Poultry Farm. The strain and breed used in all experiments was the Arbor Acres White Rock. Twelve lots of 20 chicks each were vaccinated internasally for Newcastle disease, wingbanded, randomized into a six deck starting battery and reared with heat until the fourth week, and then transferred to growing batteries until the end of the experimental period. Cumulative feed consumption was recorded every two weeks along with the individual weight record of the chicks. The chicks and feed also were weighed at the end of the ninth week or finish of the experimental period. The sick or crippled birds in the experiments were sent to the Department Of Veterinary Pathology, K. S. C. for diagnosis.

All feed was mixed as needed at the feed building at the College Poultry Farm. Platform scales were used in weighing all ingredients except the amounts used in gram levels and a lever balance was used for this purpose. With the purified diets, all minerals were pulverized with a mortar and pestle to a fineness sufficient to pass a #20 screen mesh of .0331 in. diameter. The mineral and vitamin constituents of the purified diets were weighed on an analytical balance whenever the quantity used necessitated this degree of accuracy. All water soluble vitamins were added to a #2 tin can containing cerelose and mixed with a spatula to an apparent random mix, and then added to a seven pound quantity of cerelose which made up the premix for these ingredients. The fat soluble vitamins were added to propylene glycol in Experiment II and to corn oil in Experiment III. One hundred and fifty mls of this mixture were added to the vitamin premix and mixed by hand. Following this the entire constituents of the diet were emptied into a horizontal paddle mixer and mixed for 15 minutes. All feeds were stored on the second floor of the feed building in paper bags. Recorded amounts of feed were added to the feed containers as needed.

Experiment I

The only diet used in this experiment was the K. S. C. Soybean Oil Meal Basal (K. S. C. basal) diet supplemented with varying levels of each of four antibiotics: chlortetracycline,[1] bacitracin,[2] penicillin,[3] and oxytetracycline.[4] The levels of these antibiotics are given in Table 2.

Experiment II

The same basal diet was used as in Experiment I, except for the addition of a purified ration which was fed to six lots.

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[1] The trademark of American Cyanamid Company Farm and Home Division for the antibiotic chlortetracycline is Aureomycin.

[2] The trademark of Commercial Solvents Corporation for the antibiotic zinc bacitracin is Baciferm.

[3] The trademark of Merck and Co., Inc. for the antibiotic procaine penicillin is Pro Pen.

[4] The trademark of Chas. Pfizer and Co., Inc., for the antibiotic oxytetracycline is Terramycin.

Each lot receiving the K. S. C. basal and a certain antibiotic had a corresponding level of this antibiotic in the purified ration as a counterpart. The type of ration and antibiotic used in this experiment are listed by lots in Table 4.[1]

A vitamin A deficiency resulted from the purified diet in this experiment and A and D feeding oil was given ad libitum as a corrective measure.

Experiment III

The same basal rations used in Experiments I and II were repeated in this experiment with the modification of substituting five per cent of corn oil for an equivalent amount of cerelose in the purified ration. In this experiment crystalline antibiotics were compared with crude sources, and all antibiotics were fed at the level of 200 gms per ton of feed. The rations used and their corresponding antibiotics are given in Table 5.

A vitamin A deficiency again resulted from the purified diet in this experiment, and was attributed to the use of a stabilized form of vitamin A which would not dissolve in the corn oil solution. Single individual dosages of fat soluble vitamins A, D, and E were given, and the same form of vitamin A acetate used in the K. S. C. basal ration was added to the corn oil in all diets after the symptoms occurred. Reduced mortality indicated a cure.

In all experiments, at the end of the experimental periods, all lots of chickens were slaughtered by a commercial processing

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[1] All Tables in the Appendix.

plant. As the eviscerated birds were removed from the processing line, each carcass was scored, by a pathologist, for intensity of the hemorrhage in the sartorius, ambeius, adductor longus, adductor brevis, and gracilis muscles of the inner thigh. The wing band and hemorrhagic score for each chicken was recorded. The scores ranged in value from 0 to 5 and were used later as a basis for statistical analysis.[1]

RESULTS AND DISCUSSION

Experiment I

An analysis of variance was run on the transformed individual hemorrhage scores of the birds composing all lots.[2] This analysis indicated that treatments were significantly different at the .01 level so the Kramer (1956) method of the multiple range test for unequal numbers of replications was used to locate the significant differences at the .05 level. The analysis of variance, and the table of ranked lots are given in Tables 6 and 7 respectively.

Experiment II

An analysis of variance on the same basis as Experiment I was run on this experiment, but was set up to test for interaction between diets and supplements. This analysis indicated inter-

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[1] Plates 1 to 6 and Table 12 (All Plates in Appendix).

[2] Using a $\sqrt{y+1}$ transformation in order to make the distribution of the data more nearly normal.

action significance at the .01 level and the multiple range test was repeated to locate the significant differences at the .05 level. The data tabulations of these analyses sre given in Tables 8 and 9.

Experiment III

A repetition of the analysis of variance by the same procedure as in Experiment I was carried out and indicated a significant difference among treatments at the .01 level. The multiple range test was then applied to locate these differences. Due to proven interactions between type of antibiotic and feed in Experiment II, it was possible to compare the three purified diets containing antibiotics with the K. S. C. basal diets containing antibiotics from the standpoint of interaction. This same comparison is valid between the crude sources and crystalline sources of antibiotics as well. Data given in Tables 10 and 11 show these analyses.

The results of all three experiments show a clear trend of increased hemorrhage due to certain antibiotic supplementations. More important than antibiotic supplementation, when considered as a single factor, is the interaction of antibiotic supplementation, and the type of diet with which it is combined. The only inconsistency found in all three experiments, when considered in the overall aspect, is the failure of chlortetracycline at the 100 gms level to cause significantly more hemorrhagic intensity than 0 supplementation; while the effect of the same antibiotic at the 10 gms level was significantly greater than 0 supplementation.

Another measure of the hemorrhage, other than intensity as measured by scoring, was the per cent incidence of the condition. Data tabulated in Table 13 gives the per cent incidence of the hemorrhages for all lots in each of the three experiments.

The average weights and feed conversion of the chickens at the age of nine weeks were approximately the same expected weight for commercial broilers of the same age except for those lots which were fed purified diets. The lots which were supplemented with the 200 gms per ton levels of crude penicillin were also noticeably smaller and weighed less than those lots which consumed the same levels of the other three antibiotic types. This was not true with the 50 per cent crystalline penicillin which was used in Experiment III or in lots 7 and 8 of Experiment II. The high level of 50 per cent penicillin actually gave the best growth rate of all lots in Experiment III. It was felt that the high level of crude penicillin has a toxic substance in the carrier which decreases both rate of gain and feed efficiency.

One factor which caused much concern in the experiments involving purified diets was the variation of livability of the lots which consumed this type of diet.[1]

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[1] See mortality Table 14

The feed efficiency varied between the different antibiotics and levels used. The highest levels of some antibiotics gave the best feed conversion while in others the reverse was true. The purified diets showed a wide range of feed efficiency in the experiments having both the most efficient conversion and the poorest conversion in comparison with the K. S. C. basal diet, considering both Experiments II and III.

The suggestion that the birds which eat the most are those most affected is logical as such a bird would also consume more of the supplement than other birds. The average weight and per cent hemorrhagic incidence graph (Plate 7) indicates this relationship by a larger grouping of plotted symbols clustered in the high-weight and high-incidence quadrant than in all of the other quadrants combined.

From the statistical tables a synopsis of the significant differences between hemorrhagic intensity among lots in each experiment can be made. In Experiment I, chlortetracycline at 10 gms was significantly greater than 0 supplementation, while the 100 gms level was significantly less than 0 supplementation and the 200 gms level was non significant. Chlortetracycline at 10 gms was significantly greater than penicillin at 100 gms. Bacitracin at 10 gms was not significantly different from 0 supplementation, while 200 gms was significantly greater. Bacitracin at 10 gms and 200 gms levels was significantly greater than penicillin at 10 and 100 gm levels. Bacitracin at 200 gms was significantly greater than penicillin at 200 gms. Penicillin at all three levels was not significantly different from the 0 supplementation. Oxytetracycline at 10 gms was not significantly different from 0 supplement, while both the 100 gms and 200 gms levels were significantly greater. Oxytetracycline at 100 gms was significantly greater than 10 gms levels of bacitracin, and also greater than oxytetracycline at 10 gms.

In Experiment II, chlortetracycline and bacitracin were not significantly different from either the K. S. C. basal or the purified basal. Oxytetracycline supplemented in the K. S. C. basal was significantly greater than the purified diet. The high level of penicillin supplemented in the K. S. C. basal was significantly greater than the purified diet. The K. S. C. basal plus chlortetracycline was significantly greater than the purified diet plus bacitracin. The K. S. C. basal plus chlortetracycline was significantly greater than the purified diet plus the 200 gms level of penicillin. The K. S. C. basal plus bacitracin was significantly greater than the purified diet plus oxytetracycline. The K. S. C. basal plus the 200 gms level of penicillin was significantly greater than the purified diet plus oxytetracycline. The K. S. C. basal plus chlortetracycline was significantly greater than the same diet plus penicillin at the same level. The K. S. C. basal plus oxytetracycline was significantly greater than penicillin at 50 gms in the same basal diet. All purified diets were non significant when compared to each other.

In Experiment III, none of the crystalline antibiotics were significantly different from the 0 supplement in the K. S. C. basal diets. The purified diet containing bacitracin was significantly less than the K. S. C. basal diet. The crude oxytetracycline was non significant from the K. S. C. basal diet. The purified diets were not significantly different from the K. S. C. basal diet. Crude chlortetracycline was significantly greater than crude penicillin. Both crude and crystalline bacitracin was significantly greater than crude penicillin.

Data presented in Tables 17, 18, and 19 illustrates the significant differences for all three experiments.

SUMMARY AND CONCLUSIONS

Three experiments were conducted using a standard soybean oil meal ration, purified diets, and both crude and crystalline antibiotics to determine the effect of feeding various antibiotics on the hemorrhagic syndrome in poultry. The results of these experiments verify the results of Griminger, et al. (1953) who found that chlortetracycline was without effect in decreasing hemorrhages in chickens fed a ration which induced hemorrhages during the third and fourth week. The data agreed with the work of Heuser, (1956) who found that 100 gms per ton levels of the antibiotics chlortetracycline and oxytetracycline stimulated growth and feed efficiency more than low levels. Even though different levels were used than that of Elam, et al. (1951), the results of these experiments tend to confirm his results in which 33 mgs/kg levels of penicillin stimulated the growth of birds fed an all vegetable protein diet. Data also substantiate the report of Rizzute and Alford (1956) who found that 10 gms per ton levels of bacitracin gave a significant growth response over control birds which received no antibiotics.

The determination of blood clotting times and the use of sulfa drugs was not within the scope of these experiments so no confirmation or disagreement with references based on these methods was made.

The following conclusions were made from data collected in these experiments.

1. Certain levels of antibiotic supplements caused significant increases in hemorrhages.

2. The interaction between crude antibiotics and the K. S. C. soybean oil meal basal diet revealed significant increases in hemorrhages as compared with the same antibiotics in purified diets.

3. Crystalline forms of antibiotics caused significantly less hemorrhages than crude feed grade antibiotics.

4. Crude feeding grade sources of oxytetracycline and bacitracin caused an increase in hemorrhagic severity in comparison with penicillin.

5. Penicillin was neutral in its effect in causing hemorrhages when added to a standard type ration.

6. High levels of crude penicillin decreased both growth rate and feed efficiency.

7. High levels of crystalline penicillin gave the highest rate of growth of any supplement used in all three experiments.

8. Chlortetracycline was sporadic in effect in causing hemorrhages.

9. Feed efficiency of lots consuming the purified diets varied considerably.

10. The growth rate of lots consuming the purified diets was lower than lots consuming the K. S. C. basal diet.

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Generous quantities of the following materials were supplied: Aurofac (chlortetracycline) by American Cyanamid Co., Farm And Home Division, New York, N. Y.; fat and water soluble vitamins, amino acids, Pro Pen 2-3 (penicillin) and 50 per cent crystalline penicillin by Merck and Co., Inc., Rahway, N. J.; vitamin A acetate by NOPCO Chemical Company, Harrison, New Jersey; vitamin D_3 by Dawes Laboratories, Inc., Chicago, Illinois; Menadione by Abbott Laboratories, North Chicago, Illinois; Baciferm (bacitracin) and crystalline zinc bacitracin by Commercial Solvents Corp., Terre Haute, Indiana; TM 3+3 (oxytetracycline) by Chas. Pfizer and Co., Inc., Terre Haute, Indiana.

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APPENDIX

Table 1. Composition of the K. S. C. soybean oil meal basal diet used in all three experiments (K. S. C. basal)

Ingredients	Quantity	Vitamin mix (added/100 lbs. ration)	
Ground yellow corn	61.5 lbs.	Vitamin A*	40 gms
Wheat middlings	4.0 "	Vitamin D_3**	20 "
Alfalfa meal (17% dehyd.)	1.0 "	Riboflavin mix	10 "
Soybean oil meal (44% solvent ext.)	30.0 "	Choline Chloride (25% mix)	80 "
Calcium carbonate	1.0 "	Niacin (cryst.)	10 "
Steamed bone meal	2.0 "	Calcium pantothenate (cryst.)	1 "
Salt (NaCl)	.5 "		
Total	100.0 "		

*(Supplies 10,000 USP units of vitamin A per gm of supplement)

**(Supplies 1,500 I. C. units of vitamin D_3 per gm of supplement)

Table 2. Listing of the level and type of antibiotic supplementation used in Experiment I.

Lot	Level	Antibiotic
1 K. S. C. basal	None	None
2 K. S. C. "	10 gms/Ton	chlortetracycline
3 K. S. C. "	100 gms/Ton	chlortetracycline
4 K. S. C. "	200 gms/Ton	chlortetracycline
5 K. S. C. "	10 gms/Ton	bacitracin
6 K. S. C. "	200 gms/Ton	bacitracin
7 K. S. C. "	10 gms/Ton	penicillin
8 K. S. C. "	100 gms/Ton	penicillin
9 K. S. C. "	200 gms/Ton	penicillin
10 K. S. C. "	10 gms/Ton	oxytetracycline
11 K. S. C. "	100 gms/Ton	oxytetracycline
12 K. S. C. "	200 gms/Ton	oxytetracycline

Table 3 Composition of Basal II purified diet used in Experiments II and III (Purified basal).

Ingredients	Exp. II Quantity	Exp. III Quantity
Cerelose	62.56 lbs	57.56 lbs
Corn Oil		5.00 "
Gelatin	8.00 "	8.00 "
Cellu flour	5.00 "	5.00 "
Salt mixture[1]	5.00 "	5.00 "
Cystine	180.00 gms	180.00 gms
Choline chloride	100.00 "	100.00 "
I-inositol	45.50 "	45.50 "
Arginine	35.00 "	35.00 "
Niacin	35.00 "	35.00 "
Calcium pantothenate	4.55 "	4.55 "
Riboflavin	1.60 "	1.60 "
Thiamine HCl	908.00 mgs	908.00 mgs
P-amino benzoic acid	450.00 "	450.00 "
Pyridoxine	454.00 "	454.00 "
Folic acid	227.00 "	227.00 "
Biotin	9.08 "	9.08 "
Menadione	200.00 "	200.00 "
Fat soluble vitamin mix[2]	150.00 gms	150.00 gms
Crystalline B_{12}	500.00 mgs	500.00 mgs

[1]Composition of salt mix

NaCl	226.80 gms	226.80 gms
KH_2PO_4	548.10 "	548.10 "
$Ca_3(PO_4)_2$	735.95 "	735.95 "
$CaCO_3$	559.23 "	559.23 "
$MgSO_4$ $7H_2O$	159.18 "	159.18 "
$MnSO_4$ $1H_2O$	20.00 "	20.00 "
$K_2Al_2(SO_4)_4$ $24H_2O$	.80 "	.80 "
$CuSO_4$	1.00 "	1.00 "
Fe citrate	25.00 "	25.00 "
Zn acetate	.70 "	.70 "
$NiSO_4$	.10 "	.10 "
$CoCl_2$	.20 "	.20 "
	2,227.06	2,227.06

[2]Fat soluble vitamin mix

Vitamin A acetate	(2,906,000 USP units)	1.00 gm
Vitamin D_3	(40,000,000 USP units)	60.00 mgs
Alpha tocopherol (Vit. E.)		5.00 gms
Menadione (Vitamin K)		200.00 mgs

Added to 750 mls of propylene glycol in Exp. II and corn oil in Exp. III.

Table 4. Listing of the diets and the level and type of antibiotic supplementation used in Experiment II.

Lot		Level	Antibiotic
1	K. S. C. basal	None	None
2	Purified basal	None	None
3	K. S. C. basal	200 gms/Ton	chlortetracycline
4	Purified basal	200 gms/Ton	chlortetracycline
5	K. S. C. basal	200 gms/Ton	bacitracin
6	Purified basal	200 gms/Ton	bacitracin
7	K. S. C. basal	200 gms/Ton	penicillin (50%)
8	Purified basal	200 gms/Ton	penicillin (50%)
9	K. S. C. basal	200 gms/Ton	oxytetracycline
10	Purified basal	200 gms/Ton	oxytetracycline
11	K. S. C. basal	50 gms/Ton	penicillin (50%)
12	Purified basal	50 gms/Ton	penicillin (50%)

Table 5. Listing of the diets and the level and type of antibiotic supplementation used in Experiment III.

Lot		Level	Antibiotic
1	K.S.C. basal-cryst. B_{12}	None	None
2	K.S.C. basal-cryst. B_{12}	200 gms/Ton	cryst. chlortetracycline
3	K.S.C. basal-cryst. B_{12}	200 gms/Ton	cryst. bacitracin
4	K.S.C. basal-cryst. B_{12}	200 gms/Ton	cryst. penicillin (50%)
5	K.S.C. basal-cryst. B_{12}	200 gms/Ton	cryst. oxytetracycline
6	Purified basal-cryst. B_{12}	None	None
7	Purified basal-cryst. B_{12}	200 gms/Ton	cryst. bacitracin
8	Purified basal-cryst. B_{12}	200 gms/Ton	cryst. oxytetracycline
9	K.S.C. basal	200 gms/Ton	chlortetracycline
10	K.S.C. basal-cryst. B_{12}	200 gms/Ton	bacitracin
11	K.S.C. basal	200 gms/Ton	penicillin
12	K.S.C. basal	200 gms/Ton	oxytetracycline

Table 6. Experiment I analysis of variance of transformed mean scores of birds scored at the time of slaughter.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-ratio
Lots	11	6.49	.590	4.15**
Within	208	29.57	.142	
Total	219	36.06		

** Significant $P < .01$

Table 7 Table of ranked lots for Experiment I based on Duncan's (1955) method.[1]

Lots rank from low to high in score											
8	1	4	3	7	5	10	9	12	2	6	11
								—	—	—	—
		—	—	—	—	—	—	—	—		
	—	—	—	—	—	—	—				
—	—	—	—	—							

[1] Any two lots not underscored by the same line are significantly different, and any two lots underscored by the same line are not significantly different.

Table 8. Experiment II analysis of variance of transformed mean scores of birds scored at the time of slaughter.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-ratio
Diets	1	0.3612	0.3612	2.4064 NS
Supplements	5	2.1564	0.4313	2.8734*
Interaction of diet and supplement	5	2.3803	0.4761	3.1719**
Within series	206	30.9106	0.1501	

NS Non significant
*Significant P < .05
**Significant P < .01

Table 9. Table of ranked lots for Experiment II based on Duncan's <u>op. cit.</u> method.

Lots rank from low to high in score

10	8	2	11	6	4	12	5	7	3	1	9
						—	—	—	—	—	—
					—	—	—	—	—	—	
		—	—	—	—	—	—	—			
—	—	—	—	—	—	—					

Table 10. Experiment III analysis of variance of transformed mean scores of birds scored at the time of slaughter.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-ratio
Lots	11	3.96	.360	2.38**
Within	210	31.68	.151	
Total	221	35.64		

**Significant P < .01

Table 11. Table of ranked lots for Experiment II based on Duncan's op. cit. method.

Lots rank from low to high in score

11	7	5	8	6	4	2	12	3	1	9	10
				—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—				

Table 12. Hemorrhagic mean scores per lot for all three experiments.

Lot	Experiment I		Experiment II		Experiment III	
	Av. Positive Score	Av. Total Score	Av. Positive Score	Av. Total Score	Av. Positive Score	Av. Total Score
1	1.83	.69	2.56	2.19	2.27	1.70
2	1.94	1.75	1.33	1.00	1.57	1.16
3	1.47	1.10	2.29	1.86	1.94	1.55
4	1.83	1.10	1.80	1.42	1.92	1.15
5	1.71	1.26	2.00	1.60	1.78	.94
6	2.26	2.26	1.70	1.13	1.89	.94
7	2.14	.69	1.89	1.62	1.71	.80
8	1.44	.68	1.75	1.05	1.55	1.00
9	2.00	1.60	3.13	2.50	2.19	1.75
10	1.53	1.30	1.44	.62	2.35	2.00
11	2.29	2.29	1.57	1.16	1.80	.56
12	1.76	1.58	2.10	1.50	1.86	1.30

Table 13. Per cent hemorrhagic incidence by lots for all three experiments

Lot No.	Experiment I Per cent incid.	Experiment II Per cent incid.	Experiment III Per cent incid.
1	37.50	86.00	75.00
2	90.00	75.00	73.68
3	75.00	81.00	80.00
4	60.00	79.00	60.00
5	73.60	80.00	52.94
6	100.00	66.66	50.00
7	66.66	86.00	46.66
8	47.37	57.00	64.70
9	80.00	80.00	80.00
10	85.00	43.00	85.00
11	100.00	74.00	31.25
12	89.47	66.66	70.00

Table 14. Per cent mortality by lots for all three experiments.

Lot No.	Experiment I Per cent mort.	Experiment II Per cent mort.	Experiment III Per cent mort.
1	23.81	0	0
2	4.76	57.14	5.00
3	4.76	0	0
4	0	9.52	0
5	9.52	4.76	11.76
6	9.52	23.81	10.00
7	0	0	20.00
8	9.52	4.76	10.00
9	38.10	4.76	0
10	4.76	0	0
11	22.73	9.53	10.00
12	4.76	33.33	0

Table 15. Average weight at nine weeks for all lots in all these experiments (adjusted for sex).

Lot No.	Experiment I Weight in gms	Experiment II Weight in gms	Experiment III Weight in gms
1	979.3	1,210.5	1,218.0
2	1,073.8	683.0	1,375.0
3	1,112.2	1,303.5	1,272.5
4	1,071.3	992.5	1,385.1
5	1,109.5	1,331.0	1,095.0
6	1,073.3	750.0	1,096.2
7	1,041.1	1,227.0	1,082.2
8	1,058.7	993.0	1,114.9
9	884.7	1,230.0	1,270.4
10	1,079.0	944.5	1,317.6
11	1,129.1	1,281.5	996.9
12	1,168.3	813.5	1,201.2

Table 16. Feed efficiency at nine weeks for all lots in all three experiments (adjusted for mortality).

Lot No.	Experiment I Lbs feed/lb gain	Experiment II Lbs feed/lb gain	Experiment III Lbs feed/lb gain
1	3.01	2.44	2.57
2	2.56	2.56	2.49
3	2.48	2.39	2.58
4	2.68	2.72	2.49
5	2.61	2.45	2.52
6	2.77	3.28	2.12
7	2.67	2.49	2.03
8	2.76	2.67	1.90
9	3.44	2.42	2.67
10	2.58	2.46	2.46
11	2.65	2.35	2.90
12	2.37	2.43	2.75

Table 17. Table of significant differences in hemorrhagic intensity between treatments for Experiment I.

K. S. C. Levels		Basal 0	Bacitracin 10	Bacitracin 200	Chlortetracycline 10	Chlortetracycline 100	Chlortetracycline 200	Oxytetracycline 10	Oxytetracycline 100	Oxytetracycline 200	Penicillin 10	Penicillin 100	Penicillin 200
Bacitracin	10	NS	--	NS	NS	NS	NS	NS	NS	NS	Sig >	Sig >	NS
	200	Sig	NS	--	NS	NS	NS	NS	NS	NS	Sig >	Sig >	Sig >
Chlortetracycline	10	Sig	NS	NS	--	NS	NS	NS	NS	NS	Sig >	NS	NS
	100	Sig <	NS	NS	NS	--	NS	NS	NS	NS	NS	NS	NS
	200	NS	NS	NS	NS	NS	--	NS	NS	NS	NS	NS	NS
Oxytetracycline	10	NS	NS	NS	NS	NS	NS	--	NS	NS	NS	NS	NS
	100	Sig >	Sig	NS	NS	NS	NS	Sig >	--	NS	NS	NS	NS
	200	Sig >	NS	NS	NS	NS	NS	NS	NS	--	NS	NS	NS
Penicillin	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	NS	NS
	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	NS
	200	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	--

Individual block comparisons are made by using the vertical columns on the left with a corresponding horizontal row.

Symbols: Significantly greater than Sig >
Significantly less than Sig <
Non Significant NS
Not applicable or redundant --

Table 18. Table of significant differences in hemorrhagic intensity between treatments for Experiment II.

	K. S. C. Basal 0	K. S. C. Basal Bacit. 200	K. S. C. Basal Chlortet. 200	K. S. C. Basal Oxytet. 200	K. S. C. Basal Penicillin 50	K. S. C. Basal Penicillin 200	Purified Basal 0	Purified Basal Bacit. 200	Purified Basal Chlortet. 200	Purified Basal Oxytet. 200	Purified Basal Penicillin 50	Purified Basal Penicillin 200
Bacit. 200	NS	--	NS	NS	NS	NS	NS	NS	NS	Sig >	NS	NS
Chlortet. 200	NS	NS	--	NS	NS	Sig >	NS	Sig >	NS	NS	NS	Sig >
Oxytet. 200	NS	NS	NS	--	Sig >	NS	Sig >	NS	NS	NS	NS	NS
Penicillin 50	NS	NS	NS	NS	--	NS	NS	NS	NS	NS	NS	NS
Penicillin 200	NS	NS	NS	NS	NS	--	Sig >	NS	NS	Sig	NS	NS

Symbols:
- Significantly greater than: Sig >
- Significantly less than: Sig <
- Non Significant: NS
- Not applicable or redundant: --

Table 19. Table of significant differences in hemorrhagic intensity between treatments for Experiment III.

		K. S. C. Basal									Purified Basal		
		0	Bacitracin		Chlortet.		Oxytet.		Penicillin		0	Bacit.	Oxytet.
			Cryst	Crude	Cryst	Crude	Cryst	Crude	Cryst	Crude		Cryst	Cryst
Bacit.	Cryst.	NS	--	NS	NS	NS	NS	NS	NS	Sig >	NS	NS	NS
	Crude	NS	NS	--	NS	NS	Sig >	NS	NS	Sig >	NS	Sig >	Sig >
Chlortet.	Cryst.	NS	NS	NS	--	NS	NS	NS	NS	NS	NS	NS	NS
	Crude	NS	NS	NS	NS	--	NS	NS	NS	Sig >	NS	NS	NS
Oxytet.	Cryst.	NS	--	--	--	--	--	--	--	--	NS	NS	NS
	Crude	NS	--	--	--	--	--	--	--	--	NS	NS	NS
Penicillin	Cryst.	NS	--	--	--	--	--	--	--	--	NS	NS	NS
	Crude	Sig <	--	--	--	--	--	--	--	--	NS	NS	NS
0		--	--	--	--	--	--	--	--	--	NS	Sig >	NS

Symbols: Significantly greater than Sig >
Significantly less than Sig <
Non Significant NS
Not applicable or redundant --

EXPLANATION OF PLATE I

Picture of thigh muscles of a chicken given a hemorrhagic score of 0

PLATE I

EXPLANATION OF PLATE II

Picture of thigh muscles of a chicken given a hemorrhagic score of 1

PLATE II

EXPLANATION OF PLATE III

Picture of thigh muscles of a chicken
given a hemorrhagic score of 2

PLATE III

EXPLANATION OF PLATE IV

Picture of thigh muscles of a chicken given a hemorrhagic score of 3

PLATE IV

EXPLANATION OF PLATE V

Picture of thigh muscles of a chicken
given a hemorrhagic score of 4

PLATE V

EXPLANATION OF PLATE VI

Picture of thigh muscles of a chicken
given a hemorrhagic score of 5

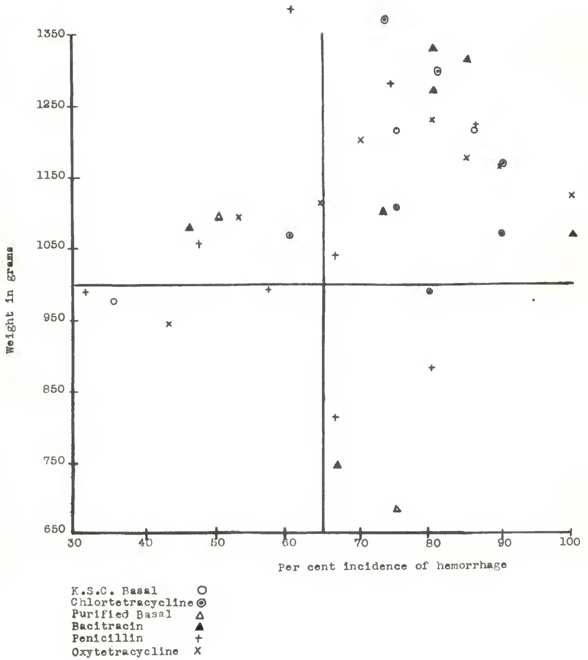
PLATE VI

EXPLANATION OF PLATE VII

Quadrant graph for all lots representing per cent hemorrhage according to average weight

1. The upper right quadrant represents the high-weight high-incidence lots.

PLATE VII


1350
1250
1150
1050
950
850
750
650
30
40
50
60
70
80
90
100
Weight in grams
Per cent incidence of hemorrhage
K.S.C. Basal
Chlortetracycline
Purified Basal
Bacitracin
Penicillin
Oxytetracycline

EFFECT OF FEEDING VARIOUS ANTIBIOTICS ON THE HEMORRHAGIC SYNDROME IN POULTRY

by

ROBERT JAMES DEMPSEY

B. S., Kansas State College
of Agriculture and Applied Science, 1953

AN ABSTRACT OF A THESIS

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OF AGRICULTURE AND APPLIED SCIENCE

1958

Three experiments were conducted in an effort to determine the effect of feeding various antibiotics on the hemorrhagic syndrome in poultry.

Chicks of the Arbor Acre White Rock strain were battery reared and normal husbandry practices were applied. In Experiment I the antibiotics chlortetracycline, bacitracin, penicillin, and oxytetracycline were added at 10, 100, and 200 gms per ton levels to a soybean oil meal type ration. In Experiment II these antibiotics were added at 200 gms per ton levels to the soybean oil meal diet and a purified diet, except for two lots which received 50 gms per ton levels of penicillin in the above mentioned rations. In Experiment III 200 gms per ton levels of the four antibiotics were fed in both crystalline and crude forms as supplements to the soybean oil meal ration: with the exception of three lots which were fed purified diets. Two of the purified diets were supplemented with bacitracin and oxytetracycline. The chick weights were recorded bi-weekly and at the termination period. The birds were processed commercially and dressed birds were scored for hemorrhagic intensity in the proximal area of the thigh muscles. The individual hemorrhagic scores were used as a basis for statistical analysis.

A quadrant graph of hemorrhagic incidence ofall lots as a function of final weight in grams was made, and indicated the positive relationship between greater growth and high hemorrhagic incidence, by a larger grouping of plotted symbols clustered in the high weight and high incidence quadrant than in all of the other quadrants combined.

Significant differences were found among the antibiotics and the interaction between type of antibiotic and type of ration was also significant. Conclusions based upon the data reveal that no significant differences exist between the diets themselves. Crystalline forms of antibiotics caused significantly less hemorrhages than crude antibiotics. Crude oxytetracycline and bacitracin cause an increase in hemorrhagic severity when compared with penicillin. Penicillin was neutral in its effect in causing hemorrhages when added to a standard type ration. High levels of crude penicillin decreased growth rate and feed efficiency. High levels of crystalline penicillin gave the highest rate of growth of any supplement used in all three experiments. Chlortetracycline is sporadic in effect in causing hemorrhages. Feed efficiency of lots consuming the purified diets varied considerably. Growth rate of lots consuming the purified diets was lower than lots consuming the soybean oil meal basal diet.