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The Effect of Antibiotics on the Performance of Broiler Chicks

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브로일러에 있어서 항생제의 성장촉진 효과

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적 요

항생제인 Spiramycin과 Virginiamycin의 성장촉진 효과를 측정하기 위하여 총 360수의 육용계(broiler chicken) 초생추를 battery에 수용하여 각각 6주씩 2차에 걸친 사양시험과 4일간의 대사시험을 실시하였다. 1차 실험에서는 고단백(21.9%), 고열량(3159kcal/kg) 사료를 사용하였으며 180수의 숫병아리를 10수씩 무첨가구 Spiramycin(5ppm)구 및 Virginiamycin(5ppm)구에 각각 6반복씩 완전임의 배치하였다. 2차실험에서는 중단백(19.95%), 중열량(2931kcal/kg) 사료를 사용하고 90수의 숫병아리와 90수의 암병아리를 10수씩 분리하여 처리당 암·수 각각 3반복씩 배치하였다.

사양시험을 통하여 얻어진 증체량, 사료섭취량, 사료효율 및 폐사율은 처리구간에 통계적 유의차가 없었으나 1, 2차 실험 공히 항생제 B구가 무처리구(1차실험) 또는 항생제 A구(2차실험)보다 약 3% 높은 증체량을 나타내었다. 사료효율에 있어서도 항생제 B구가 가장 좋은 경향을 보여주었다. 2차실험의 결과에 의하면 증체량, 사료섭취량 및 사료효율에 있어서 암수간에는 유의한($p < 0.01$) 차이가 있었다.

대사시험결과 항생제 B구가 타처리구보다 영양소 이용률이 높은 경향을 나타내었으며 특히 1차실험에 있어서 조지방의 이용률은 타처리에 비해 유의하게($p < 0.01$) 높았고 조섬유이용률도 항생제 A구에 비해 유의하게($p < 0.05$) 높았다. 한편 대사체중당 소장의 무게와 길이는 항생제 B구가 타처리구에 비해 무겁고 긴 경향을 보여주었다.

I. Introduction

Since the growth promoting effect of Streptomycin in the chickens was reported by Moore et al. in 1946, it has been recognized by many researchers that supplementation of antibiotics generally improves growth rate and feed efficiency in growing poultry and livestocks.

Spiramycin, a macrolide type antibiotics, is produced from *Streptomyces ambofaciens* and effective against gram positive microorganisms (Pinnert-Sindico 1954). Virginiamycin is an antibiotics produced by a mutant of *Streptomyces virginiae.* This antibiotics was

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first isolated by De somer and Van Dijck in 1955 and was shown to be active against gram positive microorganisms(Van Dijck 1969). It has been reported that Virginiamycin has a growth promoting effect in chicken(Eyssen 1963, De Somer 1963, Combs and Bossard 1955) and increased matabolizable energy by 7.2% when supplemented at the level of 22ppm in the broiler diet(March 1978).

Two experiments, one at high nutrient density and the other at law nutrient density, were conducted to study the effects of Spiramycin and Virginiamycin on growth rate, feed efficiency, utilization of nutrients and development of intestine in broiler chickens.

II. Material and Method

Expt. 1:

One hundred eighty male parent stock of Maniker broiler chicken were divided into 18 groups of 10 birds each. They were housed in batteries and were randomly placed on three treatments(Control, Spiramycin and Virginiamycin) to have 6 replication per treatment. The level of supplementation of both antibiotics was 5 ppm each and energy and protein level of the experimental diet were 3159 Kcal/kg and 21.9% respectively. Formula and other compositions of the diet are shown in Table 1. Feeds and water were given ad libitum and group weight, feed intake and mortality were recorded weekly for 6 weeks. On completion of feeding trial, 9 birds per treatment, 27 birds in all, were selected to have uniform body weight. They were grouped by 3 birds to provide 3 replication per treatment in the subsequent metabolic trial. Excreta was collected daily for 4 days and dried for 36hrs at 65℃.

On the completion of metabolic trial, all birds were weighed(average wt. 2.2kg) and sacrificed. Length of small intestine, weight of small intestine and cecum after removing gut contents were measured.

Table 1. Formula and chemical composition of basal diets(Expt 1, Expt 2)

Ingredients(%)	Expt. 1	Expt. 2
Corn, Yellow	58.0	66.2
S.B.M.(44%)	26.6	22.8
Canola Meal	-	3.0
Fish Meal	8.0	5.0
Animal Fat	5.0	-
D,L-Met(50%)	0.2	0.15
Dical-p	1.5	2.10
Salt	0.2	0.25
Premix[1]	0.5	0.5
Total:	100	100
Chemical Composition[2]	Expt. 1	Expt. 2
Moisture(%)	13.38	13.06
Crude Protein(%)	21.92	19.95
Crude Fat(%)	6.94	2.64
Crude Fiber(%)	1.83	3.39
Crude Ash(%)	6.12	6.07
N. F. E.	49.81	54.90
ME(Kcal/kg)	3159	2931
Ca	1.35	1.53
P	0.85	0.96

1. This premix provides following amounts of micronutrients per kg of diet; Se 0.1 mg, Mn 58mg, Cu 5mg, I 0.7mg, Zn 53 mg, Vitamin A 12,000 IU, Vitamin D_3 2,400 IU, Vitamin E 10 IU, Vitamin K_3 0.7mg, Vitamin B_{12} 0.01mg, Vitamin B_2 4.8mg, Niacin 22mg, Pantothenic acid 9.7mg, Choline 350mg, Folid acid 0.5mg, Biotin 0.3mg.
2. Average assay value of triplicate samples.
3. Calculated value.

One hundred eighty sex separated commercial broiler chickens(Maniker Strain) were divided into 9 groups of 10 birds in each sex. They were alloted into 3(treatments)× 2(sex) factorial design. Treatments and level of supplementation of antibiotics were same as those of Expt. 1. Energy and protein content were 2931 Kcal / kg and 19.95 % respectively. Formula and other compositions of the diet are shown in Table 1. Procedure for the feeding trial was same as that of Expt. 1. For the metabolic trial, 4 male birds per treatment, 12 birds in all, were selected to have uniform weight. They were individually housed in the metabolic cages and followed same procedure used in Expt. 1. On the completion of metabolic trial, birds were fasted for 36 hrs and the body weight measured 1.95 kg in average. Birds were sacrificed and length and weight of small intestine and weight of empty cecum without content were measured. Approximatly 1cm segment of small intestine located 5cm from ileocecal junction and approximately 1cm of middle portion between apex and neck of cecum were taken, fixed in Bouin's solution and then stained with eosin-hematoxiline solution for microscopic examination. Samples of diets and excreta were analyzed according to A.O.A.C.(1980) methods. For statistical analysis of data, analysis of variance was used. Significant differences between treatment means were identified by L.S.D. (Steel and Torrie 1980)

Ⅲ. Results

Overall summary of Expt. 1 is shown in Table 2. Weight gains for 6 weeks were 1562.3g for Antibiotic B treatment, 1526.8 g for Antibiotic A treatment and 1518.8 g for control but they were not different statistically. Feed efficiencies were 1.87 for Antibiotic B treatment, 1.93 for Antibiotic A treatment and 1.92 for control but they also were not different statistically. Table 3 shows nutrients availability of the experimental diets used in Expt. 1. Availabilities of dry matter and crude protein of Antibiotic B treatment, 80.6% and 61.2% respectively, were higher than those of other treatments but they were not different statistically. Availability of crude fat in Antibiotic B treatment was 91.6% and this was significantly ($p < 0.01$) higher than either 89.2% in Antibiotic A treatment or 88.4% in control. Availability of crude fiber in Antibiotic A treatment was 19.7 % and this was significantly ($p < 0.05$) lower than those in Antibiotic B treatment and control (31.8% and 32.3% respectively). The length and weight of small intestine per metabolic body size ($W_{Kg}^{0.75}$) tended to be longer and heavier for birds of Antibiotic B treatment but they were not significantly different from those of other treatments. The weight of cecum and weight of small intestine per unit length were not significantly different among treatments Overall summary of Expt. 2 is shown in Table 5. Weight gains were 1530.3g for Antibiotic B treatment, 1513.8g for control and 1479.1g for Antibiotic A treatment but they were not different statistically. Feed efficiencies were 1.968 for Antibiotic B treatment, 1.976 for Antibiotic A treatment and 1.979 for control but they were also not different statistically. There were significant ($p < 0.01$) differences

Table 2. Overall weight gain, feed intake, feed efficiency and mortality of broiler chickens (Expt 1)

Treatments	Weight gain (g)	Feed intake (g)	Feed efficiency	Mortality (%)
Nonmedicated Control	1518.8	2913.6	1.92	6.67
Antibiotic A	1526.8	2956.4	1.93	18.33
Antibiotic B	1562.3	2916.2	1.87	8.33
SEM[1]	23.08	40.18	0.02	3.64

SEM: Standard error of means

Table 3. Nutrients availability of experimental diets (Expt 1)

Nutrients / Treatments	Dry Matter (%)	Crude Protein (%)	Crude[1] Fat (%)	Crude[2] Fat (%)	N.F.E.
Nonmedicated control	78.8	57.2	89.2[a]	32.3[b]	94.3
Antibiotic A	77.9	56.2	88.4[a]	19.7[a]	94.2
Antibiotic B	80.6	61.2	91.6[b]	31.8[b]	93.7
SEM[1]	0.78	1.84	0.508	3.096	0.279

1. SEM: Standard error of means
2. $P<0.01$
3. $P<0.05$

a,b: Means in the same column with different superscripts are significantly different.

between sexes in weight gain, feed intake and feed efficiency but no significant interactions between treatments and sexes were observed. Results of metabolic trial of Expt. 2 is shown in Table 6. Availabilities of dry matter and crude protein were highest in Antibiotic B treatment being 75.85% and 58.3% respectively. Availability of crude fiber in Antibiotic A treatment were lower than other treatments. However, all the differences were not different statistically. Data for small intestine and cecum are shown in Table 7. The weight of small intestine per metabolic body size was heavier in Antibiotic B treatment but differences were not statistically significant. Microscopic examination under 1000 magnification could

Table 4. Length and weight of small intestine and cecum weight per metabolic size and weight of small intestine per unit length (Expt 1)

Item	Nonmedicated control Mean± S.D.[1]	Antibiotic A Mean± S.D.	Antibiotic B Mean± S.D.
S.I.[2] length / M.S.[3], cm	429.47 ± 28.32	432.06 ± 34.96	451.31 ± 26.86
S.I. Wt / M.S., g	135.68 ± 14.06	139.33 ± 16.29	145.64 ± 17.40
Cec.[4] Wt / M.S., g	22.83 ± 1.26	20.65 ± 3.16	22.59 ± 2.57
S.I. Wt/length of S.I.(g/cm)	0.317 ± 0.039	0.324 ± 0.044	0.323± 0.037

1. S.D.; Standard deviation
2. S.I.; Small intestine
3. M.S.; Metabolic size ($W_{Kg}^{0.75}$)
4. Cec.; Cecum

Table 5. Overall Weight gain, feed intake, feed efficiency and mortality of broiler chickens (Expt 2.)

Treatments		Weight gain (g)	Feed intake (g)	Feed efficiency	Mortality(%) (male+ female)
Control	Male	1644.7	3144.0	1.912	3.33 (1/30+1/30)
	Female	1382.9	2828.4	2.045	
	Average	1513.8	2986.2	1.979	
Antibiotic A	Male	1565.5	3059.2	1.955	11.67 (4/30+3/30)
	Female	1392.6	2780.1	1.996	
	Average	1479.1	2919.7	1.976	
Antibiotic B	Male	1648.5	3169.6	1.923	5.0 (2/30+1/30)
	Female	1412.1	2841.2	2.012	
	Average	1530.3	3005.4	1.968	
SEM[1]	Male	21.45	60.62	0.040	0.55
	Female	21.76	47.93	0.013	

1. SEM: Standard error of means

Table 6. Nutrients availability of experimental diets (Expt 2.)

Nutrients Treatments	Dry Matter(%)	Crude Protein(%)	Crude Fat(%)	Crude fiber(%)	NFE(%)
Control	73.85	56.23	82.03	22.75	98.95
Antibiotic A	71.8	50.95	86.6	17.88	89.15
Antibiotic B	75.85	58.3	78.85	23.03	90.75
SEM[1]	2.87	5.291	2.850	5.6298	1.075

1. SEM: Standard error of means

Table 7. Length and weight of small intestine and cecum weight per metabolic size and weight of small intestine per unit length(Expt 2.)

Item	Control Mean± S.D.[1]	Antibiotic A Mean± S.D.	Antibiotic B Mean± S.D.
S.I.[2] length/M.S[3]., cm	3061.01 ±37.67	328.82 ±8.98	332.54 ± 16.38
S.I. Wt/M.S., g	78.84 ± 6.12	78.82 ±7.50	84.03 ± 11.39
Cec[4]. Wt/ M.S., g	9.04 ± 1.59	6.91 ±1.04	7.81 ± 1.74
S.I. Wt/length of S.I.(g/cm)	0.23 ± 1.04	0.24 ±0.03	0.25 ± 0.02

1. S.D. ; Standard deviation
2. S.I. ; Small intestine
3. M.S.; Metabolic size($W_{Kg}^{0.75}$)
4. Cec. ; Cecum

not reveal any particular structural differences between intestinal samples of different treatments.

Ⅳ. Discussion

According to the report of A.E.C.(1975), supplementation of Virginiamycin (10 ppm) or Spiramycin (7 ppm) in the broiler diet improved growth rate by 2% and 3% respectively and feed efficiency by 3% in both. A.E.C. (1984) also reported that Spiramycin supplementation at the level of 5-20 ppm in the broiler diet improves weight gain and feed efficiency. The results of present experiments show that both antibiotics, Spiramycin and Virginiamycin, at the level of 5 ppm did not significantly improve weight gain or feed efficiency. However, Antibiotic B treatment improved weight gain and feed efficiency by about 3% in the first experiment and to a less extent in the second experiment. Especially, Antibiotic B treatment showed significantly better utilization of fat in Expt. 1 in which 5% of animal fat was used. The availabilities of dry matter and crude protein in Antibiotic B treatment were higher than other treatment in both experiments although there were no statistical significance. These may partly explain the responses in weight gain and feed efficiency. The weight of small intestine of the birds fed diets of Antibiotic B treatment tended to be heavier than those of other treatments. This result contradicts to the report(Istifanus et al. 1985.) that the weights of small intestine of 3 week old broiler ckickens, which were fed on diets supplemented with various antibiotics, were lighter than those of non-supplemented control.

It is presumed that the response of supplementation of antibiotics used in the present experiments might have been enhanced if the level of supplementation was more than 5ppm and if birds were grown on the floor.

V. Summary

Two experiments were undertaken to study the growth promoting effect of Spiramycin and Virginiamycin at the level of 5ppm each. In the first experiment, 180 day-old male broiler chickens(Maniker parent stock) were divided into 18 groups of 10 birds each. Six groups were placed on one of the three experimental diets(Nonmedicated control, Spiramycin supplemented diet and Virginiamycin supplemented diet).
Basal diet of Experiment 1 contained 21.9% crude protein and 3159kcal/kg diet. Second experiment employed same treatments as were used in the Experiment 1. Ninety male and 90 female day-old broiler chickens(Maniker commercial) were grouped by 10 birds of same sex in each and assigned to 3×2 factorial design. Basal diet of Experiment 2 contained 19.95% crude protein and 2931 kcal/kg diet. Chicks were fed for six weeks in battery with raised floor and kept further for metabolic trials.

The results of feeding trials showed that there were no statistically significant differences between treatments in weight gain, feed intake, feed efficiency and mortality. However, birds fed Antibiotic B supplemented diet grew approximately 3% more than the control in Experiment 1 and than those fed Antibiotic A supplemented diet in Experiment 2. Feed efficiency was also improved by supplementing Antibiotic B in both experiments. There were significant($P<0.01$) differences between sexes in growth rate, feed intake and feed efficiency. Birds fed Antibiotic B supplemented diet of Experiment 1 showed significantly ($P<0.01$) greater availability for crude fat than those fed other diets. Birds fed Antiobiotic A supplemented diet in Experiment 1 showed significantly($P<0.05$) lower availability of crude fiber than those of other treatments. Weight of small intestine of birds fed Antibiotic B tended to be heavier than those fed other diets.

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