THE INFLUENCE OF A TRANQUILIZER FED IN COMBINATION WITH AN ESTROGENIC COMPOUND ON CONSUMER ACCEPTANCE AND COMPOSITION OF CHICKEN FRYERS

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ABSTRACT

THE INFLUENCE OF A TRANQUILIZER FED IN COMBINATION WITH AN ESTROGENIC COMPOUND ON CONSUMER ACCEPTANCE AND COMPOSITION OF CHICKEN FRYERS

by Peggy McCullin Smith

The purpose of this study was to measure consumer acceptance of chickens fed a tranquilizer and/or a hormone in conjunction with high and low protein rations; and to compare the composition (moisture, crude fat and protein) of treated and untreated chickens.

Ninety-six male and ninety-six female White Plymouth Rock fryer-type chickens were reared on eight dietary treatments (six of both sexes at both ages on each treatment). Lipamone (a synthetic estrogen) and Quietrol (a tranquilizer, a perphenazine derivative) were incorporated into the feed at levels of 1/3 lb. per ton and 4 grams per ton, respectively. The treatments were initiated when birds were 35 days of age.

When the birds were 9 weeks of age (4 weeks on treatments), 48 male and 48 female birds were sacrificed. The remaining birds were sacrificed at the age of 13 weeks. One-half of each bird was roasted and the Pectoralis superficialis muscle evaluated by a taste panel. The Pectoralis profundus muscle was measured, mechanically, for shear force and press fluids. Total cooking losses were determined. The other half of each bird was frozen and later thawed, deboned and analyzed for moisture, crude fat and protein.

The data collected in this study were tested for significance by analyses of variance. Significant F values were then analyzed by

the studentized multiple range method. Correlation coefficients were calculated for moisture, crude fat and protein.

Statistical analyses of sensory evaluations, to measure consumer acceptance, revealed no significant differences due to treatments. The sensory factors evaluated were aroma, flavor, tenderness, juiciness, and general acceptability.

The analysis of variance for total cooking losses indicated no significant differences due to treatment or sex for 9-week-old birds. Significant differences in cooking losses due to treatment were apparent for 13-week-old male birds. The mean cooking loss for the birds fed Quietrol at the low protein level was significantly higher than the loss for birds fed the low protein control diet and for birds fed the high protein diets. The mechanical test for tenderness (shear force) revealed no significant differences in tenderness due to treatment or sex at either age level. The values for percentage press fluids of 9-week-old male birds and 13-week-old birds of both sexes did not differ significantly.

With respect to carcass composition the treated females usually differed significantly in moisture and fat content from the controls at the same level of protein intake. The treated males sometimes differed significantly from birds at a different level of protein intake, but never from the controls at the same level of protein intake. Orally administered Lipamone, in the low protein ration of 13-week-old female birds, caused significant reductions in moisture and increases in crude fat. When compared with controls, at the low protein level, the addition of Quietrol to the feed, caused significantly reduced fat contents, and increased protein in the edible portion

of 9-week-old female birds. Quietrol and Lipamone combined in the low protein ration did not differ from the control ration in effecting the moisture, fat and protein contents of male and female birds of both ages. This was also true of the combination of Quietrol and Lipamone in the high protein ration.

Significant differences, due to treatments, between the two levels of protein intake were frequently observed in the birds. It seems apparent that the decreased Calorie/Protein ratio rather than Lipamone or Quietrol, was the primary cause of the sharply decreased fat contents and increased moisture contents in the birds maintained on the high protein rations.

There was a highly significant negative correlation of fat to moisture and protein to fat in the edible portion of male and female birds at both age levels. There was no significant correlation for moisture to protein.

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INTRODUCTION

Tranquilizing drugs reduce anxiety, nervous and muscular tension and acuity of awareness. Under their influence psychotic patients are calmed and become amenable to psychotherapy. Because of their success in human therapy, producers sought similar responses in livestock and poultry. Poultrymen anticipate the drug's depressant action should curtail nervousness and fighting in certain strains of poultry and thus promote more efficient use of feed. Experimental work is in progress to test this theory.

Estrogens have a quieting effect on poultry, but may or may not affect gains in rate of growth or feed conversion. Estrogenic hormones change the appearance and flavor and alter the rate of deposition of fat and its distribution in the meat and skin of birds.

It is hoped that the combination of an estrogen and a tranquilizer in poultry feed may produce a bird of higher quality which can be marketed earlier.

This study was designed to measure consumer acceptance of treated birds and to compare the composition (moisture, crude fat and protein) of treated and untreated birds.

REVIEW OF LITERATURE

Tranquilizing Agents

Effect on growth rate and feed efficiency

Activity, growth, and feed efficiency, of White Leghorn Cockrels fed meprobamate, were measured by Babcock et al. (1957). The drug produced no consistent effect on the activity measurements. Growth rates were depressed at dosages of 1.4 per cent and above. The apparent growth acceleration of birds receiving 0.2 per cent meprobamate for 7 weeks was not significant. "During the first three weeks, the feed efficiency (grams of gain per gram of feed) was lower for the highest level of meprobamate, where growth inhibition was severe."

No significant differences in weight gain and only slight increases in feed efficiency were noted in White Rock female chicks fed reserpine at levels of 0.1 and 1.0 p.p.m. in a 20 per cent protein starter ration from the fourth through the seventh week (Rood et al., 1958).

Burger et al., (1959) reported a slight increase in growth of Single Comb White Leghorn chicks fed chlorpromazine at levels of 10 to 100 mg./kg. diet from 4 to 24 days of age. At levels of 250 to 16,000 mg./kg. diet, growth was depressed; and at the latter concentration, mortality was 100 per cent by the 24th day. Growth of New Hampshire chicks was not influenced by feeding 5 to 10 mg./kg. of diet. Reserpine fed at 0.5 mg./kg. diet increased growth slightly in Single Comb White Leghorn chicks by the 23rd day of age. At higher levels (5.0 to

500.0 mg./kg. diet) growth depression occurred; and a 96 per cent mortality was obtained by the 24th day on the 500.0 mg. concentration.

In a study on White Plymouth Rock fryer-type chickens, Rood (1959) found that body weights of 13-week-old chickens were not increased by the addition of Quietrol (4 grams/ton of diet) to their diets for the previous eight weeks. During the finishing period (9-13 weeks) Quietrol improved feed efficiency in male birds more than the high protein (16 per cent protein) control diet. The addition of Quietrol to a low protein basal diet exerted a protein sparing effect.

Effect on carcass quality

Rood (1959) found the addition of Quietrol to the diets of White Plymouth Rock fryer-type chickens improved carcass quality and increased body weight due to deposition of fat. Abdominal fat was not increased by the addition of Quietrol but there was a more even distribution of fat throughout the carcass.

Estrogenic Compounds

Effect on growth rate and feed efficiency

Camp et al. (1957) used injections of 15 mg. diethylstilbestrol (DES) in a paste carrier and obtained growth responses at protein levels of 14 per cent, 16 per cent, and 18 per cent in Cornish Cross chicks; especially at the two lowest levels. No growth response was obtained when the birds were maintained on a 21 per cent protein ration following injection. Feed conversion and yield were improved on the lower protein diets. "These data suggest that favorable responses from treatment with DES may be dependent upon a high caloric to protein ratio in the diet."

According to Adams (1957) who considered effects on gain, finish, and feed efficiency of Broad Breasted Bronze turkeys, DES as a pellet or paste was significantly more effective than as a liquid or an oil solution. Dienestrol Diacetate (DD) (1 pound per ton of feed) depressed feed efficiency and produced no favorable effect on weight gain. Mabert and Brunson (1957) found subcutaneous implantation of DES pellets significantly reduced feed conversion in 9-week-old male birds. Growth was not markedly changed by this treatment. Female birds injected with testosterone proprionate did not differ significantly from the control females in regard to growth or feed conversion.

Warden et al. (1958) added DD to the feed of broilers, in amounts of 1 pound per ton of feed, and in amounts of 1/3 pound per ton of feed. Pellet implants of DES, one at the fifth and one at the ninth week of age, were administered to broilers maintained on untreated feed. In addition, higher protein finisher and fattener rations (24, 20 and 16 per cent) were used with the addition of 1/3 pound per ton of DD. The data showed that DD, DES or a high protein finisher ration did not significantly affect rate of growth or feeding efficiency.

Effect on carcass quality

For many years synthetic estrogens have been fed to enhance carcass quality. These compounds cause an increased deposition of fat beneath the skin, in the abdominal cavity and in the flesh or muscles. Estrogens are more effective in fattening and finishing males than females since hens supply their own estrogens. Estrogen treatment of broilers of both sexes is beneficial since they usually grow too quickly to accumulate excessive fat.

Diethylstilbestrol produced a paler and more tender flesh (Heuser, 2nd edition, 1955). With this drug fat was deposited within the flesh, predominantly in the abdominal cavity. Implantation, in pellet form, back of the ear was recommended to prevent human consumption of unabsorbed pellets.

Lorenz (1943) observed fattening in leg and breast muscles of Single Comb White Leghorn Cockerels after DES pellet implantation. The birds were given 3 implants each at 3 weeks of age. Those not sacrificed at 7 weeks of age were given 3 more implants per bird. The greatest difference in body weight occurred at 8 weeks of age (after 5 weeks of treatment) when the implanted birds weighed 43 grams more than the controls. At eleven weeks, however, the implanted birds weighed less than the controls. Orally administered DES had no effect at levels of 66 and 110 mg./kg. of diet over a 4-week period (Lorenz, 1945). Oral administration of the dimethyl ether derivative of DES was more effective in fattening Barred Rocks than the oral administration of DES (Jaap and Thayer, 1944) but less so than subcutaneous injections of DES.

Warden et al. (1958) reported that DES pellet implants significantly increased the amount of abdominal fat in male and female birds. Orally administered dienestrol diacetate increased the amount of abdominal fat at the 1/3 pound per ton level on the 20 per cent protein finisher ration. "In this case the amount of fat was significantly reduced in the males, not as markedly in the females." The authors suggested that this might be due to the decreased Calorie/Protein ratio rather than to DD.

Effect on carcass composition

Hebert and Brunson (1957) analyzed the effects of DES, testosterone (in females) and two other hormones on the chemical composition of White Plymouth Rock broiler carcasses. Treatments were initiated at 5 weeks and birds were slaughtered at 9 weeks of age. Frozen halves of the birds with the same treatment were thawed at room temperature in preparation for analysis. Each half, minus neck and keel bone, was finely ground in an electric meat grinder; which was cleaned after each bird was ground. The ground material was thoroughly mixed and a portion placed in a polyethylene bag and frozen for later use in protein analysis. A 10-gram sample of the freshly ground material was used for moisture, fat and ash. For moisture determinations each sample was dried in a vacuum oven at 70 degrees C., 20-25 inches mercury for 18 hours. The dried material was extracted with ether for 15 hours. Ash was determined by heating to 725 degrees C. until ash was gray. Aliquot portions of each ground refrozen sample was analyzed for nitrogen by the Kjeldahl method. The factor 6.25 was used to convert nitrogen to protein. Samples were analyzed in duplicate and repeated if not within 1 per cent of the mean.

Subcutaneous implantation of DES pellets in 5-week-old male birds produced an increase in carcass fat but a decrease in moisture and protein. The DES-treated male birds contained 66, 13 and 19 per cent of moisture, fat and protein, respectively. These results were significantly different from the 70, 9 and 20 per cent, for moisture, fat and protein, respectively, of the control birds. Female birds injected with testosterone proprionate did not differ significantly from the control females in regard to carcass composition, both

averaged 67 per cent, 11 per cent and 19 per cent for moisture, fat and protein in that order.

Marion et al. (1958) made observations on 75 Cornish cross chicks slaughtered at 6, 10, and 14 weeks of age. The 6- and 10-week-old chicks were implanted with 10 mg. DES paste 3 weeks before slaughter. Eviscerated frozen carcasses were thawed at room temperature overnight and split in half. One-half of each bird was wrapped in aluminum foil and cooked: 90 minutes for 6-week-old birds, 120 minutes for 10-week-old birds and 150 minutes for the 14-week-old birds. Samples of dark and light meat were taken from each raw and each cooked half. These were separately ground three times, sealed in polyethylene bags and frozen. Samples of white and of dark meat were thawed and analyzed as convenient. Samples analyzed for moisture were dried in a vacuum oven at 29 inches mercury at 104 degrees C. to constant weight, usually 16 hours. Dried samples which had been ether extracted for four hours (Goldfisch extractor) were used in the macro-Kjeldahl analysis for nitrogen. Protein was calculated by multiplying nitrogen times the factor 6.25. Protein and fat values were calculated as percentage of the net sample weight. Moisture contents of the raw dark meat samples of 14-week-old, DES-treated birds (72.18 per cent for males and 71.65 per cent for females) were significantly lower than for the untreated birds, (75.20 per cent for males and 75.31 per cent for females).

Values for ether-extractable material were 6.87 per cent for the 10-week-old and 9.47 per cent for the 14-week-old treated male birds; 4.45 per cent and 5.85 per cent for the untreated 10- and 14-week-old male birds, respectively. For female birds the values were 6.14 per cent and 9.65 per cent for 10- and 14-week-old treated birds, respectively. The untreated female birds contained 4.24 per cent fat at

10 weeks of age and 5.74 per cent fat at 14 weeks of age.

"Protein content of uncooked chicken meat not only varied as commonly observed, with age of chicken but appeared to have a somewhat inverse relationship with the fat content." When protein content of all birds was compared, that of the female birds was slightly but significantly greater than that of male birds; the difference amounted to 0.46 per cent. Protein content of uncooked dark meat for female birds, 10- and 14-week-old, was 19.20 and 20.64 per cent, respectively, for hormonized birds; and 20.55 per cent and 19.48 per cent, respectively, for non-hormonized birds. Male birds contained slightly less protein than female birds at the 10- and 14-week age levels; 18.62 per cent and 19.55 per cent for 10-week-old hormonized and non-hormonized birds, respectively; and 18.22 per cent and 18.68 per cent for 14-week-old hormonized and non-hormonized birds, respectively.

Effect on eating quality

Flavor, appearance, tenderness and juiciness are desirable attributes of poultry to the consumer. Stadelman et al. (1951) implanted 112 meat-type fryers with 12-mg. pellets of DES at 6 weeks of age. These were sacrificed at 10 weeks of age. The birds were first deep-fat fried for 20 minutes and then finishes in the oven for 15-25 minutes at 325 degrees F. The Pectoralis minor muscle was tested for tenderness on a tenderometer. The average pounds of force used to shear a muscle was 10.5 pounds for control birds and 13.3 pounds for treated birds. The "F" test indicated no significant differences between the two values. A taste panel, composed of 12 members (student and faculty) found no significant differences in acceptability of the breast muscle.

Fry et al. (1958) studied the effect of age, (6-, 10- and 14-weeks) sex, and hormonization (DES paste injections) on the flavor of birds of a Vantress-White Rock cross breed. The birds were thawed overnight in a refrigerator at 40 degrees F. and placed in individual pyrex dishes; 30 ml. of water were added. The birds were then covered with aluminum foil and baked at 350 degrees F. for periods of time based on thawed weight. The foil was removed during the last 15 minutes of cooking. The birds were not salted or seasoned. One group of 6- and 10-week-old birds were baked immediately after freezing. The second group of all three ages was baked following a period of 30 weeks in frozen storage. The baked chicken was scored by five experienced judges. The scoring range was 1 (very weak) to 5 (full). "The scores of birds judged immediately after freezing indicate that almost all of the variation due to treatments is accounted for by the age of the bird." The score for 10-week-old birds (4.42) was significantly higher than the score for 6-week-old birds (3.91). The 10- and 14-week-old birds, (4.32 and 4.39, respectively) baked after 30 weeks in frozen storage, were significantly more flavorful than the 6-week-old birds (4.00). Neither sex nor hormone treatment appeared to affect the flavor of baked chickens.

"Young males (New Hampshire White Leghorn crosses), ten in each group, were given implants of either 12 mg. stilbestrol or 25 mg. testosterone at 8 weeks and 4 weeks before slaughter at 13 weeks of age." (Peterson et al., 1959). The eviscerated birds were held in chipped ice overnight before muscles were dissected, packed in polyethylene bags and held in frozen storage. Flavor evaluations by 6 to 8 judges were made on the broth from the breast muscles of each

bird (except the left deep Pectoral muscle) and the thigh and right leg muscles. Some birds (male) were given exercise treatments which consisted of walking a total of 17 minutes an hour, 10 hours a day in a cylindrical cage. These were begun at either 8 weeks or 38 days before slaughter. Diethylstilbestrol treatment tended to decrease flavor intensity. Testosterone treatment produced no detectable flavor differences. The toughness of muscles increased with age. Exercise had little effect on flavor.

Effect on cooking losses

Stadelman et al. (1951) reported significantly higher cooking losses in implanted birds (deep-fat-fryed for approximately 20 minutes, then cooked in the oven at 325 degrees F. for 15-25 minutes) than in the unimplanted controls. "In the cooking of the fryers it was apparent that the significantly greater weight loss for group 2 (the implanted fryers) was due to the extra fat on the meat being rendered off."

In a study conducted by Fromm and Margolf (1956), New Hampshire Cockrels were implanted with one 12 mg. DES pellet at 8 weeks of age, 5 weeks before slaughter. "The treated birds except for one pair, had higher percentages of edible carcass than corresponding untreated birds." Cooking loss in implanted birds averaged 30.1 per cent; this was significantly greater (5 per cent level of probability) than in unimplanted controls (29.4 per cent).

Residues in edible tissues

Bird et al. (1947) investigated quantitative recoveries of residues of estrogen from the tissues of treated birds. Barred Rock or

Leghorn Cockerels of various ages were studied. Stilbestrol compounds and extracts of tissues and excreta were assayed with ovariectomized rats. The estrogens recovered after subcutaneous administration diminished in potency in the following order: DES, DD, dimethyl ether of DES, dimethyl ether of hexosterol, and dimethyl ether of DD. After oral administration the order was unchanged except that the dimethyl ether of DES was slightly more potent than DD. Dimethyl ethers are more potent orally than subcutaneously. It was impossible to measure quantitatively the extremely small amounts of dienestrol diacetate and diethylstilbestrol present in the tissues. By far the greater portion of exogenous estrogens that could be accounted for was excreted direct. While muscle tissues were low in potency, tissues heavily infiltrated with lipids possessed high potency since exogenous fat soluble estrogens were taken up chiefly by lipid-containing tissues.

Human female patients were fed livers and rendered fat of birds treated with the dimethyl ether of DES. The dosage of DES for women was as follows: Liver in amount to contain 2 mg. DES/day for 6 days (8 chicken livers per day), and oil to give the same dosage. The menopausal picture of these patients was replaced by one characteristic of estrogenic activity. Under similar conditions no change in cytology was observed when one woman consumed oil from chickens treated with dimethyl ether of DD. The dosage administered to this woman was one-tenth that of the previous cases.

From a biological assay Gowe (1949) found negligible amounts of DD remaining in the liver, gizzard, heart and abdominal adipose tissue from Single Comb White Leghorn Cockerels fed from 2 to 13 weeks of age on a commercial mash containing 0.0044 per cent DD. Muscle and skin

tissue contained 14.5 gamma (or less) of DD per 100 grams. Gowe concluded that an individual would have to consume from 12 to 120 pounds of chickens, skin and flesh, every other day to obtain a clinical dose of estrogen, i.e., 1 to 10 mg.

Tiger et al. (1956) studied methods of incorporating estrogens into the feed of chickens, and the estrogenic activity of birds so treated. Dienestrol diacetate (32 mg./lb. finisher rations) in an oil solution was added to the feed; DD in the same amount was added to the feed in a suitable dry mix. The safety of edible tissues for human consumption was established by the use of a sensitive modification of the rat vaginal smear method. The tissues of these birds were equally safe for human consumption irrespective of whether the DD was administered in oil or in a dry mix.

Four experiments were conducted by Underger et al. (1959) to measure the estrogenic activity in edible tissues of stilbestrol-fattened animals. Different breeds of chickens were used in the experiments to eliminate the possibility of responses being attributed to one particular breed. Diethylstilbestrol was fed in pellet form (12 mg.), in paste form (15 mg.), as a liquid preparation (15 mg.) and as a liquid-rosin (15 mg.). The birds were treated at 8-weeks of age and slaughtered after 4-, 5-, or 6-weeks of treatment. Residues in tissues of the birds were estimated by a method which employed an increase in uterine weight in the mouse as the criterion of response. For seven days female mice were fed a diet which contained 100 parts of tissue to 10-20 parts of laboratory diet. On the eighth day the mice were sacrificed. No estrogenic residues were found in the lean meat of birds treated with paste, liquid or liquid-rosin. Flesh from pellet-

treated birds contained a slight amount (2 parts/billion) in the leg and breast muscles. The liver in all cases (except when the liquid preparation was used) contained nearly all of the residual estrogen. Cooking did not destroy the activity of the estrogens.

Umberger et al. (1959) conducted a similar study on a meat-breed of chicks (Peterson Cross) with DD in the feed (31.75 mg./lb.). Dinestrol diacetate was one-third as potent as DES; only the liver, kidney and intestines contained detectable estrogenic residues: 3 parts per billion, 12 parts per billion and 10 parts per billion, respectively. Ether extraction of fat in the tissues of control and treated birds produced only small differences in uterine weight of mice fed these diets. Cooking caused a 20 to 25 per cent decrease in activity of dienestrol diacetate.

Combination of Hormone and Tranquilizer

Wolterink et al. (1958) fed a combination of dienestrol diacetate and reserpine in a 12 per cent protein ration to White Rock Cockerels from one through ten weeks. The treated chickens showed improved weight gain and fat deposition. The literature included no studies on the effect of a hormone and a tranquilizer combination on consumer acceptance or composition of poultry.

EXPERIMENTAL METHODS

Experimental Details for Birds

White Plymouth Rock fryer-type chicks were raised for this study by the Poultry Department. Details in regard to the raising of the birds were recorded by Rood (1959). The chicks were separated by sex and randomly distributed in the pens. There were 16 pens of males and 16 pens of females with 27 chicks per pen. For the first five weeks the birds were fed a high energy starter ration (Appendix A).

The birds were weighed at the end of the fifth week. Selection was made on a weight basis so that there was a uniform distribution of weight throughout the experimental pens. After the extremely large and extremely small birds were discarded, there were 16 pens of male birds with 22 chicks per pen and 16 pens of female birds with 22 chicks per pen. Each of the following treatment rations were fed the birds in two pens of each sex: (1) high protein basal ration (control), (2) high protein basal ration plus Lipamone[1], (3) high protein basal ration plus Lipamone plus Quietrol[2], (4) high protein basal ration plus Quietrol, (5) low protein basal ration (control), (6) low protein basal ration plus Lipamone, (7) low protein basal ration plus Lipamone plus Quietrol, and (8) low protein basal ration plus Quietrol.

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[1]Lipamone, 14 per cent dienestrol diacetate in corn distillers dried grain, manufactured and distributed by White Laboratories, Inc., Kenilworth, N.J. (Now American Scientific Laboratories, Inc., Madison, Wisconsin).

[2]Quietrol, containing 50 grams perphenazine, 1 - (2-hydroxyethyl) - 4 [3-(2-chloro-10-phenothiazinyl)-propyl] - piperazine, per pound; manufactured and distributed by White Laboratories, Inc., Kenilworth, N. J.

At the end of the 9th week, 50 per cent of the birds in each pen were selected for slaughter on a random basis. The remaining birds were housed in the same pens as previously described except that there were then only 16 birds per pen. Two pens of each sex were continued on each of the above treatments. These birds were sacrificed at the end of the 13th week. The high and the low protein basal rations contained 20 and 16 per cent protein, respectively, from the 6th through the 9th weeks (Appendix A); and 16 and 13 per cent protein, respectively, from the 10th through the 13th weeks (Appendix A). Lipamone and Quietrol were administered at concentrations of one-third pound per ton and 4 grams per ton of diet, respectively.

In the present study the sample of nine-week-old birds consisted of six replications for both sexes on each of the eight dietary treatments. These birds were slaughtered, dressed, cooled in ice slush and halved. The backbones were discarded. The left half of each bird was packaged in a plastic film[1], frozen in moving air at -40 degrees C. and held at 0 degrees F. for subsequent analysis of the edible portion. The remaining broiler halves were held in ice slush until they were cooked and evaluated. The birds for any given replication were randomly selected within a treatment. Appendix A includes a listing of the 9-week-old birds within replications. All were cooked within one week of slaughter.

The sample of 13-week-old birds had the same distribtuion as the 9-week-old birds and was treated identically except that both halves of the birds were frozen for subsequent roasting or analysis of raw edible portion.

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[1]Cryovac.

All frozen birds were thawed for 24 hours at 5 degrees C. The order within replications for the 13-week-old birds is included in Appendix A.

Roasting Procedure

Each broiler half was washed, made ready for the table and drained for 15 minutes at room temperature. The neck skin was trimmed and the drumstick was pinned against the body with a metal clip.

The roasting was done in individual aluminum pans (13 x 9 x 2") fitted with racks and pieces of aluminum foil which were cut to fit beneath the birds. Each drained bird was weighed, positioned in a pan with the skin side up, and roasted for 90 minutes in a pre-heated oven at 325 degrees F. Each bird was basted with corn oil[1] initially and after 30 and 60 minutes of roasting. Weights were obtained so that the total amount of basting oil and total cooking losses could be calculated.

Mechanical Measurements on Cooked Meat

The Pectoralis profundus muscle was removed within 30 minutes of the end of the cooking period and was wrapped in a plastic film[2] to prevent evaporation loss. Determination of shear force and press fluid were made as rapidly as the equipment permitted. A vertical Warner-Bratzler Shear Machine measured the shearing force in pounds. Six determinations were made along the length of the Pectoralis profundus and the mean was determined. The two end pieces of the muscle were discarded, and samples (5 to 20 grams) were pressed for 10 minutes at 15,000 pounds pressure on the ram (3 1/2 in. diameter) of

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[1]Mazola.

[2]Saran Wrap.

a Carver Laboratory Press. The weight of the residue was obtained and the per cent press fluid was calculated.

Organoleptic Evaluations of Cooked Meat

After cooking, the Pectoralis superficialis muscle was removed and five center slices were prepared. These were offered to the judges so that each individual received the corresponding part of each chicken. Four or six samples were submitted simultaneously. Water was used to rinse the mouth between samples. Aroma, flavor, tenderness, juiciness and general acceptability were evaluated on a 1 to 7 scale. Flavor was categorized as standard, void, foreign or rancid. The judges also were asked whether or not they would purchase a bird of similar quality. A sample score card is included in Appendix B.

Trained panels (5 members on each) were composed of faculty and advanced students of the Foods and Nutrition Department. Three panels evaluated the 9-week-old birds and four panels participated in the study of the older birds. The total individual samples for each panel numbered 32 and 24, respectively.

Analysis of Raw Edible Portion

Preparation of Samples

The birds were thawed and prepared according to the method previously described. The chickens were then placed on cutting boards and were deboned in the cold room at 2 to 5 degrees C., to prevent loss of moisture. The entire edible portion (skin and flesh), with the exception of that beyond the first wing joint, was removed. The leg tendons were discarded. The edible portion was ground three times in

a motor driven grinder[1] fitted with a plate with one-eighth inch holes. The ground sample was collected in a plastic bag and mixed thoroughly after each grinding. Triplicate, 10-gram samples were removed from each bag for moisture, fat and nitrogen analyses. The remainder was sealed in a plastic bag, frozen and stored at -10 degrees C.

Moisture determinations

The triplicate samples were dried to constant weight (2 1/2 to 3 1/2 hours) in a semi-automatic Braebender Moisture Tester (Model F D 4) at 110 degrees C. Preliminary work had established that these conditions were adequate. Readings were taken at half-hour intervals during the drying period. The loss in weight was calculated as per cent moisture.

Crude fat determinations

The ether extract or crude fat was determined by a modification of the A.O.A.C. method (A.O.A.C., 1950, Seventh Edition) in the Goldfisch extractor. The residues from the moisture determinations were ground, quantitatively transferred to fat-free paper extration thimbles and extracted for 3-hours with anhydrous diethyl ether. The increase in weight of the Goldfisch beakers was calculated as the per cent of crude fat and was expressed in terms of the original tissue. In order to remove traces of ether, both the Goldfisch beakers and the thimbles were dried in an oven at 100 degrees C. for 30 minutes and subsequently cooled in desiccators.

[1]Hobart mixer, Model K 5A, fitted with a grinder attachment.

Protein determinations

The boric acid modification of the Kjeldahl-Gunning Method (Scales, F. M. and Harrison, A. P., 1920) was used for triplicate analyses[1] of nitrogen in the dry, fat-free residues. Nitrogen was expressed in terms of original tissue. The factor 6.25 was used to convert to protein.

Statistical Procedure

All data were statistically analyzed by the analysis of variance (Snedecor, 1946) and the multiple range and multiple F tests (Duncan, 1955). The procedures used in calculating analysis of variance for data used in this study are in Appendix B. Calculations for five missing values in the press fluid data are also given in Appendix B. Correlation coefficients were determined according to the method of Snedecor (1959).

[1]The author expresses gratitude to Elizabeth A. Smith for her assistance in these analyses.

RESULTS

Total Cooking Losses

The individual values and means for total cooking losses are recorded in Appendix C. The mean values for 9- and 13-week-old birds are included in Table 1. Analyses of variance indicated no significant differences due to treatment or replications in the cooking losses for 9-week-old male and female birds. However, significant differences were found in the cooking losses for 13-week-old male birds at the 5 per cent level of probability (Table 2). The significant range values in Table 3 reveal the mean cooking loss of birds maintained on Quietrol at the low protein level (32.6 per cent) was significantly higher than those for birds fed all treatments except Lipamone plus low protein (30.7 per cent) and the combination of Lipamone and Quietrol plus low protein (29.7 per cent).

Mechanical Measurements on Cooked Meat

Shear force

Mean shear values for the Pectoralis profundus muscle are located in Appendix C. Statistical analyses of shear force values revealed no significant differences in tenderness due to treatment or replication in the 9- and 13-week-old male and female birds.

Press fluid

The treatment means for press fluid for 9- and 13-week-old birds are recorded in Table 4. Appendix C contains the individual

KEY TO TREATMENTS

Treatment	
1	High Protein Control
2	High Protein plus Lipamone
3	High Protein plus Lipamone and Quietrol
4	High Protein plus Quietrol
5	Low Protein Control
6	Low Protein plus Lipamone
7	Low Protein plus Lipamone and Quietrol
8	Low Protein plus Quietrol

TABLE 1.--Mean total cooking loss for male and female birds maintained on various treatments at 9 and 13 weeks of age

Treatments[1]	Mean total cooking losses			
	9-week-old birds		13-week-old birds	
	Males	Females	Males	Females
	%	%	%	%
1	31.7	35.8	27.8	33.5
2	29.9	33.6	27.2	32.6
3	29.5	35.3	28.7	32.3
4	30.4	33.0	27.1	31.7
5	31.8	36.6	27.6	34.3
6	33.2	34.5	30.7	35.0
7	32.4	35.7	29.7	35.4
8	33.9	36.2	32.6	34.5

[1]For key to treatments see page 21.

TABLE 2.--Analyses of variance of total cooking loss for male and female 13-week-old birds

MALE

Source of Variation	df	Sum of Squares	Mean Squares	F
Replications	5	23.07	4.61	0.54
Treatments	7	157.84	22.55	2.63[1]
Rep. X Treat.	35	300.81	8.59	
Total	47	481.72		

FEMALE

Source of Variation	df	Sum of Squares	Mean Squares	F
Replications	5	20.21	4.04	0.52
Treatments	7	76.69	10.96	1.41
Rep. X Treat.	35	271.43	7.76	
Total	47	368.33		

[1]Significant at the 5% probability level.

TABLE 3.--Significant range values for total cooking loss for male 13-week-old birds (5 per cent probability level)

MALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R_p:	3.4	3.6	3.7	3.8	3.9	3.9	4.0

b) Results

Treatments:	4	2	5	1	3	7	6	8
Means, %:	27.1	27.2	27.6	27.8	28.7	29.7	30.7	32.6

[1]Explanation of Treatment Significance:

Any two means not underscored by the same line are significantly different.

Any two means underscored by the same line are not significantly different.

TABLE 4--Mean press fluid for male and female birds maintained on various treatments at 9 and 13 weeks of age

Treatments[1]	Press fluid			
	9-week-old birds		13-week-old birds	
	Males	Females	Males	Females
	%	%	%	%
1	43.7	45.5	47.6	43.6
2	45.1	43.9	46.4	44.6
3	45.6	45.6	45.2	43.7
4	43.0	44.3	47.8	45.8
5	43.0	45.5	47.5	43.6
6	43.5	40.6	45.8	44.0
7	43.8	44.4	45.1	45.5
8	44.7	42.2	44.2	43.5

[1]For key to treatments see page 21.

values. The effect of treatment upon press fluid was significant for the 9-week-old female birds at the 5 per cent level of probability (Table 5). According to the significant range values in Table 6, birds maintained on Lipamone and the low protein ration did not differ from birds receiving Quietrol at the same level of protein intake, but did yield significantly less press fluid (40.6 per cent) than did birds on all other treatments (43.9 to 45.6 per cent).

Organoleptic Evaluations of Cooked Meat

Mean panel scores with their treatment means for aroma, flavor, tenderness, juiciness and general acceptability are included in Appendix D. Differences in sensory evaluations due to treatment were not significant for any of the birds.

Composition of Raw Edible Portion

Individual values for percentages of moisture, crude fat and protein are listed in Appendix E.

Moisture

The mean percentage moistures for the 9- and 13-week-old birds are recorded in Table 7. Analyses of variance (Table 8) revealed significant differences, in moisture, for the 9-week-old male and female birds due to treatment at the 5 per cent level of probability. The significant range values for these birds are given in Table 9. The moisture contents of 9-week-old male birds maintained on Quietrol (69.2 per cent) and Lipamone (69.3 per cent) did not differ from those of the other two groups fed the same low protein rations; but they were significantly lower than those obtained for birds on all

TABLE 5--Analyses of variance of press fluid for male and female 9-week-old birds

MALE

Source of Variation	df	Sum of Squares	Mean Squares	F
Replications	5	43.92	8.78	1.24
Treatments	7	39.69	5.67	0.80
Rep. X Treat.	35	247.77	7.08	
Total	47	331.38		

FEMALE

Source of Variation	df	Sum of Squares	Mean Squares	F
Replications	5	122.57	24.51	3.67[1]
Treatments	7	133.70	19.10	2.86[2]
Rep. X Treat.	35	233.74	6.68	
Total	47	490.01		

[1]Significant at the 1% probability level.

[2]Significant at tne 5% probability level.

TABLE 16.--Significant range values for the crude fat in the edible portion of male and female 13-week-old birds (5 per cent probability level)

MALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
R_p:	3.8	4.0	4.1	4.2	4.3	4.4	4.4	

b) Results

Treatments:	4	2	1	3	6	7	5	8
Means, %:	8.8	9.2	10.0	10.7	13.3	14.9	15.8	16.3

FEMALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
R_p:	3.2	3.4	3.4	3.5	3.6	3.6	3.7	

b) Results

Treatments:	3	1	2	7	4	5	8	6
Means, %:	11.2	12.9	13.2	13.2	13.6	14.4	14.6	17.9

[1]For explanation of treatment significance see page 24.

for birds fed Lipamone and a high protein diet, was significantly higher than those for birds on all the low protein treatments except the one with Quietrol (16.1 per cent).

The significant difference (5 per cent probability level) in protein content among the 13-week-old male birds was due to treatment (Table 20). According to the mean significant range values (Table 21), the protein contents of birds on the high protein treatments, except the one with Lipamone and Quietrol (17.3 per cent), were significantly higher than those for the low protein control (16.3 per cent) and the low protein ration plus Quietrol (16.3 per cent).

TABLE 8--Analyses of variance of the moisture in the edible portion of male and female 9-week-old birds

MALE

Source of Variation	df	Sums of Squares	Mean Squares	F
Replications	5	19.97	3.99	0.72
Treatments	7	104.99	15.00	2.70[1]
Rep. X Treat.	35	194.41	5.55	
Total	47	319.37		

FEMALE

Source of Variation	df	Sums of Squares	Mean Squares	F
Replications	5	40.70	8.14	1.77
Treatments	7	91.88	13.12	2.85[1]
Rep. X Treat.	35	160.95	4.60	
Total	47	293.53		

[1]Significant at the 5% probability level.

TABLE 9.--Significant range values for the moisture in the edible portion of male and female 9-week-old birds (5 per cent probability level)

MALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R_p:	2.8	2.9	3.0	3.0	3.1	3.1	3.2

b) Results

Treatments:	8	6	7	5	3	2	4	1
Means, %:	69.2	69.3	70.6	71.5	72.3	72.5	72.7	73.3

FEMALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R_p:	2.5	2.7	2.7	2.8	2.8	2.9	2.9

b) Results

Treatments:	6	5	7	1	8	4	3	2
Means, %:	69.4	69.6	70.1	70.6	71.7	72.1	72.5	73.5

[1]For explanation of treatment significance see page 24.

high protein treatments (72.3 to 73.3 per cent). The moisture contents of 9-week-old female birds followed a similar pattern. The values for the birds maintained on low protein treatments did not differ from one another; however, two of these (Lipamone and the controls) were significantly lower (69.4 and 69.6 per cent, respectively) than those for birds fed the high protein rations except the high protein control. One group of female birds (high protein rations plus Lipamone) contained significantly more moisture (73.5 per cent) than the high protein controls (70.6 per cent).

The analyses of variance for the 13-week-old birds are presented in Table 10. The significant range values are in Table 11. The mean moisture content (65.0 per cent) of the male 13-week-old birds fed Quietrol and a low protein ration was significantly lower than the moisture content of birds fed the high protein rations. None of the birds on the low protein treatments differed with respect to moisture content. Thirteen-week-old female birds fed the low protein diet plus Lipamone had a mean moisture of 63.4 per cent which was significantly lower than those of birds on the other treatments.

Crude fat

The treatment means for crude fat of 9- and 13-week-old birds are included in Table 12. The statistical analyses of the data for 9-week-old birds are presented in Tables 13 and 14. The crude fat contents of 9-week-old male birds maintained on the low protein treatments did not differ. However, fat contents of birds on Lipamone (13.1 per cent) or Quietrol (13.0 per cent) at the low protein level, differed significantly from those for birds on all high protein

TABLE 15.--Analyses of variance of crude fat in the edible portion of male and female 13-week-old birds

MALE

Source of Variation	df	Sums of Squares	Mean Squares	F
Replications	5	35.77	7.15	0.67
Treatments	7	393.59	56.23	5.29[1]
Rep. X Treat.	35	371.98	10.63	
Total	47	801.34		

FEMALE

Source of Variation	df	Sums of Squares	Mean Squares	F
Replications	5	88.55	17.71	2.39
Treatments	7	155.96	22.28	3.01[2]
Rep. X Treat.	35	259.09	7.40	
Total	47	503.60		

[1]Significant at the 1% probability level.

[2]Significant at the 5% probability level.

TABLE 14.--Significant range values for the crude fat in the edible portion of male and female 9-week-old birds (5 per cent probability level)

MALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R_p:	3.4	3.5	3.6	3.7	3.8	3.8	3.9

b) Results

Treatments:	1	4	2	3	5	7	8	6
Means, %:	8.2	8.9	9.0	9.5	10.4	11.6	13.0	13.1

FEMALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R_p:	3.0	3.2	3.3	3.4	3.4	3.5	3.5

b) Results

Treatments:	2	3	8	4	1	7	6	5
Means, %:	8.2	10.0	10.2	10.4	11.7	12.5	13.1	13.7

[1]For explanation of treatment significance see page 24.

treatments. The crude fat contents of 9-week-old female birds fed the high protein ration were significantly reduced below those for controls (11.7 per cent) by Lipamone (8.2 per cent). The ether-extractable material in the birds fed Quietrol (10.2 per cent) at the low protein level differed from that of the low protein controls (12.7 per cent).

The analyses of variance (Table 15) revealed significant differences in crude fat due to treatment in 13-week-old birds (at the 1 per cent level for males and at the 5 per cent level of probability for females). The significant range values are reported in Table 16. The edible portion of male birds maintained on the low protein treatments contained significantly more fat (13.3 per cent to 16.3 per cent) than those of birds on two of the high protein diets, Quietrol (8.8 per cent) and Lipamone (9.2 per cent). The fat content of the 13-week-old female birds fed Lipamone at the low protein level was significantly higher (17.9 per cent) than those on all other treatments. The female birds maintained on the high protein ration with the combination of Lipamone and Quietrol contained significantly less fat than those on all low protein rations except the one with Lipamone and Quietrol (13.2 per cent).

Protein

The treatment means for percentage protein for 9- and 13-week-old birds are included in Table 17. Analyses of variance of the mean protein content for 9-week-old male and female birds are in Table 18. The significant range values for the 9-week-old female birds are recorded in Table 19. The mean protein content of 16.3 per cent,

TABLE 21.--Significant range values of protein for male 13-week-old birds (5 per cent probability level)

MALE[1]

a) Shortest Significant Ranges

P:	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R_p:	1.1	1.1	1.2	1.2	1.2	1.2	1.2

b) Results

Treatments:	5	8	7	6	3	1	2	4
Means, %:	16.3	16.3	16.7	16.8	17.3	17.5	17.6	17.6

[1]For explanation of treatment significance see page 24.

DISCUSSION

Total Cooking Losses

Cooking losses were measured for 9- and 13-week-old male and female birds fed the synthetic estrogen Lipamone and/or the tranquilizer Quietrol. Orally administered Lipamone did not exert any effect on cooking losses during roasting. This finding is in disagreement with reports in the literature which demonstrate increased cooking losses in hormonized birds. Fromm and Margolf (1956) found significantly higher cooking losses during broiling in 13-week-old, DES-implanted birds (33.1 per cent) than in unimplanted controls (29.4 per cent). Staddlman et al. (1951) reported similar results in frying 10-week-old DES-pellet-implanted birds and their controls. Dissimilarities in the findings of the current research and of these two reports may be attributed, at least in part, to differences in the hormones and in the cooking methods.

Quietrol did not cause any significant alteration in cooking losses of the 9-week-old birds; but significantly increased them in the 13-week-old male birds fed the low protein ration over the losses for the controls.

Mechanical Measurements

In the present study, treatment of the birds had no significant effect on shear force measurements with the Warner-Bratzler shear machine. The mean values for the shear forces of the Pectoralis

profundus muscle ranged from a low of 3.6 lb., for 9-week-old birds fed the combination of Lipamone and Quietrol at the low protein level, to a high of 6.3 lb., for 13-week-old female birds given Lipamone at the same level of protein intake. Stadelman et al. (1951) reported tenderness of the Pectoralis minor muscle was decreased by the use of DES-implants. The recorded measurements on the Tenderometer averaged 10.5 lb. for control birds and 13.3 lb. for birds implanted with DES. The difference in the magnitude of the shear force values in the current study and in Stadelman's work may be ascribed to the inherent properties of these instruments. Dissimilarities obtained in the effect of hormones in these studies may be attributed to the use of different hormones.

The only significant differences in percentage press fluid, due to treatment, occurred in the 9-week-old female birds. This significance may be explained by mechanical difficulties (breakdown of the Carver Laboratory Press) which happened during the part of the study in which female birds were evaluated. Samples were then wrapped in a plastic film and held in the refrigerator until repairs were made. There were no significant differences, due to treatment, in the press fluids obtained for 13-week-old birds.

Organoleptic Evaluations

In the present study the evaluations for aroma, flavor, tenderness, juiciness and general acceptability were not significantly altered by treatment. This is in agreement with Fry et al. (1958) who found DES hormone treatment did not affect the flavor of baked chickens. In contrast to this, Peterson et al. (1959) found DES decreased flavor in the breast muscle. Peterson also noted DES did not affect the toughness of muscle. Stadelman et al. (1951)

reported no significant differences in acceptability of the breast muscle between DES-pellet-implanted birds and the unimplanted controls.

In the present study, the taste panel occasionally remarked that 9-week-old birds were either "powdery" or "watery." The former term was used to describe one replication of females maintained on the high protein rations plus Lipamone; and the latter, one replication of females fed the same diet with Quietrol. Comments concerning the 13-week-old birds were usually more favorable. In some instances comments made by the taste panel indicated that the controls were least desirable. This occurred primarily in evaluations of the 9-week-old female birds.

Composition of Raw Edible Portion

At the beginning of this study it was hypothesized that a tranquilizer in minute quantities would cause an increase in carcass fat or in the rate of its deposition due to its quieting influence. Since the addition of hormones has been associated with an increase in the production of fat in poultry, it seemed reasonable to theorize further the combination of the two would produce still fatter birds in a shorter time. Observations during this study do not support these hypotheses. The addition of Quietrol to the low protein ration of 9-week-old females significantly reduced the fat content of these birds (10.2 per cent) below their controls (13.7 per cent). The protein of these same birds (16.1 per cent) was increased above the controls (14.7 per cent). Other than the case just cited, the addition of Quietrol alone or the combination of Lipamore and

Quietrol, did not alter the composition from those of the controls, at either level of protein intake.

Apparently, the addition of Lipamone to the low protein diet was effective as a fattener for the 13-week-old females since these birds contained an increased percentage of fat over that for the controls. There was a significant decrease in the moisture contents of these birds. This fattening effect would be expected only in male birds since adult females supply their own estrogens.

Throughout this study it was interesting to observe that treated females usually differed significantly in moisture and fat content from the controls at the same level of protein intake. With respect to composition the treated male birds sometimes differed significantly from birds at a different level of protein intake, but never from the controls at the same level of protein intake.

When comparisons of the two protein levels were made the high protein ration was less effective in producing fat in birds than the low protein ration. Fat contents of these birds were usually significantly lower than those for birds on the low protein rations. Warden et al. (1958) noted significantly reduced fat in birds fed Lipamone on a high protein finisher ration and suggested this might be due to a decreased Caloric/Protein ratio. The rations used in this study were iso-caloric at approximately 1000 calories of productive energy per pound. The high protein rations contained 20 per cent protein for the basal (6-9 weeks) and 16 per cent protein for the finisher (9-13 weeks). The low protein rations contained 16 and 13 per cent protein, respectively, for the basal and the finisher. The observations made

during this study are in agreement with those made by Marion et al.

Correlation coefficients were calculated in order to investigate the relationships between the components of the raw edible portion of the birds. Male and female birds of both age levels were included. A highly significant correlation coefficient of -0.84 was established for fat and moisture. This inverse relationship is in agreement with Hebert and Drunson (1957) who found moisture content decreased as fat content increased. The correlation coefficient for moisture and protein (0.11) was not significant, but the one for fat and protein (-0.43) was highly significant for the birds in the present study. Marion et al. (1959) also observed an inverse relationship of protein and fat content in DES pellet-implanted birds.

SUMMARY AND CONCLUSIONS

This study was designed to determine the influence of Quietrol and/or Lipamone on consumer acceptance of treated birds; and to compare the composition (moisture, crude fat, and protein) of treated and untreated birds.

Ninety-six male and ninety-six female White Plymouth Rock fryer-type chickens were reared on eight dietary treatments (six of both sexes at both ages on each treatment). Lipamone (a synthetic estrogen) and Quietrol (a tranquilizer, a perphenazine derivative) were incorporated into the feed at levels of 1/2 lb. per ton and 4 grams per ton, respectively. Lipamone and Quietrol were fed in conjunction with high and low protein rations. The high protein rations contained 20 per cent protein for the basal (6-9 weeks) and 16 per cent protein for the finisher (9-13 weeks). The low protein rations contained 16 and 13 per cent protein, respectively, for the basal and the finisher. The treatments were initiated when birds were 35 days of age. Forty-eight male and forty-eight female birds were sacrificed at the age of 9 weeks; and the remaining birds at the age of 13 weeks.

The right half of each bird was roasted under standard conditions and evaluated by trained panels. Total cooking loss was measured for each cooked half-bird. Shear force values and press fluids were determined for the cooked Pectoralis profundus muscle. The remaining portion of the left half of each bird was analyzed for moisture, crude fat and protein.

Data were statistically analyzed by the analysis of variance and the multiple range and multiple F tests. Correlation coefficients were calculated for the data collected for moisture, fat, and protein.

Statistical analyses of the sensory evaluations (aroma, flavor, tenderness, juiciness and general acceptability) to measure consumer acceptance, indicated that all of the birds in this study were equally acceptable.

Total cooking losses for the 9-week-old birds of both sexes and for the 13-week-old female birds were not significantly different. However, the loss for 13-week-old male birds fed the low protein diet plus Quietrol was significantly higher than the loss for birds fed the low protein control diet and for birds fed the high protein diets. Analyses of variance revealed no significant differences due to treatments for shear force values. The values for percentage press fluids of 9-week-old male birds and 13-week-old birds of both sexes did not differ significantly.

With respect to carcass composition the treated females usually differed significantly in moisture and fat content from the controls at the same level of protein intake. Treated males never differed from the controls at the same level of protein intake. Orally administered Lipamone, in the low protein ration of 13-week-old female birds, caused significant reductions in moisture and increases in crude fat. This was not true of birds fed the high protein rations. The addition of Quietrol to the low protein ration significantly reduced fat and increased the protein in the carcasses of 9-week-old female birds below those of the controls. Quietrol and Lipamone combined in

in the low protein ration did not differ from the control ration in effecting the moisture, fat and protein contents of male and female birds of both ages. This was also true for the combination of Quietrol and Lipamone in the high protein ration.

Significant differences, due to treatments, between the two levels of protein intake were frequently observed in the birds. It seems apparent that the decreased Calorie/Protein ration, rather than Lipamone or Quietrol, was the primary cause of the sharply decreased fat contents and increased moisture contents in the birds maintained on the high protein rations.

There was an inverse relationship of fat to moisture and protein to fat in the edible portion of the birds (both sexes). The highly significant correlation coefficients were -0.84 for the former and -0.43 for the latter. The correlation coefficient (0.11) of moisture to protein was not significant.

The tranquilizer Quietrol, in the amounts used in this study (4 grams per ton of feed) was not an effective fattener either alone or in combination with Lipamone.

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APPENDIX A

Production of Birds

TABLE 22.--High energy starter ration
(Used from 1 through 5 weeks)

Ingredient	Lb. or gm./ 100 lb.
Corn, grd. no. 2 yellow	45.00
Alfalfa leaf meal, (20 per cent protein)	2.50
Soybean oil meal, (50 per cent protein	36.00
Menhaden fish meal, (60 per cent protein)	2.00
Meat and bone scrape, (50 per cent protein)	2.50
Ground limestone	0.75
Dicalcium phosphate	1.25
Salt, iodized	0.50
Whey, delactose (50 per cent lactose)	0.50
Brewers dried yeast	0.50
No. 2 yellow grease	8.00
Vitamin supplement no. 1	34 gm.
Vitamin D_3 (3,000 I.C.U./gm.)	10 gm.
Choline chloride (25 per cent supplement)	30 gm.
Vitamin B_{12} supplement (6 mg./lb.)	0.10
Methionine	0.10
Delamix	0.10
Niacin	1 gm.
	100 lb.
Calculated analysis:	
Crude protein, per cent	25
Crude fat, per cent	10.5
Crude fiber, per cent	2.5
Productive energy (Cal./lb.)	1025

TABLE 23.--Grower ration (basal from 5 through 9 weeks)

Ingredients	High Protein Lb. or gm. per 100 lb.	Low Protein Lb. or gm. per 100 lb.
Corn, grd. no. 2 yellow	54.88	72.73
Soy bean oil, solv. 44 per cent	30.00	16.00
Fat no. 2 yellow grease	5.00	1.00
Alfalfa leaf meal, (20 per cent protein)	2.50	2.50
Meat and bone scraps, (50 per cent protein)	2.50	2.50
Fish meal (Menhaden, 60 per cent protein)	0.50	0.50
Whey, delactosed product	0.50	0.50
Yeast, dried, brewers	0.50	0.50
Salt, iodized	0.50	0.50
Dicalcium phosphate	2.00	2.00
Limestone, grd. (98 per cent $CaCO_3$)	1.00	1.00
Delamix	0.10	0.10
Vitamin supplement 249c	0.05	0.05
Choline chloride (25 per cent dry mix)	----	0.10
Nicarbazin (25 per cent dry mix)	0.05	0.05
Vit. D_3 (3000 I.C.U./gm.)	10 gm.	10 gm.
Vit. A (10,000 I.U./gm.)	10 gm.	10 gm.
	100 lb.	100 lb.
Calculated analysis:		
Crude protein, per cent	20.2	15.6
Crude fat, per cent	7.7	4.3
Crude fiber, per cent	2.5	3.2
Productive energy (Cal./lb.)	998	984

TABLE 24.--Finisher ration (basal from 10 through 13 weeks)

Ingredients	High Protein lb. or gm. per 100 lb.	Low Protein lb. or gm. per 100 lb.
Corn, no. 2 grd. yellow	68.59	78.63
Soybean oil meal, dehulled (50 per cent protein)	13.60	6.00
No. 2 yellow grease	3.50	1.00
Wheat, middling flour	5.00	5.00
Meat and bone scraps	2.50	2.50
Alfalfa leaf meal (20 per cent protein)	2.50	2.50
Whey, delactosed product	0.50	0.50
Yeast, dried brewers	0.50	0.50
Fish mean (Menhaden)	0.50	0.50
Limestone, grd.	1.00	1.00
Dicalcium phosphate	1.00	1.00
Salt, iodized	0.50	0.50
Delamix	0.10	0.10
Vitamin supplement 249c	0.05	0.05
Vitamin supplement (6mg./lb.)	0.05	0.05
Nicarbazin (25 per cent mix)	0.05	0.05
Choline chloride (25 per cent dry mix)	10 gm.	10 gm.
Vit. A supplement (10,000 U.S.P./gm.)	10 gm.	10 gm.
Vit. D_3 supplement (3,000 I.C.U./gm.)	10 gm.	10 gm.
	100 lb.	100 lb.
Calculated analysis:		
Crude protein, per cent	15.95	13.02
Crude fat, per cent	6.64	4.47
Crude fiber, per cent	2.66	2.69
Productive energy (cal./lb)	1041.30	1038.30

TABLE 25.--Replications of male and female 9-week-old birds[1]

9-week-old Male Birds						
Treatments[2]	Replications					
	1	2	3	4	5	6
1	6083	5625	5871	5907	5977	5848
2	5807	5725	6142	6120	5690	6180
3	6177	5877	5654	6097	6173	6028
4	5912	6056	5698	5936	6117	5665
5	6029	5919	5699	5718	6048	5980
6	5790	6046	5823	5643	5650	5636
7	5618	6166	5661	5795	5858	5785
8	6110	5688	5993	5760	6107	6016

9-week-old Female Birds						
Treatments[2]	Replications					
	1	2	3	4	5	6
1	6251	246	6433	344	311	6476
2	213	325	6326	373	6426	6360
3	6463	6252	300	6248	6274	6431
4	358	6430	249	492	6316	225
5	6285	6437	382	6375	6255	6384
6	216	6402	289	6383	6409	6373
7	384	269	473	415	6429	6237
8	6374	6350	352	341	343	429

[1]This is the order in which sensory evaluations were made. The same replications were used throughout the study.

[2]For key to treatments see page 21.

TABLE 26.--Replications of male and female 13-week old birds[1]

13-week-old Male Birds						
Treatments[2]	Replications					
	1	2	3	4	5	6
1	5723	5727	6147	5992	6071	6066
2	5610	5944	5892	6158	5890	5953
3	5675	5862	5613	5783	5965	6067
4	5923	5989	5737	5866	5764	5780
5	6111	6011	6115	5616	5928	5686
6	5920	5739	6037	5629	5629	6003
7	5743	6151	5908	6082	5724	6077
8	5885	6137	5700	6081	5749	5762

13-week-old Female Birds						
Treatments[2]	Replications					
	1	2	3	4	5	6
1	6328	6490	6307	6435	6363	264
2	6212	390	6244	209	400	248
3	6209	480	302	6386	6203	255
4	425	6397	479	387	6284	6279
5	208	6358	6473	6344	220	203
6	6325	242	6364	6392	261	6401
7	6331	6257	237	402	6396	6497
8	427	365	6478	6468	238	6334

[1]This is the order in which sensory evaluations were made. The same replications were used throughout the study.

[2]For key to treatments see page 21.

APPENDIX B

Statistical Procedures

TABLE 27.--Procedure for calculating taste panel scores for the aroma of the Pectoralis superficialis muscle of 9-week-old male birds[1]

Source of Variation	df	Method
Correcting term$_1$		$\frac{(\Sigma P-)^2}{24} = \frac{116.2}{24} * 562.60$
Treatments Sum of Squares	7	$\frac{\Sigma Tr^2}{3} - C.T._1 = \frac{1688.48}{3} - 562.60=0.23$
Panels Sum of Squares	2	$\frac{\Sigma Pa^2}{8} - C.T._1 = \frac{4516.74}{8} - 562.60=1.99$
Total Sum of Squares	23	$\Sigma X_a^2 - C.T._1 = 565.58 - 562.60 = 3.18$
Treatment x Panels Sum of Squares	16	Total-Treatments-Panels 3.18 - 0.23 - 1.99 = 0.96
Correcting term$_2$		$\frac{(\Sigma X)^2}{48} = \frac{53515.36}{48} = 1115.54$
Total	47	$\Sigma X^2 - C.T._2 = 1126.68 - 115.54 = 11.14$
Classes	23	$\frac{\Sigma y^2_c}{2} + \frac{\Sigma y^2_d}{1} + \frac{\Sigma y^2_e}{3} - C.T._2 =$
		$\frac{1534.22}{2} + \frac{24.36}{1} + \frac{782.18}{3} - 115.54 = 7.25$
Error	24	Total - Classes 11.14-7.25 = 3.89
Mean Square$_1$ of Error		$\frac{3.89}{24 \text{ df}} = 0.16$
Mean Square$_2$ of Error		$1/24 \left[\frac{16}{2} + \frac{4}{1} + \frac{47}{3}\right] = 0.56 \times 0.16=0.09$

[1]These calculations followed the "Unweighted Mean" method of Snedecor (1947). Calculations for analyses of variance of aroma for 9-week-old female birds were computed by this method also.

TABLE 28.--Procedure for calculating analysis of variance for taste panel data

9-week-old Birds			
Source of Variation	df	Male	Female
Correcting term		$\frac{(\Sigma M)^2}{48}$	$\frac{(\Sigma F)^2}{48}$
Treatments Sum of Squares	7	$\frac{\Sigma T^2_m}{6}$ - C.T.	$\frac{\Sigma T^2_f}{6}$ - C.T.
Panels Sum of squares	2	$\frac{\Sigma P^2_m}{16}$ - C.T.	$\frac{\Sigma P^2_f}{16}$ - C.T.
Treat.X Panel Sum of Squares	14	$\frac{\Sigma Y^2_a}{2} + \frac{\Sigma Y^2_b}{1} + \frac{\Sigma Y^2_c}{3}$ - C.T.	Same for females
		Subtract above from Panels and Treatments.	
Total Sum of Squares	47	ΣX^2_m - C.T.	ΣX^2_f - C.T.
Error term Sum of Squares	24	Total - Treatments - Panels - Treat.X Panels.	

TABLE 20.--Procedure for calculating analysis of variance for taste panel data

13-week-old Birds			
Source of Variation	df	Male	Female
Correcting term		Same as for 9-week-old birds	
Treatments Sum of Squares	7	Same as for 9-week-old birds	
Panels Sum of Squares	3	$\frac{\Sigma P^2_m}{12}$ - C.T.	$\frac{\Sigma P^2_f}{12}$ - C.T.
Treat. X Panel	21	$\frac{\Sigma Y_a^2}{2} + \frac{\Sigma Y_b^2}{1}$ - C.T.	Same for females
		Subtract above from Panels and Treatments.	
Total Sum of Squares	47	Same as for 9-week-old birds	
Error term Sum of Squares	16	Total - Treatments - Panels - Treat. X Panels.	

TABLE 30.--Procedure for calculating analysis of variance for all other data

Source of Variation	df	Male	Female
Correcting term		Same as for Taste Panel Data	
Replications Sum of Squares	5	$\frac{\Sigma R^2 m}{8}$ - C.T.	$\frac{\Sigma R^2 f}{8}$ - C.T.
Treatments	7	$\frac{\Sigma T^2 m}{6}$ - C.T.	$\frac{\Sigma T^2 f}{6}$ - C.T.
Treat. X Rep. Sum of Squares	35	Total - Treatments - Replications	
Total Sum of Squares	47	ΣX^2 - C.T.	ΣX^2 - C.T.

TABLE 31.--Procedure for calculating the missing values in percentage press fluid in the Pectoralis profundus muscle for 9-week and 13-week-old birds

The following formula was used:

$$X = \frac{r.R_j + t.T_j - G}{(r-1)\quad(t-1)}$$

Key:

X = missing value

r = number of replications = 6

R_j = Σ of rep. = total of 7 values for male or female birds in the replications.

t = number of treatments = 8

T_j = Σ of treat. = total of 5 values for male or female birds in the treatment.

G = Grand Total of all Male OR Female birds.

I. 9-week-old birds. Replication #3. Treatment #8.

$$X = \frac{(6)\ 303.23 + (8)\ 219.32 - 2071.42}{(5)\quad(7)}$$

$X = 42.93$

II. 9-week-old birds. Replication #3. Treatment #15.

$$X = \frac{(6)\ 311.82 + (8)\ 221.39 - 2069.22}{(5)\quad(7)}$$

$X = 44.94$

TABLE 31.--Continued

III. 9-week-old birds. Replication #5. Treatment #5.

$$X = \frac{(6)\ 303.79 * (8)\ 204.00 - 2073.36}{(5)\ (7)}$$

$$X = 44.22$$

IV. 9-week-old birds. Replication #5. Treatment #6.

$$X = \frac{(6)\ 297.52 * (8)\ 228.72 - 2067.09}{(5)\ (7)}$$

$$X = 39.47$$

V. 13-week-old birds. Replication #3. Treatment #4.

$$X = \frac{(6)\ 308.46 * (8)\ 229.05 - 2080.15}{(5)\ (7)}$$

$$X = 45.80$$

APPENDIX C

Cooking Losses and Mechanical Measurements on Cooked Meat

TABLE 32.--Total cooking loss for male and female 9-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	32.0	31.3	33.5	31.6	32.7	29.2	31.7
2	26.7	25.9	29.8	32.4	37.3	27.4	29.9
3	24.0	31.3	33.7	27.3	30.7	30.1	29.5
4	23.9	29.6	27.5	35.1	34.4	31.6	30.4
5	32.5	32.3	33.7	31.4	31.3	29.7	31.8
6	31.9	34.8	35.4	36.3	29.5	31.2	33.2
7	28.4	33.1	34.5	33.6	34.6	30.4	32.4
8	36.9	33.6	31.8	33.6	33.2	34.5	33.9

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	44.7	39.5	32.9	34.0	35.1	28.7	35.8
2	27.5	35.2	31.8	35.0	36.2	35.9	33.6
3	34.3	34.5	33.1	34.9	37.2	37.8	35.3
4	27.3	38.7	29.2	36.6	34.3	32.2	33.0
5	35.6	35.1	33.4	35.2	38.3	42.1	36.6
6	36.3	31.9	31.5	29.5	37.6	40.4	34.5
7	38.8	35.6	35.7	33.2	34.4	36.6	35.7
8	36.7	34.1	32.7	38.6	34.5	40.3	36.2

[1]For key to treatments see page 21.

TABLE 33.--Total cooking loss for male and female 13-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	30.2	26.9	27.7	24.7	25.9	31.2	27.8
2	27.7	28.3	25.1	29.4	27.8	25.2	27.2
3	26.6	33.1	26.2	29.1	26.1	31.0	28.7
4	27.1	30.2	28.4	22.5	25.8	28.5	27.1
5	33.6	26.8	24.4	24.1	32.6	24.4	27.6
6	26.2	26.3	32.9	31.6	34.2	33.0	30.7
7	30.0	31.9	30.1	26.7	30.9	28.4	29.7
8	34.6	33.2	29.5	35.2	32.4	30.6	32.6

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	34.3	34.7	35.9	34.4	33.4	28.2	33.5
2	32.0	35.5	31.6	33.4	33.1	30.3	32.6
3	32.6	33.9	33.7	29.4	30.7	33.4	32.3
4	29.8	29.1	33.7	32.4	33.6	31.8	31.7
5	25.7	39.2	32.8	36.3	30.0	41.7	34.3
6	36.6	34.9	34.0	34.7	33.3	36.7	35.0
7	37.8	34.8	33.9	36.0	35.7	34.4	35.4
8	32.9	36.2	34.7	33.5	35.2	34.5	34.5

[1]For key to treatments see page 21.

TABLE 34.--Mean shear value in pounds for the Pectoralis profundus muscle of male and female 9-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 lbs.	2 lbs.	3 lbs.	4 lbs.	5 lbs.	6 lbs.	lbs.
1	3.8	4.8	3.6	5.0	4.5	3.4	4.2
2	4.5	5.9	5.9	6.4	3.9	4.1	5.1
3	3.8	3.5	7.3	4.6	4.1	4.2	4.6
4	5.1	6.4	3.9	3.4	4.5	4.7	4.7
5	7.1	6.5	3.2	6.0	5.7	3.0	5.2
6	5.4	6.0	4.8	4.2	3.5	3.9	4.6
7	3.8	3.5	7.6	3.7	5.5	5.4	4.9
8	4.1	5.4	4.2	4.1	3.0	4.7	4.2

FEMALE

Treatments[1]	Replications						Means
	1 lbs.	2 lbs.	3 lbs.	4 lbs.	5 lbs.	6 lbs.	lbs.
1	3.2	5.3	3.5	4.9	6.4	5.4	4.8
2	4.2	4.1	3.5	5.9	2.6	3.6	4.0
3	3.0	3.8	4.1	4.0	4.0	3.0	3.6
4	3.0	3.6	3.6	6.8	4.6	4.7	4.4
5	3.2	3.7	3.3	4.5	3.5	5.0	3.9
6	4.2	5.0	6.2	4.1	3.9	4.1	4.6
7	3.3	2.9	5.0	3.5	3.5	4.5	3.8
8	4.2	3.9	4.0	5.7	3.2	4.8	4.3

[1]For key to treatments see page 21.

TABLE 35.--Mean shear value in pounds for the Pectoralis profundus muscle of male and female 13-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 lbs.	2 lbs.	3 lbs.	4 lbs.	5 lbs.	6 lbs.	lbs.
1	7.1	4.7	5.0	4.5	5.7	5.2	5.4
2	8.1	6.6	4.4	5.6	5.5	6.7	6.2
3	6.2	5.1	5.9	6.5	3.1	4.6	5.2
4	5.4	4.8	4.5	5.6	7.2	5.2	5.4
5	3.5	5.3	5.9	6.5	5.3	5.1	5.3
6	5.4	4.3	6.5	7.5	5.5	5.8	5.8
7	3.6	6.2	6.1	10.5	4.2	5.0	5.9
8	5.2	4.2	5.6	5.5	4.4	5.6	5.1

FEMALE

Treatments[1]	Replications						Means
	1 lbs.	2 lbs.	3 lbs.	4 lbs.	5 lbs.	6 lbs.	lbs.
1	5.3	6.3	6.2	4.4	4.8	6.9	5.6
2	6.3	4.6	5.5	6.4	5.3	9.7	6.3
3	6.0	6.0	4.1	7.0	5.2	4.9	5.5
4	5.9	6.3	3.8	8.2	4.7	4.1	5.5
5	3.7	6.7	7.3	5.7	5.3	6.0	5.8
6	8.0	7.3	5.2	4.8	6.0	5.1	6.1
7	5.6	6.0	5.4	4.9	3.9	6.7	5.4
8	6.0	7.6	5.1	7.1	3.5	6.4	6.0

[1]For key to treatments see page 21.

TABLE 36.--Press fluid for the Pectoralis profundus muscle from male and female 9-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	48.7	41.6	42.9[2]	44.6	41.5	43.0	43.7
2	49.3	47.9	42.3	43.3	41.6	46.3	45.1
3	50.0	45.8	43.0	45.0	45.7	43.9	45.6
4	50.0	43.1	39.4	42.7	41.1	42.0	43.0
5	40.9	43.2	44.4	44.6	41.9	42.7	43.0
6	44.5	41.8	41.1	43.5	43.0	46.9	43.5
7	43.8	43.0	44.1	42.6	45.4	43.8	43.8
8	40.9	48.9	48.8	42.0	46.6	41.1	44.7

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	47.6	43.0	46.5	46.0	44.9	44.8	45.5
2	46.6	47.6	44.9	42.4	41.2	40.7	43.9
3	49.5	47.1	42.2	48.8	43.6	42.5	45.6
4	48.2	44.1	45.6	42.0	43.2	42.6	44.3
5	45.4	48.4	47.2	48.5	44.2[2]	39.2	45.5
6	44.0	45.4	42.0	31.4	39.5[2]	41.2	40.6
7	44.3	48.4	44.9[2]	42.4	41.8	44.4	44.4
8	42.4	43.1	43.3	40.6	43.5	40.0	42.2

[1]For key to treatments see page 21.

[2]Missing values; calculations in Appendix B.

TABLE 37.--Press fluid for the Pectoralis profundus muscle in male and female 13-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	52.8	43.6	47.6	48.6	50.7	42.0	47.6
2	45.9	47.1	49.4	44.7	44.4	47.1	46.4
3	45.4	41.7	45.4	49.0	44.1	45.9	45.2
4	51.9	41.7	51.6	48.1	47.3	46.1	47.8
5	49.3	49.7	45.4	46.0	45.5	49.3	47.5
6	46.4	46.2	47.2	44.4	40.5	50.0	45.8
7	47.6	42.2	44.7	42.3	45.0	48.6	45.1
8	45.8	44.6	46.2	42.6	41.6	44.7	44.2

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	41.7	42.8	40.5	45.0	46.0	45.4	43.6
2	42.8	34.8	44.7	48.1	54.4	42.7	44.6
3	42.5	43.0	42.9	46.1	45.1	42.6	43.7
4	46.6	45.9	45.8[2]	40.0	48.5	48.1	45.8
5	47.4	42.5	43.0	46.0	45.5	37.4	43.6
6	44.8	44.0	44.8	42.9	47.6	39.8	44.0
7	47.7	44.4	47.1	45.7	44.0	44.0	45.5
8	41.2	40.0	45.4	43.3	45.2	46.1	43.5

[1]For key to treatments see page 21.

[2]Missing values; calculations in Appendix B.

APPENDIX D

Organoleptic Evaluations

TABLE 38.--Score card for birds

Res. Judge _____ Date _____

	FACTOR	7	6	5	4	3	2	1
Breast	Aroma	Extremely Good	Very Good	Good	Medium	Fair	Poor	Very Poor
	Flavor	Extremely Good	Very Good	Good	Medium	Fair	Poor	Very Poor
	Tenderness	Extremely Tender	Very Tender	Tender	Medium	Fair	Tough	Very Tough
	Juiciness	Extremely Juicy	Very Juicy	Juicy	Medium	Fair	Dry	Very Dry
	General Acceptability	Extremely Good	Very Good	Good	Medium	Fair	Poor	Very Poor
	Acceptable Yes or No							

Flavor	Breast
Standard	_____
Void	_____
Foreign	_____
Rancid	_____

TABLE 39.--Mean scores for panels for the evaluation of the aroma of the male and female 9-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.4	4.2	5.4	5.2	5.2	4.8	4.6	5.8
	5.4	5.4	5.2	5.4	5.2	5.0	5.2	5.0
2	5.2	4.6	5.0	5.2	5.2	5.4	5.4	4.8
	4.6	4.6	-	-	4.6	5.6	4.8	5.2
	-	-	-	-	4.2	5.4	-	-
3	5.2	4.8	4.0	4.2	4.6	4.6	4.0	4.2
	4.0	4.4	4.2	4.2	-	-	4.6	4.6
	-	-	4.4	4.2	-	-	-	-
MEAN	4.8	4.7	4.7	4.7	4.8	5.1	4.8	4.9

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	5.6	5.6	5.2	5.4	5.6	5.6	5.8	5.8
	5.6	5.4	5.4	5.4	5.6	5.6	5.6	5.8
2	5.4	5.4	5.6	5.0	5.4	5.4	6.0	5.8
	5.0	6.2	-	-	6.2	5.8	5.8	5.3
	-	-	-	-	5.3	5.5	-	-
3	4.2	4.4	4.2	4.8	4.0	4.2	4.4	4.2
	4.0	4.6	4.0	4.2	-	-	4.4	4.0
	-	-	4.8	4.2	-	-	-	-
MEAN	5.0	5.3	4.9	4.8	5.4	5.4	5.3	5.2

[1]For key to treatments see page 21.

TABLE 40.--Mean scores for panels for the evaluation of the flavor of male and female 9-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.6	4.0	5.8	5.4	5.0	4.0	5.0	5.4
	4.6	4.4	4.6	5.2	4.4	4.4	5.4	5.4
2	3.8	2.6	3.6	4.4	3.8	5.0	5.0	4.0
	4.0	3.8	-	-	3.2	4.4	3.2	3.8
	-	-	-	-	1.8	3.6	-	-
3	4.6	4.4	3.4	3.0	3.8	3.0	3.2	2.0
	3.6	2.8	4.3	1.4	-	-	3.2	3.8
	-	-	4.2	4.0	-	-	-	-
MEAN	4.2	3.7	4.3	3.9	3.7	4.1	4.2	4.1

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	5.2	5.2	4.6	4.4	4.8	5.4	4.6	5.6
	5.0	5.0	4.2	4.6	5.0	4.4	4.0	4.8
2	5.2	4.0	4.0	4.6	5.6	5.0	5.4	4.4
	3.0	4.0	-	-	5.6	4.6	4.8	4.8
	-	-	-	-	2.6	3.6	-	-
3	3.8	4.2	3.8	4.0	3.6	3.4	4.2	4.2
	3.6	2.6	3.2	4.0	-	-	3.6	3.8
	-	-	2.6	3.6	-	-	-	-
MEAN	4.3	4.2	3.7	4.2	4.5	4.4	4.4	4.6

[1]For key to treatments see page 21.

TABLE 41.--Mean scores for panels for the evaluation of the tenderness of male and female 9-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	3.8	5.0	4.2	4.6	4.6	4.2	5.4	4.8
	5.0	5.8	4.4	4.4	3.4	5.6	5.4	4.8
2	5.0	3.6	5.8	4.8	5.6	6.2	5.2	3.2
	4.6	5.0	-	-	4.2	5.8	2.6	5.0
	-	-	-	-	5.6	6.0	-	-
3	3.8	3.8	3.6	2.2	5.8	3.4	5.2	3.4
	5.4	3.6	3.2	5.8	-	-	5.0	4.8
	-	-	5.2	4.4	-	-	-	-
MEAN	4.6	4.5	4.4	4.4	4.9	5.2	4.8	4.3

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.8	4.2	5.6	5.2	4.0	5.0	4.6	5.8
	4.6	5.0	4.6	4.8	2.8	4.0	3.8	4.8
2	5.0	5.2	2.4	2.6	4.4	4.6	5.6	4.2
	3.6	4.2	-	-	6.0	5.0	5.2	4.2
	-	-	-	-	3.4	4.0	-	-
3	5.6	3.4	3.8	4.6	3.6	3.6	3.0	3.2
	3.4	5.6	5.8	2.6	-	-	3.0	3.6
	-	-	5.2	4.0	-	-	-	-
MEAN	4.5	4.6	4.6	4.0	4.0	4.4	4.2	4.3

[1]For key to treatments see page 21.

TABLE 42.--Mean scores for panels for the evaluation of the juiciness of male and female 9-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.4	4.0	5.0	5.2	4.0	3.6	5.2	5.0
	3.8	3.8	4.2	4.6	4.0	3.6	4.4	4.2
2	4.2	3.8	3.8	3.8	4.0	4.6	4.2	3.8
	4.6	4.8	-	-	3.8	3.8	2.8	4.4
	-	-	-	-	4.8	5.0	-	-
3	4.4	3.8	2.6	3.4	4.0	3.8	3.4	3.0
	4.2	2.8	4.0	2.4	-	-	4.6	3.0
	-	-	3.8	3.8	-	-	-	-
MEAN	4.3	3.8	3.9	3.9	4.1	4.1	4.1	3.9

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.6	4.0	5.0	3.8	4.2	5.0	4.4	4.8
	4.0	3.8	3.4	4.0	3.8	3.0	4.0	4.0
2	3.0	4.4	3.6	4.2	4.4	4.0	3.8	4.2
	4.2	5.0	-	-	4.8	4.4	4.0	3.8
	-	-	-	-	3.6	3.8	-	-
3	3.8	2.8	3.2	3.2	3.8	3.4	2.6	2.8
	4.2	2.4	3.4	3.6	-	-	3.2	3.6
	-	-	4.0	4.5	-	-	-	-
MEAN	4.0	3.7	3.8	3.9	4.1	3.9	3.7	3.9

[1]Forkey to treatments see page 21.

TABLE 43.--Mean scores for panels for the evaluation of the general acceptability of the male and female 9-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	3.8	4.5	4.4	4.8	4.2	4.0	5.0	5.2
	4.6	4.4	4.4	4.6	3.8	4.4	4.6	4.4
2	4.2	2.8	4.0	4.0	4.0	5.0	4.6	3.6
	4.2	4.8	-	-	3.2	4.4	3.6	4.2
	-	-	-	-	2.0	4.0	-	-
3	4.4	4.4	2.4	3.0	4.2	3.2	3.4	2.6
	3.8	3.0	4.0	2.2	-	-	3.6	4.0
	-	-	4.2	4.2	-	-	-	-
MEAN	4.2	4.0	3.9	3.8	3.6	4.2	4.1	4.0

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.8	4.4	4.8	4.4	4.4	5.0	4.2	5.6
	4.6	4.6	3.8	4.4	3.6	3.6	3.8	4.4
2	4.4	4.2	3.4	4.2	5.2	5.0	5.2	4.4
	3.4	4.2	-	-	5.0	5.0	4.8	4.6
	-	-	-	-	3.0	3.8	-	-
3	3.6	3.6	3.8	4.0	3.8	3.6	3.6	3.6
	3.6	3.0	3.4	3.4	-	-	3.6	3.6
	-	-	3.2	4.0	-	-	-	-
MEAN	4.1	4.0	3.7	4.1	4.2	4.3	4.2	4.5

[1]For key to treatments see page 21.

TABLE 44.--Mean scores for panels for the evaluation of the aroma of the male and female 13-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	5.4 5.8	4.2 5.8	4.4 5.8	5.0 5.8	5.2 -	5.2 -	5.2 -	5.6 -
2	5.0 -	5.5 -	5.5 -	5.0 -	5.4 5.0	5.8 4.8	5.2 4.8	4.8 4.8
3	4.8 -	5.2 -	5.4 -	4.6 -	5.2 4.8	4.8 4.4	5.2 5.2	5.4 4.6
4	5.2 4.6	5.0 4.8	4.8 4.0	5.0 4.8	3.8 -	4.6 -	4.8 -	5.0 -
MEAN	5.1	5.1	5.0	5.0	4.9	4.9	5.1	5.0

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.4 -	5.0 -	4.8 -	5.4 -	5.4 4.8	5.0 4.2	5.8 5.2	5.2 4.0
2	5.0 5.6	5.6 5.2	5.0 4.8	5.6 4.8	5.0 -	5.2 -	5.4 -	4.4 -
3	5.0 4.8	5.2 4.4	5.0 4.0	4.8 4.8	4.6 -	4.2 -	4.6 -	4.6 -
4	4.8 -	5.4 -	4.6 -	4.2 -	4.6 4.0	4.4 4.8	4.8 5.2	5.2 5.0
MEAN	4.9	5.1	4.7	4.9	4.7	4.6	5.2	4.7

[1]For key to treatments see page 21.

TABLE 45.--Mean scores for panels for the evaluation of the flavor of the male and female 13-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.8	5.0	5.4	5.4	4.8	4.8	4.4	5.0
	5.6	5.8	5.0	5.6	-	-	-	-
2	4.2	4.6	4.8	3.8	4.0	4.8	4.2	4.8
	-	-	-	-	3.6	4.8	3.6	4.6
3	4.6	4.6	4.8	4.2	4.8	4.8	5.6	5.2
	-	-	-	-	4.6	4.5	5.4	4.2
4	5.6	4.6	4.4	4.6	4.0	4.5	4.0	4.6
	4.6	4.2	4.2	5.2	-	-	-	-
MEAN	4.9	4.8	4.8	4.8	4.3	4.7	4.5	4.7

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.8	5.2	4.4	5.0	4.6	4.0	5.6	5.0
	-	-	-	-	4.8	4.2	4.8	4.0
2	4.2	4.8	4.0	4.6	4.6	5.4	4.6	4.0
	4.6	3.8	4.8	4.4	-	-	-	-
3	3.0	5.2	4.4	4.4	3.6	4.2	3.4	4.0
	4.6	4.6	4.2	4.2	-	-	-	-
4	4.4	5.4	4.6	5.2	4.0	4.0	4.4	4.8
	-	-	-	-	4.0	3.4	4.2	4.8
MEAN	4.3	4.8	4.4	4.6	4.3	4.2	4.5	4.4

[1]For key to treatments see page 21.

TABLE 46.--Mean scores for panels for the evaluation of the tenderness of the male and female 13-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	5.4	4.2	6.0	6.2	4.8	4.2	5.4	4.8
	5.8	6.0	5.4	5.4	-	-	-	-
2	4.0	4.0	4.8	5.4	5.8	5.4	5.6	3.2
	-	-	-	-	5.6	5.2	5.4	5.6
3	5.4	5.2	5.8	3.8	5.4	5.4	4.8	5.4
	-	-	-	-	4.4	4.4	4.4	5.2
4	6.4	6.2	4.6	5.6	4.4	4.8	5.6	5.2
	5.0	4.2	4.2	5.6	-	-	-	-
MEAN	5.3	5.0	5.1	5.3	5.1	4.9	5.2	4.9

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	3.8	5.8	5.6	4.6	6.0	5.4	4.0	4.8
	-	-	-	-	5.4	2.6	4.8	3.6
2	4.8	3.6	5.4	5.4	4.8	4.0	5.6	5.2
	6.0	4.8	3.2	5.4	-	-	-	-
3	3.4	4.4	4.8	4.6	2.0	5.0	5.4	5.6
	3.2	4.4	5.4	3.6	-	-	-	-
4	5.2	5.0	4.6	5.8	3.2	4.4	4.0	5.2
	-	-	-	-	3.0	4.2	5.2	3.2
MEAN	4.4	4.7	4.8	4.9	4.1	4.3	4.8	4.6

[1]For key to treatments see page 21.

TABLE 47.--Mean scores for panels for the evaluation of the juiciness of the male and female 13-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	3.4	4.0	5.6	4.8	5.0	4.2	3.6	4.6
	4.8	5.4	4.8	5.8	-	-	-	-
2	2.8	4.4	3.8	3.4	4.8	4.8	4.2	3.2
	-	-	-	-	3.4	3.2	3.8	3.4
3	3.8	4.4	5.0	4.0	5.4	4.8	4.6	4.0
	-	-	-	-	3.8	4.4	3.2	4.0
4	5.6	5.4	5.0	4.6	4.6	3.8	4.6	4.8
	3.6	4.6	3.8	4.6	-	-	-	-
MEAN	4.0	4.7	4.7	4.5	4.5	4.2	4.0	4.0

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	3.4	3.0	2.8	4.6	4.8	3.4	4.2	5.2
	-	-	-	-	3.2	2.8	3.6	4.2
2	2.8	4.4	4.2	4.4	3.4	4.2	3.4	2.6
	4.4	3.0	4.6	3.8	-	-	-	-
3	3.8	4.2	2.6	3.4	3.6	3.0	3.2	3.6
	4.4	4.4	3.8	3.4	-	-	-	-
4	4.6	4.6	3.8	4.2	3.8	3.8	3.6	4.2
	-	-	-	-	3.0	3.6	4.2	4.6
MEAN	3.9	3.9	3.6	4.0	3.6	3.5	3.7	4.1

[1]For key to treatments see page 21.

TABLE 13.--Mean scores for panels for the evaluation of the general acceptability of the male and female 13-week-old birds maintained on various treatments

MALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	4.6	4.4	5.6	5.6	4.8	4.4	5.0	4.8
	5.2	5.8	5.0	5.8	-	-	-	-
2	4.0	4.0	4.6	3.8	4.6	4.8	5.0	3.8
	-	-	-	-	3.8	4.4	4.2	4.4
3	4.6	4.8	5.2	4.2	5.2	4.8	5.0	5.2
	-	-	-	-	4.4	4.2	4.8	4.4
4	5.4	5.0	4.2	4.4	4.3	4.0	4.4	4.6
	4.4	3.8	4.0	5.4	-	-	-	-
MEAN	4.7	4.6	4.8	4.9	4.5	4.4	4.7	4.5

FEMALE

Panels	Treatments[1]							
	1	2	3	4	5	6	7	8
1	3.8	4.6	4.2	4.6	5.0	4.2	4.6	5.0
	-	-	-	-	4.6	3.2	5.0	4.2
2	3.8	4.2	4.0	4.8	3.6	4.6	4.0	4.2
	5.0	3.8	4.4	4.8	-	-	-	-
3	3.0	4.6	4.0	4.2	2.4	4.0	3.8	4.0
	4.4	4.4	4.0	3.8	-	-	-	-
4	4.6	5.0	4.0	5.0	3.6	3.8	3.8	4.8
	-	-	-	-	3.4	3.4	4.0	3.8
MEAN	4.1	4.4	4.1	4.5	3.8	3.9	4.2	4.3

[1]For key to treatments see page 21.

APPENDIX E

Composition of Raw Edible Portion

TABLE 49.--Moisture in the raw edible portion of male and female 9-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	70.8	76.2	72.8	70.9	74.2	74.7	73.3
2	72.8	73.9	72.5	74.4	72.0	69.4	72.5
3	71.4	66.6	72.9	75.6	73.1	74.3	72.3
4	73.2	73.1	72.0	70.1	74.9	73.0	72.7
5	72.4	73.4	69.0	69.7	69.7	74.6	71.5
6	73.6	71.1	65.7	66.9	68.6	69.7	69.3
7	70.1	69.6	72.1	69.5	67.5	74.9	70.6
8	67.7	67.7	70.9	69.2	68.1	71.3	69.2

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	69.0	72.6	72.6	74.1	67.9	67.6	70.6
2	77.3	75.0	73.9	70.5	72.7	71.8	73.5
3	73.7	71.7	75.6	75.0	70.9	67.9	72.5
4	72.8	76.2	73.1	70.8	70.7	69.2	72.1
5	70.7	71.5	67.4	70.3	68.8	69.1	69.6
6	70.2	70.7	70.5	70.3	68.5	66.4	69.4
7	65.7	69.6	71.2	70.4	71.1	72.5	70.1
8	71.0	72.4	71.1	70.5	71.2	74.0	71.7

[1]For key to treatments see page 21.

TABLE 50.--Moisture in the raw edible portion of male and female 13-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	68.8	69.1	70.3	68.9	69.8	72.4	69.9
2	72.9	68.2	73.8	69.1	68.9	70.0	70.5
3	73.7	67.2	65.4	68.9	69.5	71.6	69.4
4	73.4	69.4	67.4	72.3	72.6	70.7	71.0
5	67.4	61.5	66.2	67.3	66.3	64.9	65.6
6	67.6	68.9	68.1	69.5	65.6	65.2	67.5
7	63.9	63.7	65.9	61.6	70.1	70.2	65.9
8	62.6	65.7	66.3	64.0	68.5	63.0	65.0

FEMALE

Treatment[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	67.7	63.7	70.0	70.2	65.4	68.9	67.6
2	66.0	61.7	68.6	66.9	71.7	70.2	67.5
3	69.9	65.3	68.1	71.9	68.1	70.7	69.0
4	66.1	66.9	67.7	67.0	67.5	68.2	67.2
5	66.4	67.0	65.4	63.6	66.3	65.8	65.8
6	58.2	64.0	66.6	63.2	65.2	63.2	63.4
7	65.5	68.0	69.7	64.4	66.6	68.1	67.0
8	64.2	65.6	66.7	65.1	67.3	66.2	65.8

[1]For key to treatments see page 21.

TABLE 51.--Crude fat in the raw edible portion of male and female 9-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	10.8	4.5	9.4	10.5	8.5	5.5	8.2
2	8.0	7.2	9.4	6.6	10.5	12.5	9.0
3	10.5	16.4	9.4	4.8	8.0	7.9	9.5
4	7.9	9.7	9.0	10.9	7.0	8.8	8.9
5	9.6	7.7	13.0	11.9	13.1	6.8	10.4
6	8.2	10.6	17.6	16.1	13.7	12.6	13.1
7	12.8	13.2	10.1	12.7	15.5	5.3	11.6
8	14.8	14.9	11.4	12.3	13.9	10.6	13.0

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	13.6	9.4	9.2	7.0	15.3	15.7	11.7
2	3.8	6.3	7.9	11.3	9.9	10.3	8.2
3	8.9	10.7	5.7	8.1	12.0	14.5	10.0
4	10.3	6.1	9.9	11.7	10.8	13.6	10.4
5	14.3	11.2	14.9	12.7	14.4	14.6	13.7
6	12.1	11.8	11.6	11.7	14.2	17.4	13.1
7	18.8	12.6	11.0	12.3	10.8	9.3	12.5
8	10.4	9.4	10.3	12.6	11.4	6.8	10.2

[1]For key to treatments see page 21.

TABLE 52.--Crude fat in the raw edible portion of male and female 13-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	12.1	10.0	9.4	11.1	11.0	6.1	10.0
2	6.4	11.8	5.3	11.4	11.6	9.0	9.2
3	5.6	13.1	16.4	11.3	9.8	8.2	10.7
4	5.0	10.1	13.1	7.6	7.1	9.7	8.8
5	14.1	21.1	15.4	12.8	15.0	16.5	15.8
6	12.1	11.6	12.1	11.9	16.2	15.8	13.3
7	18.4	17.8	14.9	20.4	9.5	8.3	14.9
8	19.5	14.9	13.8	18.4	12.2	18.9	16.3

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	12.9	18.4	10.3	9.5	15.8	10.5	12.9
2	14.2	21.0	12.5	13.6	7.7	10.0	13.2
3	10.7	15.4	12.4	7.3	12.7	8.9	11.2
4	14.8	14.6	12.4	14.5	12.7	12.8	13.6
5	13.5	13.2	15.5	16.8	13.7	13.7	14.4
6	25.0	17.2	13.8	17.6	15.7	18.1	17.9
7	15.1	12.2	9.4	16.6	14.7	11.1	13.2
8	16.8	15.3	12.8	15.6	12.6	14.6	14.6

[1]For key to treatments see page 21.

TABLE 53.--Protein in the raw edible portion of male and female 9-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	16.3	16.7	15.7	16.5	15.2	17.5	16.3
2	17.0	17.2	16.4	17.0	15.8	16.1	16.6
3	16.1	15.0	15.9	17.4	17.1	15.6	16.2
4	16.9	15.4	16.7	16.9	16.1	16.2	16.4
5	16.2	16.7	15.8	16.6	15.1	16.4	16.1
6	16.0	16.3	14.6	15.1	15.6	15.6	15.5
7	15.0	15.2	15.6	16.0	15.2	17.8	15.8
8	15.6	15.2	15.4	16.2	15.5	16.0	15.6

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	15.5	16.0	16.2	16.9	14.8	14.6	15.7
2	17.0	16.5	16.3	16.8	15.4	15.6	16.3
3	15.5	15.4	16.8	15.0	15.4	15.7	15.6
4	15.1	15.7	15.1	15.6	16.7	15.3	15.6
5	13.1	15.3	15.6	15.0	14.7	14.3	14.7
6	15.6	15.1	15.7	15.9	15.4	14.2	15.3
7	13.7	15.4	15.7	15.2	16.0	16.0	15.3
8	16.4	16.2	16.2	15.0	15.4	17.2	16.1

[1]For key to treatments see page 21.

TABLE 54.--Protein in the raw edible portion of male and female 13-week-old birds maintained on various treatments

MALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	16.6	18.0	17.5	17.6	16.5	19.0	17.5
2	18.0	17.5	18.2	16.9	17.0	18.2	17.6
3	18.1	16.9	15.8	17.2	18.3	17.6	17.3
4	19.0	17.7	16.9	17.2	17.5	17.2	17.6
5	16.4	15.0	16.2	17.6	16.4	16.2	16.3
6	17.6	17.0	17.4	16.1	16.0	16.5	16.8
7	15.2	16.3	16.6	15.7	17.9	18.6	16.7
8	15.8	17.3	17.1	15.4	16.7	15.7	16.3

FEMALE

Treatments[1]	Replications						Means
	1 %	2 %	3 %	4 %	5 %	6 %	%
1	17.2	15.6	17.4	17.7	16.4	18.2	17.1
2	17.5	15.3	16.5	17.1	18.5	17.2	17.0
3	17.0	17.0	17.1	18.1	17.0	17.8	17.3
4	16.8	16.0	17.5	15.9	17.2	16.6	16.7
5	18.0	17.5	16.8	17.0	17.3	17.9	17.4
6	14.5	16.4	17.4	17.2	16.9	16.4	16.5
7	16.8	17.3	18.6	16.7	16.0	18.6	17.3
8	16.2	16.7	18.3	16.7	17.7	17.0	17.1

[1]For key to treatments see page 21.