# THE EFFECT OF ANTIBIOTICS ON SEMEN PRODUCTION

by

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# THE EFFECT OF ANTIBIOTICS ON SEMEN PRODUCTION

## INTRODUCTION

The discovery that antibiotics increased the growth rate of livestock developed much interest in the use of antibiotics in diets. Many reports showed a favorable effect of antibiotics on the growth of experimental animals. These reports indicated that the addition of a small amount of antibiotic to the ration can increase the growth rate of livestock, especially if the ration has a suboptimal amount of some essential nutrients, particularly vitamins of the B-complex. The antibacterial agents may exert their growth promoting action by altering the intestinal flora, particularly the coli-form group. Some reports indicated that antibiotics can be fed continuously with safety to beef cattle during the growing and fattening periods, and that often such a supplement will prove profitable by increasing weight gain and efficiency of feed utilization. The use of antibiotics in animal feeds has become widespread for all classes of livestock, but mostly for feeding growing rather than mature animals. This implies that antibiotics are used less during the reproductive cycle than during the growth period. Use has been for a short term growth period, and thus lifetime and successive generation

effects are usually avoided.

Experimental data on the effects on reproduction are rather limited. Certain pilot studies have been conducted with laboratory animals such as the rat and guinea pig. The effect of antibiotics on reproduction of the male, and particularly on semen production has had little study.

The objective of this study was to determine the effect of antibiotics on the quantity and quality of semen production in the rabbit, particularly the effect of high doses of antibiotics used in veterinary practice in combating disease. Therapeutics doses of antibiotics (terramycin, penicillin, and streptomycin) were injected into rabbits for a three week period. Semen was collected by artificial vagina once a week to study the volume, motility, per cent alive, morphology, and the concentration of spermatozoa; and the time of storage in the refrigerator (about 40-44°F) until loss of motility. The body temperature, body weight and general condition of the rabbits were also followed. The daily dosage of the antibiotics was about three times the dosage ordinarily recommended (Hung et al., 4, p.612) for inclusion in the diet to increase rate of gain. As the antibiotics were given intramuscularly, no alimentary destruction or failure of absorption ensued, and it is estimated that the dosage levels used intramuscularly would be equivalent

to about 10 times the amount of antibiotic given in feed. The study has an important bearing on the question frequently raised whether infertility following antibiotics is due to the administration of antibiotics, or is the effect of the disease requiring treatment.

# REVIEW OF LITERATURE

No papers have been found in the literature directly bearing on the effects of antibiotics on semen production by the rabbit. A few papers, however, do yield some information on aspects of reproduction in the male. Thus, Carpenter and Larson (1, p.812) fed 20 milligrams of aureomycin as an antibiotic-vitamin $B_{12}$ supplement per pound of a plant and animal protein ration to gilts from weaning to 200 pounds and then 10 milligrams through two gestation and lactation periods. The antibiotic had neither a harmful nor a beneficial effect on reproductive performance of the sows. DePape, Burkit and Flower (3, p.77) studied the effect of the addition of 0.5 per cent APF supplement to the ration of brood sows during pre-breeding, gestation, and lactation. Although the data of the first year were in favor of the sows fed aureomycin, the second year the findings were reversed. The authors concluded that the addition of antibiotic yielded no significant improvement in the number of pigs farrowed, number farrowed alive, average birth weight and number of pigs weaned per sow.

Catron (2, pp.34-41) fed 20 milligrams of crystalline aureomycin hydrochloride per pound of ration to a group of 20 sows during pre-breeding, gestation and lactation. The sows fed aureomycin farrowed nearly one more pig per

litter and weaned 84 per cent of those farrowed alive compared to 59 per cent weaned by the control sows. There was little difference in birth or weaning weights of the pigs in spite of the fact that the pigs had access to their dams' ration. The average conception rate of the control sows was 79 per cent and of the sows fed aureomycin 87 per cent. Although each figure quoted slightly favored the antibiotic, the differences were not statistically significant, and Catron concluded that the feeding of antibiotics had neither a detrimental nor beneficial effect upon the per cent conception, number of live pigs farrowed per litter, birth weight of the pigs or weaning weight. He thought that any effect of feeding antibiotics to sows during gestation and lactation would depend upon the disease level of the environment and upon the nutritional adequacy of the ration.

Rusoff et al. (10, p.774) studied the effect of aureomycin, in ten mature bulls with low and moderate levels of fertility, by adding an aureomycin supplement to the ration (level in the grain mixture equivalent to intake of approximately 300 milligrams aureomycin daily per animal). A reversal type experiment was run, each period being of ten weeks duration. The number of ejaculates, volume per ejaculation, sperm per millimeter, sperm per ejaculation and non return rate showed no

significant differences between treatments. There was no evidence of alteration from the feeding of aureomycin to the bulls.

Sciortino (11, p.1616) studied the action of antibiotics on spermatogenesis. Only very slight histological changes were observed in the testicular tissue of 4 rabbits treated with 3,600,000-7,690,000 units of penicillin.

Uram et al. (12, p.481) found that when groups of 10 males and 30 female weanling rats were fed one of three diets: basal, basal plus 0.04 per cent terramycin, or basal plus 0.04 per cent streptomycin, if the rats were bred at 4 months of age and again one month after weaning their young, there was no significant difference in reproductive ability between the groups of rats fed the three diets.

Thus the literature provides little evidence directly or indirectly of an effect of antibiotics on semen production in the rabbit.

## EXPERIMENTAL PROCEDURE

It was the purpose of this experiment to study the effect of intramuscular injection of antibiotics at therapeutic doses on the semen production in the rabbit. The properties of the semen to be studied were the volume per ejaculation, motility, per cent alive, and morphology of the spermatozoa, the concentration of the semen and survival time during storage of the semen. Rectal temperature and body weight were also followed.

Experimental Animals, Feeding and Management. Twelve New Zealand White male rabbits were randomly separated into 4 groups of 3 rabbits each. The first three groups were treated with antibiotics (terramycin, penicillin and streptomycin) and the fourth group was a control. All animals were fed a ration consisting of commercial rabbit pellets. Feed and water were given once a day in the morning in an adequate quantity. Each rabbit was kept in a separate wire cage.

Semen was collected by the artificial vagina once a week for two month control period. The antibiotics were then injected intramuscularly into each rabbit daily in the morning as follows for three weeks:

Group I. Terramycin, 2 milligrams in aqueous solution per kg of body weight

Group II. Penicillin, 4,000 units in aqueous solution per kg of body weight

Group III. Streptomycin, 40 milligrams in aqueous solution per kg of body weight

Group IV. Control group, no antibiotic

During the treatment the semen samples were taken once a week to study the change in properties. The study was continued for five weeks subsequent to antibiotics treatment. The injections were started June 1, 1957.

Collection of Semen. The semen was collected from each rabbit once a week in the morning by an artificial vagina, as described by Lambert and McKenzie (6, p.55). The height of the semen was measured in millimeters in calibrated vials and the volume calculated. General appearance such as the color, viscosity and opacity of the semen were also followed.

Concentration of Spermatozoa. A Spencer hemocytometer was used to determine the concentration of spermatozoa. Semen was diluted in the ratio 1:200 with a mixture composed of 1 part of 2% eosin (eosin B) and 50 parts of 2% NaCl. After the diluted semen had been introduced into the counting chamber, the cells within the boundaries of five blocks of sixteen squares each were counted, and the sum of these counts multiplied by 10,000 to give the

number of spermatozoa per cubic millimeter.

Spermatozoan Motility. Immediately after the collection the semen was transferred to the processing laboratory. After the volume of the semen and general appearance were recorded, the undiluted semen was examined to determine the motility. Drops of semen were placed on a cover glass and the cover glass inverted over a clean slide, and the motility observation made at about 102°F on a warming stage. The observed motility was designated as 0 to 10 inclusive, 10 denoting maximum motility. A system of classifying motility for this purpose is as follows (Wu, Elliker and McKenzie, 14, p.21; Perry et al., 9, pp.72-73):

| Motility rating | (observed under 430 X magnification) |
|---|---|
| 10 | Most spermatozoa are very active, motile and progressive |
| 9 | Most spermatozoa are active, motile and progressive |
| 8 | Many spermatozoa are active, motile and progressive |
| 7 | Many spermatozoa are motile and slowly progressive |
| 6 | Some spermatozoa are motile but only slowly progressive |
| 5 | Some spermatozoa are motile but only weakly progressive |
| 4 | Many spermatozoa are motile but have only oscillatory motion |

| | |
|---|---|
| 3 | Some spermatozoa have oscillatory motion |
| 2 | Only a few spermatozoa with very weak oscillatory motion |
| 1 | Only 1 or 2 spermatozoa with very weak oscillatory motion |
| 0 | No motile spermatozoa can be found |

Percentage of Live Spermatozoa. The percentage of live spermatozoa was determined from smears stained with fast green eosin (Mayer, Squiers, Bogart and Oloufa, 8, pp.231-232). A spermatozoan county of 300 was made under the high objective of the microscope. Spermatozoa which absorbed the dye, deep purplish red in color, were classified as dead while those not staining or partially stained, as living.

Percentage of Abnormal Spermatozoa. The percentage of abnormal spermatozoa was determined by counting the number of abnormal cells present in a total of 300 spermatozoa on the slide previously stained with the fast green eosin. Spermatozoa without tails, with broken or looped tails, headless, abnormally large headed, small headed or two headed spermatozoa, or spermatozoa having a pyriform (pear shaped) head, and those with enlarged middle pieces were considered as abnormal.

Survival Time During Storage. The semen samples for each collection were diluted with four volumes of heated

homogenized milk as an extender (Thacker and Almquist, 13, p.174), and were stored in the refrigerator at 40-44°F. Each sample was rated for motility at 48 hour intervals until motility was zero. Thus a time limit of useful storage was established.

Body Weight, General Condition and Rectal Temperature. The initial weight of each rabbit was taken on the first day of the experiment and then once a week during and after treatment with antibiotics. General condition, appetite and sex drive were observed before, during and after treatment. The rectal temperature was obtained before and about one and one-half hours after each injection. During the first week after cessation of antibiotics treatment, the rectal temperature was checked once a day in the morning.

## EXPERIMENTAL FINDINGS

For clarity and convenience, the observations will be presented as follows: semen volume, initial motility, sperm concentration, percentage of live spermatozoa in fresh semen, percentage of abnormal spermatozoa, survival time during storage, body weight, general condition and rectal temperature.

Semen Volume. Average values (calculated from three rabbits) of volume of semen per ejaculation varied from 0.86 to 1.33 ml. between the four groups during the control period, and from 0.46 to 1.23 over 16 weeks for the control group (IV) (see Table 1). Evidence of an alteration in semen volume by terramycin, penicillin and streptomycin was not obtained.

Sperm Concentration. Average values for the concentration of spermatozoa in semen varied from 539 to 684 millions per ml. over the four groups during the two month control period and from 283 to 886 millions per ml. in untreated group IV over a 16 week period. There is a possibility that the antibiotics may, at some phase or phases during and after the administration of the antibiotics, increase the concentration of spermatozoa. Thus 5 out of 24 (three groups by eight weeks) average values for semen concentration lay above the range of 283 to 886

Table 1. Semen Volume (in ml.)

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 1.33 | 0.86 | 1.01 | 0.99 |
| During Treatment | | | | |
| 1st week | 1.50 | 1.00 | 1.30 | 0.83 |
| 2nd week | 0.67 | 0.56 | 0.66 | 0.73 |
| 3rd week | 1.27 | 0.90 | 0.90 | 1.13 |
| Average | 1.14 | 0.82 | 0.95 | 0.89 |
| After Treatment | | | | |
| 1st week | 1.26 | 0.90 | 0.93 | 0.96 |
| 2nd week | 1.56 | 1.03 | 0.63 | 0.46 |
| 3rd week | 1.26 | 0.33 | 0.90 | 0.76 |
| 4th week | 1.00 | 0.83 | 0.73 | 0.93 |
| 5th week | 1.64 | 0.83 | 1.16 | 1.23 |
| Average | 1.35 | 0.78 | 0.87 | 0.87 |

Table 2. Sperm Concentration (millions per ml.)

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 559 | 632 | 684 | 604 |
| During Treatment | | | | |
| 1st week | 550 | 950 | 516 | 590 |
| 2nd week | 870 | 803 | 860 | 580 |
| 3rd week | 250 | 860 | 473 | 283 |
| Average | 557 | 871 | 617 | 484 |
| After Treatment | | | | |
| 1st week | 137 | 793 | 687 | 453 |
| 2nd week | 377 | 643 | 1217 | 887 |
| 3rd week | 850 | 1027 | 937 | 810 |
| 4th week | 553 | 583 | 703 | 887 |
| 5th week | 1020 | 823 | 560 | 577 |
| Average | 587 | 774 | 821 | 723 |

million per ml. (see Table 2). Unusually low values of semen concentration were irregularly obtained after terramycin, streptomycin, and in the control rabbits, but not after penicillin. A definite effect of the antibiotics on sperm concentration was not established. If there is an effect, it is variable from rabbit to rabbit and from time to time in the same rabbit, with both unusually high and unusually low values of spermatozoa concentration being obtained.

Total Number of Spermatozoa per Ejaculate. Average control values varied from 321 to 827 millions per ejaculate. It seems that prolonged administration of terramycin may lead to a reduction in the number of spermatozoa per ejaculate. Cessation of terramycin administration is followed by an increase, beyond the normal range, in the number per ejaculate. Effects of penicillin and streptomycin, if any, were evanescent (see Table 3).

Spermatozoan Motility. Average values of spermatozoan motility varied from group to group and from time to time in the control group (Table 4). Spermatozoan motility in semen, as collected, was somewhat higher during treatment in the group given antibiotics, particularly with terramycin and penicillin. Spermatozoan motility was higher after the cessation of treatment with

Table 3. Total Number of Spermatozoa Per Ejaculation (million)

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 746 | 548 | 693 | 600 |
| During Treatment | | | | |
| 1st week | 825 | 950 | 672 | 492 |
| 2nd week | 579 | 455 | 572 | 425 |
| 3rd week | 317 | 774 | 426 | 321 |
| Average | 574 | 726 | 557 | 413 |
| After Treatment | | | | |
| 1st week | 173 | 714 | 641 | 438 |
| 2nd week | 590 | 665 | 770 | 413 |
| 3rd week | 1076 | 342 | 843 | 623 |
| 4th week | 553 | 486 | 516 | 827 |
| 5th week | 1699 | 686 | 653 | 711 |
| Average | 818 | 576 | 685 | 602 |

Table 4. Initial Motility (0 to 10)

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 6.8 | 7.1 | 7.3 | 7.4 |
| During Treatment | | | | |
| 1st week | 7.7 | 8.0 | 6.7 | 6.7 |
| 2nd week | 7.3 | 8.3 | 8.7 | 7.3 |
| 3rd week | 7.0 | 7.7 | 7.7 | 6.7 |
| Average | 7.3 | 8.0 | 7.7 | 6.9 |
| After Treatment | | | | |
| 1st week | 7.3 | 8.0 | 7.0 | 7.3 |
| 2nd week | 6.0 | 8.0 | 8.7 | 8.7 |
| 3rd week | 9.0 | 8.0 | 9.0 | 7.7 |
| 4th week | 8.0 | 7.0 | 8.0 | 8.0 |
| 5th week | 9.0 | 8.3 | 7.7 | 8.0 |
| Average | 7.9 | 7.9 | 8.1 | 7.9 |

all three antibiotics than during antibiotics treatment. Motility, in general, was higher in samples after the antibiotics, than in the samples from the control rabbits.

Percentage of Live Sperm in Fresh Semen. There were no clear cut directions of change in percentages of live sperm in fresh semen in either treated or control groups (Table 5). Perhaps some increase in the percentage of live sperm may have developed during and after treatment with penicillin.

Percentage of Abnormal Sperm. The average percentage of abnormal sperm in fresh semen (Table 6) varied from 16 to 20 among the groups during the control period. In the control group the average percentage of abnormal sperm fluctuated from time to time and ranged between 9 and 20 per cent. No clear cut effects of the antibiotics on the percentage of abnormal sperm was established, although terramycin may have reduced the percentage of abnormal spermatozoa.

Sperm Survival Time During Storage. The time limit for successful storage of semen samples was determined by the examination of motility of the spermatozoa in diluted semen. The limit was not altered significantly by terramycin, penicillin and streptomycin administration

Table 5. Percentage of Live Sperm in Fresh Semen

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 89 | 84 | 88 | 88 |
| During Treatment | | | | |
| 1st week | 86 | 94 | 91 | 89 |
| 2nd week | 92 | 95 | 92 | 91 |
| 3rd week | 87 | 94 | 94 | 92 |
| Average | 88 | 94 | 92 | 91 |
| After Treatment | | | | |
| 1st week | 92 | 95 | 90 | 84 |
| 2nd week | 82 | 90 | 95 | 91 |
| 3rd week | 93 | 91 | 96 | 86 |
| 4th week | 91 | 93 | 86 | 93 |
| 5th week | 90 | 95 | 92 | 88 |
| Average | 90 | 93 | 92 | 88 |

Table 6. Percentage of Abnormal Sperm

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 16 | 16 | 18 | 20 |
| During Treatment | | | | |
| 1st week | 8 | 12 | 8 | 11 |
| 2nd week | 15 | 20 | 11 | 13 |
| 3rd week | 14 | 18 | 13 | 9 |
| Average | 12 | 17 | 11 | 11 |
| After Treatment | | | | |
| 1st week | 6 | 11 | 21 | 10 |
| 2nd week | 25 | 13 | 4 | 14 |
| 3rd week | 11 | 16 | 10 | 10 |
| 4th week | 11 | 10 | 18 | 8 |
| 5th week | 15 | 10 | 10 | 16 |
| Average | 14 | 12 | 13 | 12 |

(Table 7). Data from both control and treated rabbits showed an unexpected, unexplained, and rough parallel increase in magnitude with time.

Table 7. Survival Time During Storage (Days)

| Collection | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | | | | |
| Average | 10.1 | 12.9 | 12.6 | 12.6 |
| During Treatment | | | | |
| 1st week | 12.0 | 12.0 | 12.0 | 11.3 |
| 2nd week | 13.3 | 13.3 | 16.0 | 17.3 |
| 3rd week | 11.3 | 12.0 | 10.7 | 12.0 |
| Average | 12.2 | 12.4 | 12.9 | 13.6 |
| After Treatment | | | | |
| 1st week | 17.3 | 19.3 | 18.0 | 13.3 |
| 2nd week | 12.0 | 17.3 | 17.3 | 18.0 |
| 3rd week | 16.7 | 14.7 | 16.7 | 16.0 |
| 4th week | 14.0 | 13.3 | 14.0 | 14.7 |
| 5th week | 10.7 | 13.3 | 11.3 | 12.0 |
| Average | 14.1 | 15.6 | 15.5 | 14.8 |

Body Temperature. The body temperature of rabbits was checked once a day in the morning for one week before the treatment and three weeks after treatment. During the treatment period it was checked twice a day, once before injection and once about one and one-half hours after the injection. The body temperature did not change noticeably with the administration of the antibiotics (see Table 8).

Table 8. Body Temperature (°F)

| Time | Group I Terramycin | | Group II Penicillin | | Group III Streptomycin | | Group IV Control | | Room Temp. |
|---|---|---|---|---|---|---|---|---|---|
| | Before Injection | After Injection | Before Injection | After Injection | Before Injection | After Injection | Before Injection | After Injection | |
| Before Treatment | | | | | | | | | |
| Average | 102.8 | - | 102.6 | - | 102.7 | - | 102.6 | - | 64.6 |
| During Treatment | | | | | | | | | |
| 1 week | 103.0 | 102.7 | 102.7 | 102.6 | 103.0 | 103.0 | 102.8 | - | 67.3 |
| 2 week | 102.7 | 102.6 | 102.5 | 102.3 | 102.7 | 102.7 | 102.6 | 102.5 | 72.1 |
| 3 week | 102.6 | 102.5 | 102.5 | 102.4 | 102.6 | 102.5 | 102.5 | 102.6 | 72.9 |
| Average | 102.8 | 102.6 | 102.6 | 102.5 | 102.8 | 102.7 | 102.6 | 102.5 | 70.8 |
| After Treatment | | | | | | | | | |
| 1 week | 102.7 | - | 102.4 | - | 102.8 | - | 102.6 | - | 76.2 |
| 2 week | 102.8 | - | 102.6 | - | 102.6 | - | 102.6 | - | 75.8 |
| 3 week | 102.8 | - | 102.7 | - | 102.9 | - | 102.7 | - | 77.4 |
| Average | 102.8 | - | 102.6 | - | 102.8 | - | 102.6 | - | 76.8 |

Body Weight and General Condition. The average daily gains in weight for rabbits in treated and control groups are presented in Table 9. The rabbits in the control group yielded a gain in weight, increasing from 3,914 to 4,267 grams while the terramycin and streptomycin treated rabbits gained from 4,102 to 4,273 and from 3,686 to 4,006 grams respectively. The penicillin treated rabbits showed little change in weight (3,881 grams at the beginning and 3,863 grams at the end of the experiment). Thus penicillin definitely interfered with gain in weight of the adult rabbits, while terramycin and streptomycin had little or no effect on gain in body weight.

Rabbits from the terramycin group produced a dark yellow urine during treatment and during the first two weeks after treatment. They had some soft scybala (but not as soft as the rabbits under streptomycin) and a long rough haircoat. Under terramycin treatment the sex drive of the rabbits was reduced. The sex drive began to decrease on the last week of injection. The semen collections were more difficult than before and the semen appeared watery rather than milky. The semen concentration decreased at this time.

Rabbits receiving penicillin showed a marked depression in appetite and some loss in body weight. They

Table 9. Body Weight (grams)

| Time | Group I Terramycin | Group II Penicillin | Group III Streptomycin | Group IV Control |
|---|---|---|---|---|
| Before Treatment | 4102 | 3881 | 3686 | 3914 |
| During Treatment | | | | |
| 1 week | 4208 | 3880 | 3666 | 3976 |
| 2 weeks | 4154 | 3882 | 3654 | 3922 |
| 3 weeks | 4301 | 3788 | 3714 | 4083 |
| After Treatment | | | | |
| 1 week | 4325 | 3883 | 3803 | 4124 |
| 2 weeks | 4263 | 3897 | 3813 | 4076 |
| 3 weeks | 4263 | 3823 | 3834 | 4092 |
| 4 weeks | 4324 | 3861 | 3934 | 4198 |
| 5 weeks | 4273 | 3863 | 4006 | 4267 |
| Total Gain in Weight | 170 | -17 | 319 | 353 |
| Daily Gain (grams/day) | 3.05 | -0.32 | 5.71 | 6.30 |

appeared quiet all the time. They did not eat or drink but were asleep most of the time. The urine, scybala and sex drive were normal as compared with the controls. Semen concentration possibly may have increased but there was no change in other characteristics.

Rabbits receiving streptomycin gained in body weight as rapidly as control rabbits but they showed a marked change in the general condition and appearance. These rabbits developed a long rough haircoat and very loose feces, similar to scouring, during and after the treatment. The urine was dark pink or red in color during the

treatment period and immediately after treatment. The appetites were normal. The sex drive of one buck was reduced subsequent to the injections. This buck did not want to mount the doe at the time of the semen collection and the semen appeared watery. There was a little reduction in sex drive of the other two bucks and they regularly yielded normal semen. The effect on sex drive of streptomycin was less than that of terramycin. Of the three antibiotics, penicillin has the least effect on semen production while growth, as expressed in body weight, was retarded.

# DISCUSSION

The variation in semen production of rabbits in this experiment may be due to three main factors: (1) A possible effect of the antibiotics, (2) the physiological condition of the rabbits, and (3) the environment. Even when rabbits are healthy, some yield semen mixed with urine. This may occur at any time and there is no method of control. Such semen samples were discarded routinely. The rapidly changing temperature and light periods of late spring and early summer are possibly responsible for some of the variations noted in semen characteristics.

In the experiments here reported, the antibiotics produced no increase in rate of gain, and penicillin led to a decrease in rate of gain. The failure of an increase is consistent with other observations recorded in the literature. Thus Hung et al. (4, p.612) found that when terramycin or aureomycin was fed at the level ordinarily recommended for other species (33 parts per million of terramycin), no change in rate of growth was found for young rabbits fed a pelleted natural ration. Terramycin did not improve growth when the diet contained 0.5 per cent sulfathalidine. Terramycin was also ineffective in improving the rate of growth of rabbits which received a semi-purified ration containing 25 per cent casein or

24.7 per cent protein, plus 0.5 per cent methionine. Purified rations consisting either of 10 per cent casein plus niacin or 20 per cent casein without niacin were observed to be inadequate for the growth of rabbits. Nevertheless, terramycin did not improve these rations. Lawrence and McGinnis (7, p.164) found that the feeding of graded levels of terramycin (1, 3, 10 and 50 parts per million of basal ration) to weaning rabbits failed to show any effect of the antibiotic on the bodyweight gains during a 6 week experimental period.

Lassiter (5, p.1132) stated in his review article on antibiotics as growth stimulants that the feeding of antibiotics to mature animals has no beneficial effects on the growth of animals. The rabbits used in the study here recorded had attained adult weights before the start of the experiment.

# SUMMARY AND CONCLUSIONS

Twelve New Zealand male rabbits about 5 months old were used to study the effect of antibiotics on semen production. They were divided randomly and equally into 4 groups. Group IV served as a control and groups I, II and III were injected daily intramuscularly with therapeutic doses of terramycin, penicillin and streptomycin (2 milligrams of terramycin, 4,000 units of procaine penicillin and 40 milligrams of streptomycin in aqueous solution per kilogram of body weight daily respectively) for 3 weeks.

Semen collections and weights of rabbits were taken every seven days during the 3 weeks of treatment and for 5 weeks after the treatment. The semen was examined for volume, motility, concentration, percentage of live sperm, percentage of normal sperm and survival time during storage. Terramycin possibly caused irregular and somewhat unrelated increases in semen volume, decreases and increases in semen concentration and decreases and increases in the total number of spermatozoa per ejaculate. None of the antibiotics caused a definite change in the semen volume, percentage of live sperm, or percentage of abnormal sperm. If any possible beneficial or harmful effect was induced by these antibiotics,

it disappeared very rapidly and caused little permanent change in the average semen production. Antibiotics did not alter significantly the survival time of spermatozoa in stored rabbit semen. The antibiotics caused no change in body temperature. Rabbits of the control group gained the most in body weight, followed by rabbits in streptomycin and terramycin groups, while rabbits in the penicillin group showed no significant change in body weight.

Terramycin and streptomycin reduced sex drive of rabbits. This effect occurred during the last week of injections and the first part of the post injection period, and then disappeared a week later. Rabbits under terramycin showed a decrease in concentration and total number of spermatozoa per ejaculate during this time. Rabbits under streptomycin showed some decrease but rabbits under penicillin showed no change in sex drive.

Streptomycin caused the feces to become soft and the haircoat to become long and rough. The urine was changed from yellow or white to red or dark pink during the last weeks of treatment and in the week following cessation of treatment respectively. No disturbances of appetite under streptomycin were observed even when the rabbits had soft feces. Gain in body weight was similar to that of the control group. Rabbits in the terramycin group had urine with a dark yellow color and the feces were

soft. The appetite was slightly depressed and sex drive was reduced. Rabbits in penicillin group showed a marked depression of appetite and did not gain in body weight.

Table 10. The Effect of Antibiotics on Semen Production

| Group | Collection | Average | | | | | |
|---|---|---|---|---|---|---|---|
| | | Volume ml | Motility 0-10 | % Alive | % Abnormal | Conc./cmm thousands | Total No. millions |
| I. Terramycin (2 mg/kg body weight daily I.M.-21 days | Before Treat. | 1.33 | 6.83 | 89 | 16 | 559 | 746 |
| | During Treat. | 1.14 | 7.32 | 88 | 12 | 557 | 635 |
| | After Treat. | 1.35 | 7.86 | 89 | 13 | 587 | 795 |
| II. Penicillin (4,000 units/kg body weight daily I.M.-21 days | Before Treat. | 0.86 | 7.07 | 84 | 16 | 632 | 548 |
| | During Treat. | 0.82 | 7.99 | 94 | 17 | 871 | 714 |
| | After Treat. | 0.78 | 7.86 | 93 | 12 | 774 | 608 |
| III. Streptomycin (40 mg/kg body weight daily I.M.-21 days | Before Treat. | 1.01 | 7.26 | 87 | 18 | 684 | 693 |
| | During Treat. | 0.95 | 7.65 | 92 | 11 | 617 | 586 |
| | After Treat. | 0.87 | 8.06 | 92 | 13 | 819 | 715 |
| IV. Control | Before Treat. | 0.99 | 7.37 | 88 | 19 | 604 | 600 |
| | During Treat. | 0.90 | 6.88 | 91 | 11 | 484 | 436 |
| | After Treat. | 0.87 | 7.93 | 88 | 12 | 723 | 631 |

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