THE EFFECT OF RESERPINE ON CHICKEN MALES ON RANGE

By

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MALES ON RANGE

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INTRODUCTION

Tranquilizers have been used for many years in human medicine but have only recently been introduced into the poultry and animal sciences.

Reserpine, one of the better known tranquilizers, has been predicted by some workers to be of value in reducing mortality, in increasing feed efficiency, growth and egg production and in reducing injury when birds are handled. To this date no information is available as to the effect of reserpine on range males.

In poultry management practice, it is generally the procedure to separate young breeding males from the females during the advanced growing period. Because of the fighting and cannibalistic tendencies, mortality and morbidity are serious factors during this period. The less aggressive males are forced away from the feeders and may ultimately be beaten down and killed by the more aggressive males. This results in a considerable loss in money as well as loss in genetic progress.

The present study was conducted in order to obtain basic information as to the effect of reserpine on mortality, growth, and feed efficiency of segregated males. This study was also conducted in order to determine the satisfactory level at which reserpine may be administered to these males.

REVIEW OF LITERATURE

For hundreds of years medicine men of India advocated the use of the root of Rauwolfia serpentina in the form of ground roots or as a tea. It was used as an anti-hypertensive drug, for high blood pressure and as a sedative agent. It has also been used in the treatment of such conditions as snake and insect bites, diarrhea, dysentery, and insanity.

Schlittler et al. (1954) reported that in 1582 Lenard Rauwolf, a German physician and botanist, published the results of his investigations made on medicinal plants while on an expedition to Asia and Africa. He had learned of these plants from writings by the early Greek and Arab physicians.

Several years after the investigation, a new genus was added to the plant family Apocynaceae and was called Rauwolfia in honor of Rauwolf.

After Rauwolf's study in 1582, little or no investigations were made until the Indian chemists, Siddiqui and Siddiqui (1931), isolated the first crystalline alkaloid. Since that time many have worked in this field, until today some fourteen substances have been isolated.

Mueller et al. (1952) were the first to identify reserpine, which has become the most important Rauwolfia alkaloid. Reserpine is a colorless, crystalline substance with a melting point of 262° to 265° C. This alkaloid is insoluble in water

but is readily soluble in acid solutions such as acetic acid, ascorbic acid, and citric acid. It is also soluble in a 1:1:2 mixture of ethyl alcohol, propylene glycol and water.

The Pharmacology of Reserpine

Reserpine has become the most important alkaloid of Rauwolfia. Because of its unusual pharmacological effects, reserpine cannot be classified with any of the classic groups of drugs. Schneider (1957) stated that it may be listed under hypotensive agents, central nervous depressants or sedatives; but none of these describes adequately its type of drug action. Probably the best way to classify it is to call it a phrenotropic--a drug which influences the function of the mind and its effective behavior.

General Behavior

Schneider (1957) reported that animals first began to show the effects of reserpine ten to twenty minutes after oral or intravenous administration. The general effects were slight excitement, hyperpena and shivering. Bein (1953) was the first to show that a pronounced myosis was one of the earlier signs of reserpine activity, accompanied by a relaxation of the nictitating membrane. These signs were among the last to disappear.

Plummer et al. (1954) reported that there was a latent period of from one to two hours after oral or intravenous administration of reserpine before animals became tranquilized.

Provided sub-toxic doses were given, animals were capable of normal reaction, normal feed intake, and could be aroused at any time by various types of external stimuli.

Six to eight hours after the administration of small non-toxic doses of reserpine, animals began to show signs of recovery and were generally completely recovered in twenty-four to seventy-two hours.

Effects on Body Temperature

In general, reserpine produces a drop in body temperature after oral or intravenous administration.

Schneider (1957) reported that the magnitude of the drop in body temperature was dependent upon the dose of reserpine given. Lessin and Parkes (1957) reported that in mice no hypothermia occurred if the room temperature were maintained near the doby temperature of the mouse. When mice were moved to a room temperature of approximately 32° C. for periods up to four hours, there was a drop in body temperature. Earl (1956) stated that the hypothermic effects of reserpine can be prevented by the raising of the environmental temperature to near normal body temperature. Lessin and Parkes (1957) concluded that no hypothermia occurred in mice at an ambient temperature of 38° C. They also reported that no signs of sedation were seen in mice when they were kept under these conditions. This indicated that reserpine in some way interfered with the temperature regulating mechanism of animals. Plummer et al.(1954) agreed that hypothermia did not occur when the

room temperature was maintained at near body temperature. They reported that in monkeys maintained in an environmental temperature of 74° F., hypothermia did occur, but it did not occur when the room temperature was raised to 89° F.

Cardiovascular Effects

Bein (1956) stated that, in general, single doses of reserpine administered either orally or intravenously caused a drop in blood pressure of most animals. Plummer et al. (1954) reported that reserpine caused a slowly-developing drop in mean arterial blood pressure of twenty to thirty millimeters of mercury in dogs upon administration of single intravenous doses of three hundred to five hundred micrograms per kilogram of body weight. They also reported that dogs and monkeys given minimum effective oral dosages for several months did not show a significant alteration of their blood pressure from pre-existing normotensive levels. He suggested that compensatory pressor reflexes were sufficient to prevent a drop below the normotensive level.

Browder et al. (1958) concluded that in cats reserpine caused an initial decrease in arterial blood pressure followed by a gradual rise of twenty to one hundred millimeters of mercury above the control level. They also suggested that the rise may have been due to the release of pressor amines, notably epinephrine, norepinephrine and serotonin. Bein (1956) reported that the fall in blood pressure produced by reserpine was due to vasodilation and was not accompa-

nied by reduction in cardiac performance.

Effects on Central Nervous System

Yonkman (1956) indicated that reserpine had a strong potential to block central sympathetic emission of impulses from the region of the hypothalmus and upper medulla. Its central depressant effect was elicited in a manner apparently different from that produced by barbiturates and other cerebral sedatives.

Brodie et al. (1956), Deming et al. (1956), Shore et al. (1957) and Brodie et al. (1957) all agreed that the central action of reserpine is mediated through the release of serotonin from a bound form in the brain to a free form. Shore et al. (1957), in a lenghty discussion on the role of brain serotonin, stated that the amine had an asymmetric distribution. The highest concentrations were found in the brainstem, particularly in the hypothalamus; a lower concentration was noted in the cortex, with almost none in the cerebellum. It was in the hypothalamus, where serotonin levels were the highest, that reserpine was believed to have its central action. Shore et al. (1957) also stated that reserpine after administration rapidly entered the serotonin binding sites and then disappeared. Serotonin was then released and the unstable free form was metabolized by the action of monoamine oxidase. The serotonin that continued to be produced presented a persistently low concentration of free serotonin to the brain tissue. It was this free serotonin that was con-

sidered to exert the actions proclaimed for reserpine. These actions persisted until the binding sites had recovered or until new ones were found.

Metabolism and Excretion

Glazko et al. (1956) reported that after oral administration of reserpine it was readily hydrolyzed to methyl reserpate in the rat by enzymes found in the intestinal mucosa. After the reserpine was hydrolyzed to methyl reserpate, it was absorbed into the blood and excreted via the urine. This accounted for approximately sixty-five percent of the dose. They also stated that there was no significant degree of hydrolysis from the intestinal mucosa of the dog and monkey. Numerof et al. (1955) stated that reserpine, whether given orally or intravenously, was rapidly metabolized. From thirty to forty percent of the dose appeared in the urine as methyl reserpate within four hours. From these data it was evident that definite consideration must be given not only to the animal species used in reserpine experiments, but also to the route of administration of the drug.

Earl (1956) indicated that there were species differences in animals as to the response to reserpine. Dogs were easily tranquilized at dosages of 0.05 to 0.1 milligram per kilogram of body weight. Studies indicated that this drug was effective in the cat in about the same dosage ranges as for the dog. The horse seemed to be particularly sensitive to reserpine. The effective parenteral dosage was about 1.0

milligram per thousand pounds of body weight. Cattle appeared to be less sensitive to reserpine than the horse. The effective parenteral dosage in cattle was reported to be 7.0 to 7.5 milligrams per thousand pounds of body weight.

Reserpine in Avians

Very little information is available with respect to the use of reserpine in avians. To date, no articles have been published dealing with the effect of reserpine on male chickens.

Hewitt and Reynolds (1957) used reserpine to control cannibalism in the ring-necked pheasant (Phasianus colchicus). Reserpine was fed at levels of five milligrams and seven milligrams per kilogram of feed to young pheasants. It was found that reserpine reduced the incidence of cannibalism and feather picking. Also, the results indicated that reserpine reduced the feed consumption and improved the efficiency of feed utilization.

Carlson (1956), in work with growing turkeys, used two levels of reserpine, 0.5 and 1.0 milligram per kilogram of diet. He thought that reserpine at this level depressed growth and feed efficiency. It was believed that rations low in tryptophan, which is a precursor of serotonin, might have caused a depression in growth because of a deficiency of this amino acid.

Van Matre et al. (1957) reported that reserpine administered orally afforded protection against death from high

environmental temperatures, as well as protection from a decrease in egg production and shell quality in White Leghorns. Gilbreath et al. (In Press) stated that reserpine improved shell quality and shell thickness, but had no effect on albumen quality in White Leghorn hens.

Sturkie et al. (1958) stated that within four hours after intra-muscular injections of reserpine into capons and females, the drug effects were observed. The sedative or tranquilizing dose of reserpine was reported to be between 0.1 and 0.2 milligram per kilogram of body weight. Following a 0.2 milligram dose, birds remained in a standing position for a long period of time. They were reluctant to move, and when prodded responded mainly by squawking as though annoyed. Dosages of this size apparently caused relaxation of the feather follicles and increased the tendency toward molting or shedding of the feathers when the birds were handled. Sturkie et al. (1958) also reported that the general effect of reserpine was similar in birds and in mammals. The dosage required for tranquilization produced a significant depression in body temperature, heart rate, blood pressure, and was accompanied by a diarrhea. He cautioned that these changes over a long period of time may affect the health and productive performance of birds.

EXPERIMENTAL PROCEDURE

Four feeding trials were conducted in order to find satisfactory levels at which reserpine could be administered to segregated chicken males. It was felt necessary to determine the effect of reserpine on such economic factors as growth, feed efficiency, feed consumption and mortality. Because Trial I was conducted during the summer of 1957 and Trials II, III, and IV were conducted during the summer of 1958, it is necessary to discuss the procedures of each trial separately.

Trial I

Trial I was initiated as a pilot study in order to obtain fundamental knowledge concerning the actions of reserpine on range males. Three breeds were used as the experimental units in this trial. These units, Oklahoma Silver Bars, Single Comb White Leghorns, and Single Comb White Plymouth Rocks, were hatched from eggs laid by flocks maintained by Oklahoma State University. The experimental males were reared in confinement under comparable environmental conditions. They were fed a standard starter-grower ration recommended by Oklahoma State University. The composition of this ration is shown in Table I.

On June 25, 1957, when the males were approximately six-

teen weeks of age, sixty males from each breed were selected at random. Ten birds from each breed were then randomly selected to be placed in six ranges, which made a total of thirty males per range.

The ranges were located at the Perkins Turkey Farm of the Oklahoma Agricultural Experiment Station. Each range measured approximately fifty feet by two hundred feet. Each range was equipped with one small range shelter which measured ten and one-half feet by six feet and was three and one-half feet high at the eave. One four-foot feeder and one pan-type automatic range waterer were used. A metal shade three feet by six feet in dimensions and approximately thirty inches from the ground was used to protect the water from the heat of the sun. The grass and weeds were mowed periodically to maintain uniformity of shading conditions.

At the time the males were placed on range, three treatment levels were randomly alloted to the six ranges. The treatments were 0.0, 0.5, and 1.0 milligram of reserpine per kilogram of diet. The composition of the ration used is shown in Table II. This ration served as the basal diet, with the only difference being in the levels of reserpine mixed with the feed. The males were provided feed and water ad libitum.

Body weights of the males were obtained every fourteen days. Records were kept to determine the difference in feed consumption among treatment levels. Mortality records were kept for each range in order to determine any differences that may have been associated with the treatments. Mortality records

consisted of the number of males lost and the cause of death.

On October 1, 1957, the treatment phase of the experiment was terminated. At that time four Single Comb White Leghorn males were selected at random from each treatment level. Two sets of two males each were placed in six small colony houses with twenty Single Comb White Leghorn pullets per house. The pullets were laying at the rate of fifty to sixty-five percent. After the males were in the pens with the pullets for two weeks, the eggs were collected for seven days. The eggs were then incubated to determine the effect of reserpine on fertility and hatchability.

TABLE I

COMPOSITION AND CALCULATED ANALYSIS
OF STARTER-GROWER RATION
TRIAL I

Ingredients	Parts of total ration
Ground yellow corn	52.2
Wheat shorts	5.0
Alfalfa meal (17% protein)	5.0
Menhaden fish meal (60% protein)	10.0
Soybean oil meal (44% protein)	12.5
Meat and bone scraps (50% protein)	5.0
Dried whey	3.0
Dried fish solubles	3.0
Dried butyl solubles	3.0
Di-calcium phosphate (20% phosphorus)	0.5
Salt (NaCl)	0.5
Trace mineral mix[1]	0.05
VC-55[2]	0.25
Total	100.00
Calculated Analysis	
Crude protein, percent	22.6
Crude fiber, percent	3.5
Calcium, percent	1.3
Phosphorus, percent	1.4
Calorie-protein ratio	56.0

FOOTNOTES

1. Trace mineral mix -- adds per pound of ration: manganese 27.5 milligrams, iodine 0.33 milligrams, cobalt 0.59 milligrams, iron 8.3 milligrams, copper 1.65 milligrams, zinc 1.52 milligrams.

2. VC-55 -- vitamin concentrate adds the following per pound of finished ration: vitamin A, 2,000 I.U.; vitamin D_3, 1,000 I.C.U.; riboflavin, 1.5 milligrams; pantothenic acid, 2 milligrams; niacin, 10 milligrams; choline chloride, 150 milligrams; vitamin B_{12}, 1.5 micrograms; procaine penicillin, 1 milligram; and menadione, 1.5 milligrams.

TABLE II

COMPOSITION AND CALCULATED ANALYSIS
OF BASAL RATION
TRIAL I

Ingredients	Parts of total ration
Feed grade fat	2.0
Corn starch	5.0
Ground yellow corn	28.0
Ground milo	30.0
Dehydrated alfalfa meal (17% protein)	2.0
Pulverized oats	15.0
Pex (liquid whey)	3.0
Menhaden fish meal (60% protein)	3.0
Soybean oil meal (44% protein)	10.0
Di-calcium phosphate	1.0
Calcium carbonate	0.5
Salt (NaCl)	0.5
Trace mineral mix[1]	0.05
VC-55[2]	1.0
Total	101.05
Calculated Analysis	
Crude protein, percent	14.1
Crude fiber, percent	4.1
Calcium, percent	0.69
Phosphorus, percent	0.44
Calorie-protein ratio	100.00

FOOTNOTES

1. Trace mineral mix -- see footnote 1, Table I.

2. VC-55 -- vitamin concentrate adds the following per pound of finished ration: vitamin, 8,000 I.U.; vitamin D_3, 4,000 I.C.U.; riboflavin, 6 milligrams; pantothenic acid, 8 milligrams; niacin, 40 milligrams; choline chloride, 600 milligrams; vitamin B_{12}, 6 micrograms; menadione, 6 milligrams; and procaine penicillin, 4 milligrams.

Trial II

Trial II, which began February 3, 1958, was initiated using higher levels of reserpine.

This trial consisted of five hundred Single Comb White Leghorn cockerels of Foreman x Ghostly breeding and five hundred New Hampshire cockerels of Christie breeding. They were purchased from a local hatchery as day-old sexed cockerels. These two breeds were brooded separately in adjoining pens in a brooder house. The pens in the brooder house each measured fifteen feet by thirty feet in dimensions. Each pen in the brooder house was equipped with two radiant gas brooders with a hover capacity of three hundred chicks each. From day-old to four weeks of age, the cockerel chicks were provided with ten feeders four feet each in length and six waterers each with a two and one-half gallon capacity. After four weeks of age, the baby chick feeders were removed and were replaced by ten adjustable feeders each four feet in length. Each pen was provided with one automatic V-trough waterer, six feet long.

The composition of the starter-grower ration fed in this trial is shown in Table III.

On April 26, 1958, when the males were twelve weeks of age, they were moved to the range which was located on the Perkins Turkey Farm of the Oklahoma Agricultural Experiment Station.

Four hundred males of each of two breeds were selected at random to be placed on range. Each breed was then divided at random into eight groups of fifty males each. The groups were then placed at random into sixteen separate ranges.

Each of the sixteen ranges measured fifty feet by one hundred feet in dimensions. The ranges were equipped with the same type of facilities as in the ranges used in Trial I, with the exception of one four-foot range feeder which was added to accomodate the increase in the number of males. Again, as in Trial I, the grass was mowed periodically to maintain uniformity of shading conditions.

In this study, four treatments were alloted to the eight ranges of each breed. Four levels of reserpine, 0.0, 1.0, 2.0, and 3.0 milligrams per kilogram of diet, were mixed into the basal ration. The composition of the basal is shown in Table IV. Each treatment level was duplicated for each breed. Feed and water were provided ad libitum.

Individual body weights and feed consumption by ranges were recorded at twenty-one day intervals during the feeding trial. Records of the daily high and low environmental temperatures were obtained using a maximum-minimum registering thermometer.

On July 19, 1958, this trial was concluded.

TABLE III

COMPOSITION AND CALCULATED ANALYSIS
OF STARTER-GROWER RATION
TRIAL II

Ingredients	Parts of total ration
Feed grade fat	2.0
Ground yellow corn	20.0
Ground milo	30.0
Wheat shorts	5.0
Alfalfa meal (17% protein)	5.0
Menhaden fish meal (60% protein)	10.0
Soybean oil meal (44% protein)	12.5
Meat and bone scraps (50% protein)	5.0
Pex (liquid whey)	4.0
Live yeast culture	2.0
Dried fish solubles	3.0
Dried distillers solubles	3.0
Di-calcium phosphate	0.5
Salt (NaCl)	0.5
Trace mineral mix[1]	0.05
VC-55[2]	0.25
Nicarbazine[3]	0.05
NF-180[4]	0.05
Total	102.90

TABLE III

(Continued)

Calculated Analysis	
Crude protein, percent	25.9
Crude fiber, percent	3.8
Calcium, percent	1.7
Phosphorus, percent	1.0
Calorie-protein ratio	54.0

1. Trace mineral mix -- see footnote 1, Table I.
2. VC-55 -- see footnote 2, Table I.
3. Nicarbazine -- used to control coccidiosis.
4. NF-180 -- furazolidone (N-(5-nitro-2 furfurylidene)-3 amino-2-oxazolidone).

TABLE IV

COMPOSITION AND CALCULATED ANALYSIS
OF BASAL RATION
TRIAL II

Ingredients	Parts of total ration
Feed grade fat	3.0
Ground yellow corn	28.5
Ground milo	28.5
Dehydrated alfalfa meal (17% protein)	2.0
Pulverized oats	15.0
Pex (liquid whey)	3.0
Menhaden fish meal (60% protein)	6.0
Soybean oil meal (44% protein)	11.0
Di-calcium phosphate	2.0
Calcium carbonate	0.5
Salt	0.5
Trace mineral mix[1]	0.05
VC-55[2]	1.0
Total	101.05
Calculated Analysis	
Crude protein, percent	17.1
Crude fiber, percent	4.1
Calcium, percent	1.18
Phosphorus, percent	0.81
Calorie-protein ratio	77.0

1. See footnote 1, Table I.

2. See footnote 2, Table II.

Trial III

As Trial II progressed, it became evident that no observable effects were being obtained from the levels of reserpine used. It was then decided to use the current design and increase the levels of reserpine to a point which was considered by most researchers to be well above the practical therapeutic dose.

On July 19, 1953, Trial III was initiated using higher levels of reserpine. These levels were obtained by multiplying each of the previous levels by three. This multiplication increased the reserpine levels from 1.0 to 3.0, 2.0 to 6.0, and 3.0 to 9.0 milligrams per kilogram of diet. The only treatment level not affected by this increase was the control, which remained 0.0 milligram of reserpine per kilogram of diet.

As in previous trials, body weight, feed consumption and mortality were recorded at twenty-one day intervals. Daily high and low environmental temperatures were obtained using the same instrument as in Trial II.

Trial IV

On August 11, 1958, Trial IV was initiated in order to find a level at which reserpine would produce a visual or otherwise detectable sign of tranquillization. In this trial, ten males were randomly selected from a group of New Hampshire males hatched from eggs laid by flocks maintained by the Oklahoma State University. These males were approximately twenty-four weeks of age when the trial was begun.

The males were placed in ten individual cages which measured two feet wide by two and one-half feet long by two feet high.

Five treatments were randomly alloted to the ten males. These treatments were 0.0, 10.0, 15.0, 20.0 and 25.0 milligrams of reserpine per kilogram of diet. Each treatment was replicated. These levels were mixed with the same basal ration as that used in Trials II and III.

For the first five days, the feed consumption was restricted to 0.26 pound of feed per day. For the following five days, feed was provided ad libitum to the males. Feed consumption and body weights were recorded for individual males on a daily basis for the ten-day trial.

Rectal temperatures of the ten males were obtained daily at 8:00 a.m. and at 2:00 p.m. This measurement was taken as another method of detecting any degree of tranquilization that might not be visible.

RESULTS AND DISCUSSION

Trial I

A summary of body weight, gain, feed consumption and mortality data obtained from Trial I is presented in Table V. Pen means of gain and total feed consumption were examined statistically using the analysis of variance technique as outlined by Snedecor (1955). These analyses are presented in Table VI.

From this analysis, it is apparent that weight gains were not affected in any way by the levels of reserpine used in the trial. The analysis of total feed consumption showed a significant difference between the two treatment levels and the control. This analysis is limited to some degree in its reliability because of the lack of replications. It was felt, however, that these results indicated the possible effects of the drug on feed consumption.

The summary of mortality data in the trial does not indicate a difference that can be associated with treatment level. It is also realized that the small numbers of replications associated with treatment levels do not provide reliable data on this factor because of the many circumstances associated with it.

After this trial was concluded, it was believed that if the levels of reserpine were increased, a possible saving in feed consumption could be obtained. It would appear that

this result could be obtained without a serious reduction in body weight. It was also believed that higher levels of reserpine would produce a mild sedation. This sedation would have a possible value in reducing the vicious sex drive that is so prevalent in mature males. This sex drive seemed to be the cause of a large percentage of the mortality that occurred while the males were on range.

A summary of the fertility and hatchability data of eggs that were fertilized by males after they had been removed from treatment is presented in Table VII. It is evident that fertility and hatchability were not adversely affected by any residual action of the drug on the males.

TABLE V

SUMMARY OF BODY WEIGHT, GAIN, FEED CONSUMPTION AND MORTALITY DATA FOR TRIAL I

Treatment	Pen	Breed	Initial weight	Final weight	Gain	Total feed consumption per pen		Total mortality
0.0	1	Silver Bar	4.47	6.68	2.21			2
	2	Silver Bar	4.25	6.60	2.35			1
0.0	1	White Plymouth Rock	4.13	7.61	3.48			1
	2	White Plymouth Rock	4.12	6.74	2.62			2
0.0	1	White Leghorn	2.71	5.43	2.72			1
	2	White Leghorn	2.94	5.41	2.47			1
Average	1				2.80	549.5		4
	2				2.48	552.5		4
Average for treatment					2.64	551.0	Total	8
0.5	3	Silver Bar	4.39	6.01	1.62			2
	4	Silver Bar	4.09	5.63	1.54			3
0.5	3	White Plymouth Rock	3.97	7.32	3.35			1
	4	White Plymouth Rock	3.91	7.35	3.44			1
0.5	3	White Leghorn	2.70	5.29	2.59			1
	4	White Leghorn	2.69	5.37	2.68			1

Average	3				2.52	509.5		4
	4				2.57	528.5		5
Average for treatment					2.55	519.0	Total	9
1.0	5	Silver Bar	4.22	6.09	1.87			2
	6	Silver Bar	4.48	6.97	2.49			2
1.0	5	White Plymouth Rocks	3.87	7.06	3.19			0
	6	White Plymouth Rocks	3.98	7.23	3.25			0
1.0	5	White Leghorn	2.62	5.27	2.65			2
	6	White Leghorn	2.73	5.18	2.45			0
Average	5				2.57	517.5		4
	6				2.73	521.0		2
Average for treatment					2.65	519.3	Total	6

TABLE VI

ANALYSIS OF VARIANCE OF GAIN
FOR TRIAL I

Source	d.f.	S.S.	M.S.	F.
Total	17	5.6322		
Treatment	2	.0417	.0209	
Error (a)	3	.2369	.0790	
Breed	2	4.3341	2.1671	35.41**
T X B	4	.6521	.1630	2.66
Error (b)	6	.3674	.0612	

** Significant at the 99% level.

ANALYSIS OF VARIANCE OF TOTAL FEED CONSUMED
FOR TRIAL I

Source	d.f.	S.S.	M.S.	F.
Total	5	1,550.81		
Treatment	2	1,358.97	679.48	10.63*
Error	3	191.84	63.95	

* Significant at the 95% level.

TABLE VII

FERTILITY AND HATCHABILITY CHECK FOR TRIAL I

Male from treatment	Pen	Total eggs set	Infertile	Dead embryos	Chicks hatched	Percent fertility	Percent hatch of total eggs set
0.0	1	86	0	4	77	100	89.5
	2	92	0	3	84	100	91.3
Total		178		7	161		180.8
Average		89			81		90.4
0.5	3	91	0	5	82	100	90.1
	4	74	0	4	68	100	91.8
Total		165		9	150		181.9
Average		83			75		90.9
1.0	5	75	0	3	62	100	82.6
	6	57	0	2	52	100	91.2
Total		132		5	114		173.8
Average		66			57		86.9

Trial II

Trial II was initiated in order to find a level at which reserpine would be of value in reducing mortality and possibly improving feed efficiency. The levels of drug and results secured in Trial I were the basis for the selection of the treatment levels used in this trial. A summary of the average body weight, gain, total feed consumption, feed efficiency and mortality data is presented in Table VIII.

The analysis of variance technique, Snedecor (1955), was used to analyze gain, adjusted feed consumption, and feed efficiency data. The analysis is presented as part of Table VIII. The analysis of the data indicates that weight gain was not influenced by the use of reserpine at these levels. The results also show that feed efficiency, as measured in pounds of feed per pound of gain, was not significantly improved at these levels.

The analysis of total feed consumption showed no statistical difference which could be associated with treatment. This analysis was adjusted to the minimum number of males in any pen at the completion of the trial. These results are difficult to explain, considering the results obtained in Trial I. The possibility remains that the results obtained in Trial I were due to chance and not a true difference that could be associated with treatment.

From the summary of total mortality as shown in Table VIII, it is evident that the losses were not decreased by treatment but may have been increased. This observation is

in agreement with the statement made by Sturkie et al. (1958) that reserpine would appear to affect the health of birds treated with this drug.

Again, as in Trial I, a large percentage of the mortality seemed to be caused by the vicious sex drive of the males. Actually, 81 percent of the Leghorn mortality and 93 percent of the New Hampshire mortality resulted from this cause. When a male apparently became weak or crippled from any cause, he quickly became the object of the other males' attention. Riding was continuous until the male died or was removed from the pen. After the weak males were removed from the pen, fighting became prevalent among other males. Defeated males were chased until they were too weak to escape. These males were then ridden until death occurred.

At no time during the trial were there any visual signs of sedation. A summary of average high and low environmental temperatures is presented in Table X. These data were kept in order to determine whether a relationship existed between environmental temperatures and the factors being considered in the study. Lessin and Parkes (1957) reported that signs of sedation did not occur in the mouse when the environmental temperatures were maintained at near the body temperature of the mouse. From analysis of data obtained during each weigh period, there were no indications that the increase or decrease in environmental temperature had any effect upon the measurements taken.

TABLE VIII

SUMMARY AND ANALYSIS OF DATA OBTAINED IN TRIAL II

Treat.	Rep.	Breed	Initial weight	Final weight	Gain	Total feed con. adj. to 39 birds	Feed con. per bird per day	Lbs. feed per bird	Lbs. of feed per lb. gain	Mortality
0.0	I	N.H.	4.15	6.57	2.42	848.91	.259	21.77	9.00	4
0.0	II	N.H.	4.12	6.63	2.51	853.74	.260	21.88	8.72	3
0.0	I	W.L.	3.03	4.62	1.59	720.06	.220	18.46	11.61	7
0.0	II	W.L.	2.89	4.65	1.76	693.87	.212	17.79	10.11	6
									Total	20
1.0	I	N.H.	4.12	6.61	2.49	847.54	.259	21.73	8.73	8
1.0	II	N.H.	4.17	6.62	2.45	877.29	.259	21.80	8.90	5
1.0	I	W.L.	3.02	4.59	1.57	710.33	.216	18.20	11.59	4
1.0	II	W.L.	3.02	4.81	1.79	702.25	.214	18.01	10.06	10
									Total	27
2.0	I	N.H.	4.03	6.48	2.45	831.18	.254	21.32	8.70	3
2.0	II	N.H.	4.05	6.59	2.54	859.89	.262	22.05	8.68	9
2.0	I	W.L.	3.05	4.69	1.64	726.38	.222	18.63	11.36	11
2.0	II	W.L.	2.95	4.82	1.87	712.00	.217	18.26	9.76	8
									Total	31
3.0	I	N.H.	4.12	6.71	2.59	864.45	.264	22.17	8.56	4
3.0	II	N.H.	4.09	6.52	2.43	804.68	.246	20.64	8.49	6
3.0	I	W.L.	2.99	4.74	1.75	725.33	.221	18.60	10.63	8
3.0	II	W.L.	3.10	4.69	1.59	732.53	.224	18.79	11.82	6
									Total	24

Source	d.f.	M.S.	M.S.	M.S.
Total	15			
Replication	1	.012	89.92	.198
Breed	1	2.50**	70,879.75**	18.404**
Treatment	3	.003	18.46	.054
T X B	3	.002	485.63	.079
Error	7	.019	483.22	.620

** Significant at the 99% level.

Trial III

A summary of the results obtained in Trial III using higher levels of reserpine is presented in Table IX. Total feed consumption, weight gain, and feed efficiency data were examined statistically according to the method of analysis of variance presented by Snedecor (1955). From this analysis it is evident that weight gains are not affected by the higher levels of reserpine. This is in agreement with the results obtained in Trials I and II. This would probably lead to the conclusion that levels of reserpine up to nine milligrams per kilogram of diet do not significantly affect weight gains. Again, as in Trial II, total adjusted feed consumption and efficiency of feed utilization were not apparently affected by the treatment levels used.

A close observation of total mortality for each treatment level would lead to the conclusion that no difference was obtained from the levels of reserpine used in this trial. As in the previous trial, mortality appeared to be caused by the vicious sex drive of the males. As in Trials I and II, no visible signs of sedation were observed. A summary of the average high and low temperatures of each of the weigh periods is presented in Table XI. During the final period, from August 31 to September 20, the average high environmental temperature was considerably lower than in previous periods. This temperature was well below the average body tempera-

ture of the male (106.5° F.). No visual signs of sedation were obtained.

Analysis of the data for this period indicated that there were no differences in the results because of the lower temperature.

The results obtained from Trials I, II and III indicated that the levels of reserpine used had not significantly influenced feed consumption, weight gains and mortality. At this point, it became desirable to know if the mature male chicken could be influenced by a very high oral intake of reserpine.

TABLE IX

SUMMARY AND ANALYSIS OF DATA OBTAINED IN TRIAL III

Treat.	Rep.	Breed	Initial weight	Final weight	Gain	Total feed con. adj. to 32 birds	Feed con. per bird per day	Lbs. feed per bird	Lbs. of feed per lb. gain	Mortality
0.0	I	N.H.	6.57	7.56	.99	521.17	.259	16.29	16.45	7
0.0	II	N.H.	6.76	7.73	.97	545.29	.271	17.04	17.54	12
0.0	I	W.L.	4.64	5.43	.79	467.34	.232	14.60	18.48	4
0.0	II	W.L.	4.64	5.45	.81	443.26	.220	13.85	17.10	2
									Total	25
3.0	I	N.H.	6.49	7.56	1.07	540.43	.268	16.89	15.79	7
3.0	II	N.H.	6.62	7.43	.81	522.32	.259	16.32	20.45	7
3.0	I	W.L.	4.61	5.46	.85	452.28	.224	14.14	16.63	3
3.0	II	W.L.	4.82	5.44	.62	482.34	.239	15.07	24.31	4
									Total	21
6.0	I	N.H.	6.49	7.44	.95	512.68	.254	16.02	16.86	8
6.0	II	N.H.	6.60	7.43	.83	551.24	.274	17.23	20.76	9
6.0	I	W.L.	4.65	5.35	.70	465.95	.231	14.56	20.80	2
6.0	II	W.L.	4.83	5.17	.34	466.70	.232	16.56	42.91	3
									Total	22
9.0	I	N.H.	6.69	7.44	.75	543.77	.270	16.99	22.65	8
9.0	II	N.H.	6.51	7.56	1.05	529.97	.263	16.56	15.77	9
9.0	I	W.L.	4.74	5.43	.69	449.48	.223	14.05	20.36	5
9.0	II	W.L.	4.70	5.47	.77	462.85	.230	14.47	18.76	2
									Total	24

Source	d.f.	M.S.	M.S.	M.S.
Total	15			
Replication	1	.022	161.74	54.91
Breed	1	.214*	20,784.27**	68.39
Treatment	3	.024	23.19	47.41
T X B	3	.009	71.46	36.01
Error	7	.023	280.45	37.71

* Significant at the 95% level.

** Significant at the 99% level.

TABLE X

AVERAGE TEMPERATURE BY PERIODS, 1958

Trial II

	4-26 to 5-17	5-18 to 6-7	6-8 to 6-28	6-29 to 7-19
High	75.0	90.4	87.1	90.4
Low	58.3	64.1	66.4	70.0

TABLE XI

AVERAGE TEMPERATURE BY PERIODS, 1958

Trial III

	7-20 to 8-9	8-10 to 8-30	8-31 to 9-20
High	91.1	91.1	84.0
Low	72.1	72.1	66.1

Trial IV

Trial IV was initiated in order to find a level at which males would show visual signs of sedation, or possibly other signs of drug effect. To the knowledge of the author, twenty-five milligrams of reserpine per kilogram of diet is three or four times greater than any level that has ever been fed to any avian species.

The summary and analysis of the data obtained in this trial are presented in Table XII. The relative size and the number of replications in this trial was a limiting factor in the reliability of this experiment. Although these factors were present, it was evident that these levels did not affect either growth or feed consumption to a degree that may have been detrimental.

The drop in morning and afternoon body temperature does not show an apparent difference due to treatment levels. The average daily high environmental temperature for this ten-day trial was 92.3° F. As stated previously, high environmental temperature may possibly inhibit signs of sedation and hypothermia. This agrees with work reported by Earl (1956), when he stated that the hypothermic effect of reserpine may be prevented by high environmental temperatures.

The summary of average daily consumption of reserpine in milligrams is presented in Table XII. The two males that received twenty-five milligrams of reserpine per kilogram of

diet were consuming an average of 3.33 and 3.09 milligrams of reserpine per day. On the basis of milligrams of reserpine per kilogram of body weight, this would be approximately 0.94 milligram.

Sturkie et al. (1958) reported that capons were tranquilized with intra-muscular injections of 0.1 to 0.2 milligram of reserpine per kilogram of body weight. This could lead to one of two conclusions. First, that the metabolism and absorption of this drug was not high enough to cause visible signs of sedation. This assumption is not safe considering the results secured by Hewitt and Reynolds (1957), Carlson (1956) and others using orally administered reserpine. Secondly, if the drug were sufficiently absorbed, which seems likely, endocrine secretion of the testes must in some way buffer the ability of reserpine to produce tranquilization.

From these observations, it becomes evident that the possibility of a sex difference in the response to reserpine treatment may be a limiting factor in the use of this drug on males. This possible sex difference is supported by work by Gilbreath et al. (In Press). This study indicated a savings in feed and an improvement in egg weight and shell quality with White Leghorn hens receiving a diet containing 2.0 milligrams of reserpine per kilogram of ration.

TABLE XII

SUMMARY AND ANALYSIS OF DATA OBTAINED IN TRIAL IV

Treat.	Male	Initial weight	Final weight	Gain	Initial A.M. body temp.	Final A.M. body temp.	Drop in A.M. body temp.
0.0	2	5.8	6.8	1.0	107.4	106.6	.8
	3	5.8	6.4	.6	108.0	107.0	1.0
10.0	7	5.2	5.7	.5	107.8	106.7	1.1
	9	6.5	6.8	.3	107.8	106.3	1.5
15.0	6	6.9	7.5	.6	107.6	106.0	1.6
	8	5.7	6.7	1.0	107.8	106.2	1.6
20.0	4	6.3	6.8	.5	107.2	106.2	1.0
	10	7.1	7.5	.4	107.0	106.2	.8
25.0	1	7.2	7.9	.7	107.4	106.6	.8
	5	6.2	7.0	.8	108.6	106.5	1.1

Source	d.f.	M.S.
Total	9	
Treatment	4	.079
Error	5	.038

TABLE XII (Con't)

Initial P.M. body temp.	Final P.M. body temp.	Drop in P.M. body temp.	Feed con. in grams	Actual daily con. of reserpine in milligrams
107.2	106.7	.5	1,200.2	0.0
107.8	107.0	.8	1,121.7	0.0
107.2	106.7	.5	951.1	0.95
108.0	106.0	2.0	977.7	0.98
107.5	106.4	1.1	1,148.7	1.72
107.4	106.0	1.4	1,381.2	2.07
106.8	106.1	.7	1,067.7	2.14
107.6	106.0	1.6	1,230.2	2.46
107.2	106.4	.8	1,330.7	3.33
108.4	107.0	1.4	1,237.7	3.09

Source	d.f.	M.S.
Total	9	
Treatment	4	11,043.35
Error	5	26,648.50

SUMMARY AND CONCLUSIONS

Four trials, involving approximately nine hundred ninety chicken males, were conducted to find levels at which reserpine would reduce mortality and provide satisfactory growth when administered to segregated males on range.

Levels of reserpine were administered in the feed well above the recommended therapeutic doses for other domestic animals. Levels ranging as high as twenty-five milligrams of reserpine per kilogram of diet did not appear to have any affect on growth, feed consumption, mortality or social conduct of the males under study.

From the results obtained, there appeared to be no difference between males of the four breeds used as to their susceptibility to drug action. There was, however, a significant difference between these breeds in their rate of gain and efficiency of feed utilization.

Results obtained from these experiments show the need of further research. The high mortality that occurred in Trials II and III, as a result of fighting, shows the real need for a neurotropic drug or drugs that will control this loss. It is possible that levels of reserpine higher than those used in these trials would be effective in controlling high death losses in range males. There is the possibility that other neurotropic agents may be used to a greater advantage than that which was used in these trials.

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