# COMPARISON OF BONE STRENGTH AND GROWTH BETWEEN CAGE AND FLOOR REARED TURKEYS (MELEAGRIS GALLOPAVA VARIETY DOMESTICA)

A Dissertation
for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
Gibril O. Fadika
1975

This is to certify that the

thesis entitled

Comparison of Bone Strength and Growth Between Cage and Floor-reared Turkeys (Meleagris gallopava Variety domestica)

presented by

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has been accepted towards fulfillment of the requirements for

Ph.D. degree in Poultry Science

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Date May 16, 1975

O-7639

ABSTRACT

COMPARISON OF BONE STRENGTH AND
GROWTH BETWEEN CAGE AND FLOOR REARED
TURKEYS (Meleagris gallopava Variety domestica)

by

Gibril O. Fadika

Two experiments were conducted to evaluate the cage system as an environment for growing turkeys with respect to growth, cage density, type of flooring materials and bone characteristics.

In the first experiment 440 commercial turkeys (Nicholas variety) were brooded to eight weeks of age in a wire cage or on a litter floor. From 8 to 17 (female) or 8 to 21 (male) weeks of age the litter floor brooded birds were continued on litter floors; whereas, the cage birds were kept in the wire cage.

Male and female 8-week body weights were not significantly ($P > .05$) affected by housing the birds on a litter floor or in cages. The floor and cage reared females had nearly equal body weight averages, 2.568 kg. (5.6 lbs.) vs 2.585 kg. (5.7 lbs.) at 8 weeks of age. Cage reared males averaged 3.175 kg. (7.0 lbs.) at 8 weeks of age in comparison to 3.112 kg. (6.8 lbs.) for the floor reared males.

Growing turkey females to 17 weeks and males to 21 weeks of age in cages, on a litter floor or in cages to 8 weeks and then on a litter floor thereafter did not significantly ($P > .05$) affect the 17 or 21-week body weight. The average 17-week female body weights were 6.77 kg. (14.9 lbs.), 6.93 kg. (15.2 lbs.), and 7.18 kg. (10.8 lbs.) for the cage, cage-floor and floor grown birds, respectively. The average 21-week male body weights were 10.75 kg. (23.7 lbs.), 11.20 kg. (24.6 lbs.), and 11.71 kg. (25.18 lbs.) for the cage, cage-floor and floor grown birds, respectively.

Breast blisters were not a problem in the female turkeys grown to 17 weeks of age on a litter floor or in cages having a Bressler plastic floor, although a 10.8 percent incidence was observed in the females grown in cages with wire floors. Males grown in the cages with wire floors had an 81.8 percent incidence of breast blisters; however, the incidence was considerably lower (32.1 percent) in the males grown on the Bressler plastic floor. Despite this difference, the economic considerations obviously dictate a different type of cage floor than any used in this experiment.

In experiment two, 495 commercial turkeys (Nicholas variety) were started on wire floors or on a litter floor. From 6 to 17 (females) or 6 to 21 (males) weeks of age cage brooded birds were either kept in cages with wire floors or were transferred to a litter floor or to other cages with different type of floor bottoms.

Cage brooded commercial turkeys had heavier body

weights than did the litter floor brooded birds at six weeks of age. Livability averaged 93.4 percent for the cage brooded birds and 96.9 percent for the floor brooded birds. A bird density of 0.046 square meter (0.5 sq. ft.) per bird in the cage system was satisfactory for growth (body weight) to six weeks of age when compared to the litter floor brooded birds.

Cage grown female turkeys (6 to 17 weeks of age) had heavier body weights, 7.39 kg. (16.3 lbs.) versus 6.95 kg. (15.3 lbs.) than did the litter floor grown birds when housed at 0.212 square meter (2.3 sq. ft.) per bird. The average body weight of birds grown in cages at 0.141 square meter (1.5 sq. ft.) per bird or in cages to six weeks of age and then on a litter floor to 17 weeks were not significantly ($P > .05$) altered when compared to litter floor brooded and grown birds. All turkeys grown on a litter floor at a density of 0.319 square meter (3.4 sq. ft.) per bird had heavier 21-week body weights than birds grown on wire floor cages at a density of 0.182 square meter (2.0 sq. ft.) or 0.319 square meter (3.4 sq. ft.). The average 21-week body weights were 13.40 kg. (29.5 lbs.), 12.55 kg. (27.6 lbs.), 11.86 kg. (26.1 lbs.) and 13.06 kg. (28.7 lbs.) for the birds on litter floor, cage floor, wire cage floor and soft plastic mat cage floor, respectively.

During the brooding period (0-6 weeks of age), the feed-gain ratio (feed efficiency) averaged 1.77 and 1.74 for the cage brooded female and male turkeys, respectively. The

feed efficiency averaged 1.65 (female) and 1.71 (male) for the litter brooded birds. A lower feed efficiency was observed in the cage housed (3.22) females from 6-17 weeks of age. Feed efficiency for the males (6-21 weeks of age) was lower for the cage housed (3.32 and 3.27) birds at a density of 0.319 square meter than in the litter floor housed (3.60) birds.

Breast blisters were not observed in the birds grown in cages that had either Bressler plastic or plastic slats as flooring material. The breast blisters, which were trimmed at the time the birds were processed, were observed in 3.0, 29.4, 40.0 and 19.0 percent of the litter floor, cage floor, wire cage floor and soft plastic mat cage floor birds, respectively.

The average force required to break the legs was not significantly affected by the type of growing floor used. Breaking strength of legs of both sexes grown in cages was not substantially different from birds grown in floor pens. Bone breakage was numerically weaker for the cage reared birds in comparison to the floor reared birds. Foot disfigurement was greater in the cage grown brids in comparison to the litter floor grown birds. Hock size was not significantly altered by the type of housing system; however, it was greater numerically in birds grown in the cages in comparison to the control (floor grown) birds.

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By

Gibril O. Fadika

A DISSERTATION

Submitted to

Michigan State University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

(Avian Physiology)

Department of Poultry Science

1975

TO MY MOTHER AND MEMORY OF MY FATHER
WHO HAD THE FORESIGHT TO GUIDE THEIR
FOUR CHILDREN INTO HIGHER EDUCATION.

ACKNOWLEDGEMENTS

For counsel, encouragement, and training in my graduate study, Dr. J. H. Wolford,* then academic advisor deserves my humble-given acknowledgement of appreciation. His efforts, counsel and suggestions were a constant source of encouragement and help in carrying through my education.

The author is indebted to Dr. R. K. Ringer, academic advisor, for his critical reading and suggestions in writing the dissertation. To Drs. T. H. Coleman, H. C. Zindel, both of Poultry Science Department, and H. E. Larzelere, of Agricultural Economics Department, appreciation is expressed for serving as members of my committee and for their comments and suggestions for making this volume a reality.

Special thanks are due to the Sierra Leone Government for providing financial aid which made my dreams a reality.

Last, as always, but by no means least, the author would like to express his sincere thanks and gratitude to my mother Fatmata for her patience and understanding. She probably had the most difficult role to play and played it well.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

# INTRODUCTION

Attempts to raise birds in cages or on wire floors is as old as the poultry industry itself. We appear to have come close to the practical limit to housing density in traditional litter floor bird raising. In order to decrease cost, more attention has turned to cage rearing and attempts have revealed problems that are either entirely new or much greater in magnitude than similar problems on litter floors.

At the onset of the growth and popularity of cage operation it has become evident that a great number of problems are to be encountered. Together with its advantages there would be some decided disadvantages when compared to the conventional floor unit.

The first obvious problem encountered in growing birds in cages is a consistent disastrously high incidence of breast blisters. While there seemed to be relationship to variety or weight attained, the variation in breast blister incidence related to these factors is a small fraction of that related to the change from litter to cage. Plastic mesh floors, for example, have not been successful because of the occurrence of breast blisters as shown by Atkins (1969). McCume and Dillmann (1968) observed fewer

incidences of breast blisters on polyurethane foam mats compared with wire floors.

A second problem of primary concern with cage rearing system is bone breakage. It has been well established that cage reared birds have a lower bone breaking strength than birds on litter in floor pens. This decrease in bone strength of cage birds causes downgrading of processed carcasses. Bone fragility of birds has been recognized for many years. The bone mass loss which accompanies bone fragility occurs with aging and is particularly prevalent in caged birds even though it does occur in floor birds to a lesser extent.

These primary problems encountered in cage rearing system--breast blister and bone breakage--have been considered as much an inherent part of cage rearing of birds as a great search began for a floor material which would permit birds to be grown in cages without the excess breast blisters or bone abnormality. Should these problems be solved, possible advantages for the cage system include better control of internal parasitic disease, increased housing density and greater brooder house operation and labor efficiency.

A floor that would eliminate these problems has been the main stumbling block in cage design. The most important factor in the new developments is that should the forebodings in regard to other uses for sawdust be realized, the poultry grower would have an alternative.

## LITERATURE REVIEW

The growing of turkeys in cages or on wire is not a new idea; however, in reviewing the literature, very few reports dealing with this have been published. Reports involving raising and/or keeping of chickens in cages are rather numerous.

Parker and Rodgers (1954) found no consistent difference in egg production or mortality in tests which compared the performance of layers in floor pens, individual cages and colony cages. Gowe (1955) in a test involving seven White Leghorn strains, reported an average hen housed production of 176 eggs for birds housed on the floor compared with 154 eggs for comparable birds in laying batteries. Miller (1956) reported more eggs, better feed efficiency and lower mortality for birds housed in individual cages as compared to conventional floor housing. Lowry *et al.* (1956) in a four-year study of cage versus floor management found that the floor birds were superior in performance for egg production while the caged birds showed significantly lower mortality and heavier eggs.

Bailey *et al.* (1959) compared the performance of layers in cage and floor housing. They found that the average body weight of the cage housed birds was greater than that of floor housed birds. Their study also showed

that birds in cages consumed less feed than those on the floor. In terms of mortality, no significant difference was observed between the cage and floor housed birds. Miller and Quisenberry (1959) observed lower mortality in cage housed birds than in those housed in floor pens. Osborn et al. (1959) comparing the performance of White Leghorn hens on slats versus litter reported results of 53.0 and 62.2 percent mortality, respectively, for slat and litter floors. Body weight of hens on slats was less than that of hens on litter.

Woodard et al. (1961) conducted an experiment to determine egg and semen production performance of turkeys under cage management. In this study, it was found that turkey hens kept on wire laid at a higher rate of production than comparable birds on the floor; however, productivity of caged hens excelled floor pen production. Males housed in individual cages produced as much semen as males held on the floor. Semen volume from males on wire was not affected by severity of foot swelling.

Woodard and Abplanalp (1967) found that males tended to have the same fertility whether they were kept in cages or on litter; but caged hens had less fertility than hens on litter. These same workers found that semen volume from caged toms was higher than from toms on litter. Seventy percent of the males had swollen feet but only seventeen percent had moderate to severe swelling.

Magruder and Nelson (1965) studied the performance of laying pullets housed on slatted and litter floor. They reported that mortality was greater for the slatted birds. Magruder and Nelson (1968) compared three rearing regimes--floor confinement, floor confinement and cage combination, and cage rearing from day-old to 20 weeks of age. Comparisons were made for body weight, feed consumption, feed conversion and mortality. They found that the three rearing regimens produced pullets of about the same body weight at 20 weeks. Rearing mortality was lowest for the floor rearing system and highest for the floor cage combination. In terms of food consumption the cage reared birds consumed the most feed.

Logan (1964) in an experiment designed to study the influence of cage versus floor, density, and dubbing on laying house performance reported that caged birds laid fewer eggs, and had 7.8 percent lower mortality than did birds housed on the floor. Floor birds attained smaller body weight, laid smaller eggs and consumed less food per dozen eggs produced as indicated by feed efficiency index.

Wildey et al. (1968) carried out an experiment to determine the effect of cage versus floor rearing of replacement pullets. They reported that there were no differences in average body weights between cage reared birds and combination floor brooded and cage reared birds. Average feed consumption per bird was 6.99 kgs. for the floor reared birds versus 7.91 kgs. for the cage reared

and combination floor brooded and cage reared birds. Mortality to 20 weeks of age was 2.0, 4.35 and 5.67 percent for the cage reared, combination floor brooded and cage reared floor reared birds, respectively.

Burr et al. (1970) reported on the performance of Leghorn breeders housed on A and V-type sloping wire floors at 0.50 square foot of floor space per bird. Average hen day egg production was 71 and 70 percent, fertility was 94 and 95 percent, and hatchability was 92 and 93 percent, respectively.

Olsen and Lucas (1963) compared a plastic-coated wire cage bottom to 1 by 1 in. and 1 by 5 in. welded wire cage bottoms. They found a substantial decrease in the cracked eggs with the plastic-covered wire. Besides reducing egg breakage, they also reported that the use of the special floor enjoys the added advantages of being easier on the birds' feet. The incidence of calloused feet was reduced.

Carter et al. (1972) compared the biological performance of broiler breeders using the slooping wire floor system with those using a conventional litter floor system. Egg production and mortality were significantly higher in wire houses than in litter floor houses. Hatchability of fertile eggs was similar in both management systems during the 28-week test. Fertility was significantly different as it averaged 9.2 percent lower in wire floor houses. Cooper and Barnet (1972) studied the performance of broiler

breeders on slat versus slat-litter floors. They found that mortality was significantly higher for birds on slat-litter floor than for those on slat floor; however, in a second trial, even though mortality was higher in pens with slat floors, the difference was not significant.

Reece et al. (1971) determined the effect of cage versus floor rearing on broiler performance. They reported that body weight gain was not depressed for broilers reared in cages, but in most instances, especially under summer conditions, was increased over floor reared broilers. Mortality for males reared in cages was higher than for males on floor at a bird density level of 743 $cm^2$/bird. Breast blister incidence was greater for cage reared broilers; however, the seasonal effect on weight gain was noted to significantly influence breast blister incidence in cages. Feed utilization was significantly higher for the cage reared treatments. Feed utilization for males reared in cages at 465 $cm^2$/bird was significantly different from that of males reared on the floor at 743 $cm^2$/bird. They also reported a significant seasonal effect on leg weakness. Significantly more leg weakness occurred for both males and females reared in the summer in cages than males and females reared in cages in winter. No significant difference was observed for floor reared males or females for leg weakness between summer and winter. In general leg weakness was significantly greater for cage reared birds.

Hartung (1955), Brooks et al. (1957), Heishman et al. (1952) and Moreng et al. (1961) found that increasing population density beyond a certain point reduced the average size of chicken broilers. However, Siegel and Coles (1958) observed little if any effect on the body weight, feed efficiency or livability of broiler grown at densities ranging from one-half to one and one-half square feet of floor space per bird.

Bell (1969) reported the results of four experiments designed to measure the effect of crowding pullets in cages. In trial 1, birds were placed at the rate of 6, 8, 10, 12, 14, 16, 18, or 20 per cage at one day of age. Birds were weighed at 6, 10, 12, and 16 weeks of age. It was found that the average body weight at each age tended to decrease as density was increased. No significant differences were found in variability of body weights or in mortality among the density levels.

In trial 2, birds were placed in cages at the rate of 8, 10, 12, 14, or 16 birds per cage. Statistical analyses of weights taken at 6, 12, and 16 weeks of age indicated a definite relationship between body weight and density but the difference was not apparent at 16 weeks of age.

In trial 3, densities of 6, 8, or 10 pullets per cage were used for the growing period between 7 1/2 and 15 1/2 weeks of age. Body weights taken at 15 1/2 weeks of age tended to decrease as cage density increased.

In trial 4, the same densities as in trial 3 were used except that the growing period extended from 7 to 18 weeks of age. The results of this test showed no significant differences in body weights of birds due to density.

Wells (1972) reared pullets on litter at .070, .093, .139 and .186 $m^2$ of floor area per bird. Results showed that the different densities of stocking had no commercially important effect on growth rate, feed consumption or viability. The use of high stocking densities caused no impairment of the performance of layers that were transferred to batteries, but was possibly responsible for a small decline in productivity of layers housed on deep litter.

Francis (1957) in a study involving five strains of White Leghorns and two hybrids, suggested that the strains of Leghorns appeared to adapt themselves to cages better than the hybrids.

Shupe and Quinsenberry (1961) reported data than involved subsequent production tests of cage-reared birds. Their work involved rearing birds in cages only during the latter part of the growing period. In their trial, pullets were reared on the floor for 14 weeks in conventional confinement pens. At 14 weeks the pullets were equally divided among floor pens, range and colony cages with slat and wire floors. The data showed that colony cage reared birds were heaviest in body weight and consumed the most feed. The range reared birds were significantly heavier than those

reared in floor pens. Mortality was highest for birds in the colony cages and lowest for those in the floor pens.

Andrews (1972) reared male chickens in cages and compared them with another group raised by conventional method on the floor. Caged birds averaged 3.01 pounds each while floor reared birds averaged 2.99 pounds. In a second trial, both males and females were reared in cages and on floor. Caged broilers averaged 3.26 pounds and floor grown averaged 3.26 pounds.

Koonz et al. (1963) designed an experiment to determine the influence of litter, wire floors, concrete floors, prominence of keel bone and rubber pads on the appearance and size of blisters. Wire floors were found to encourage breast blister development whereas rubber pads markedly retarded them. Reed et al. (1966) in an experiment designed to study the effectiveness of different types of cage bottoms in reducing breast blisters found in young birds that breast blisters could be reduced from as high as 70 percent to less than 1 percent is cage floors were padded with a cushioning material such as polyester urethane and the proper cage bottom.

Lloyd (1969) showed that broilers weighing 3.75 to 3.99 pounds reared on wire were downgraded 21.7 percent and 27.3 percent, respectively, due to breast blisters. Welch et al. (1970) found breast blisters to be 68 to 91 percent, 55 to 82 percent, 60 to 67 percent, and 2 to 10 percent on broilers reared on wire floors, wood slats,

plastic mesh and litter, respectively. Peterson et al. (1971) found fewer breast blisters on birds grown on wooden slats as compared to those grown on wire; but even on wooden slats, the breast blisters ranged from 25 to 34 percent on broilers that averaged 1800 grams at 8 weeks of age. Welch et al. (1971) compared growth performance and incidence of breast blisters in broilers reared at two densities and six colony sizes for each sex. Their results indicated that live-weight was the determining factor influencing the extent of blistering and also showed that mean live-weight for each sex was negatively correlated with colony size.

Yates et al. (1971) studied the effect of wire cages, plastic coops and littered floor pens on the quality of broiler carcasses. The data showed that breast blister incidence was greater for the cage reared birds. The bone quality was also evaluated by determining incidence of breakage due to processing, strength and ash. Generally, they found that bones from cage and coop reared birds were significantly poorer in quality. Additional calcium improved bone quality of caged broilers, but they still were not equal in quality to floor reared birds.

Lloyd (1972) reported a reduction in breast blisters on broilers by placing a plastic mat in the coop or wire cage.

Seay et al. (1973) investigated the development of a covered slat floor for loading broilers from cages. The cage floors studied were 1) wire, 2) rubber-nylon mat,

3) ash, 4) plastic mats, 5) wood slat, 6) slat covered with rubber coated nylon, and 7) slat covered with nylon plastic hose. No breast blisters were noted on birds from litter pens or floors 4), 6), and 7). Birds grown on floors 3) and 5) had few blisters, but those grown on floors 1) and 2) had a higher incidence (35-77 percent). They reported severe leg abnormalities from birds grown on floors 2) to 7) with the highest percentage on floor 3). No leg abnormalities were observed in birds grown on wire or litter.

Marion (1968) reported that birds housed in cages had a higher body weight as opposed to those grown on the floor. He also reported that carcasses of birds grown in cages had a smaller percentage of bone, lost more weight during cooking and had less moisture and more fat than those housed on the floor. Less force was required to shear the breast muscle of caged birds.

Adams et al. (1968) examined a small sample of hens obtained from a commercial processing plant, and reported that the bone breaking strength of hens kept in cages was slightly better than that of those maintained on the floor. It was found by Rowland et al. (1968) that there was no significant change between tibia breaking strength of hens maintained in cages for ten months as compared to birds maintained five months. Rowland et al. (1968) in an experiment involving two trials compared the bone breaking strength of hens maintained in wire cages and in floor pens. Breaking strength of bones from hens maintained on the floor

was significantly greater than for those birds maintained in cages. Bone ash in one experiment was found to be significantly higher for hens maintained on the floor when compared to those maintained in cages.

Rowland et al. (1968) and Rowland and Harms (1970) found a significantly higher bone breaking strength in floor layers compared to caged layers and that the difference could not be corrected by increasing dietary phosphorus. The lower breaking strength of bones from caged layers resulted in more broken bones during processing. In a histological study of medullary bones, Riddle et al. (1969) reported the most massive medullary bones were found in layers maintained on litter. Birds maintained on wire floor and in cages fed the same diet had less massive medullary bones, respectively.

Rowland et al. (1971) raised broilers in wire batteries. Results of this experiment indicated that bone breaking strength and tibia ash of broilers grown on wire were not substantially different from broilers grown in floor pens. This would indicate that bone breakage which is a characteristic of caged layers, does not occur to any extent in eight-week-old battery grown broilers. Bone breaking strength was significantly lower for battery grown broilers. Although the battery grown broilers had weaker bones, this did not appear to have any substantial effect on processing. The incidence of breast blisters was less

than 2 percent and no significant difference between the battery and floor birds was observed.

Rowland et al. (1972) reported that within four weeks after housing there was a highly significant difference in breaking strength between floor and caged pullets' bones. This difference in breaking strength increased from the fourth to eighth week. They suggested that pullets placed in cages had a gradual decrease in breaking strength of bones while pullets on floor had an increase in their initial tibia breaking strength. It was Rowland et al. (1972) who also reported a significant strain difference in tibia ash among strains. They also found that caged hens had a significantly lower tibia breaking strength when compared to floor hens of the same strain; there were, however, some strains of pullets that were maintained in cages that had a higher breaking strength than other strains maintained on the floor. Wabeck et al. (1972) conducted trials to determine if a bone fragility problem existed in broilers reared in cages with different bottoms when compared to broilers reared in a floor pen with built-up pine shavings litter. The results showed that wing and leg breakage after processing was higher for broilers reared in cages with the highest proportion of breakage in wings. Breaking strength of the humeri from broilers reared on the litter floor was twice that of the humeri from broilers in the cage bottom treatments. Breaking strength difference of the tibiae was not as great, but tibia bone strengths for the cage

treatments were significantly less than for those from the litter floor treatment.

Andrews et al. (1973) reported no significant differences for 8-week live body weights among broilers grown on floor and in cages; however, they found that birds grown in cages were heavier than those grown on the floor. They reported the occurrence of breast blisters to be higher on broilers grown on plastic mesh than those grown on litter or rubber covered nylon. There was no difference among the cage and the floor reared broilers as to tibiae breakage strength.

Merkley (1973) undertook a study to determine if broilers raised in coops could be force exercised to counteract the development of bone fragility in the wings. The breaking strength of bones from the cockerels in the screened pens was significantly lower than that of other floor birds. Siegel et al. (1973) compared the bone characteristics and growth of broilers in plastic coops and on floor litter under two temperature regimes (high and moderate temperatures). They reported that high temperature significantly restricted growth, especially in the coop reared birds. The difference between coop and floor reared birds grown under moderate temperature was not significant. Breaking strength of tibiae was less for birds reared at high temperature, and this reduction was greatest in coop reared birds. Humeri of birds grown at high temperature in plastic

coops had lower breaking scores than those of birds in moderate temperatures or on litter. In a second experiment, they also found that tibiae of birds reared on litter at moderate temperature were strongest, while tibiae from coop reared birds at high temperature were weakest. Breaking strength of humeri was greatest for litter reared birds at moderate temperature while the lowest value was found in coop reared birds at high temperature.

Lack of exercise has been suggested to be one of the causes for brittle bones from birds reared in cages or plastic coops.

Wabeck and Merkley (1974) measured the effect of stocking density upon humeri and tibiae strength. Humeri and tibiae from male broilers placed in cages were compared to those from birds reared in floor pens. Storage effect on bone strength from drying immediately and drying after two weeks'frozen storage was also measured. Humeri breaking strengths were numerically greater for floor reared broilers in all trials and significantly higher (22.43 vs 14.65; $P < .01$) for the last two trials regardless of technique used. Tibiae breaking strengths were numerically greater for floor reared broilers than for cage reared and the differences were significant (17.99 vs 15.78; $P < .05$) in the last trial. Freezing significantly ($P < .01$) reduced the breaking strength of the tibiae (14.53 vs. 20.77) and humeri (14.19 vs 19.44) when compared to bones dried immediately.

Berg (1972) reported that the 17-week body weight and feed efficiency of caged turkey hens were slightly better than for floor reared controls; however, nearly 100 percent downgrading occurred because of breast blisters.

Poss et al. (1972) in two separate experiments, pointed out that cage brooding of turkeys appears to be feasible; on the contrary, poults raised in cages performed better on their legs than did floor reared controls. In the first experiment, they reported that ten-day mortality was higher in the cages, but lower than that of the floor reared birds in a second experiment after a change in heating system. Average body weight of broad, white toms, in the first experiment, was less than that of the floor reared birds at eight weeks of age when transferred to the floor, but it was equal to the controls at 18 and 22 weeks of age. In the second experiment with both hens and toms, the 12-week weights for the cage reared poults were slightly below those of the controls.

Carson et al. (1973) reported that large white turkey hens adapted quite well to cage rearing up to 18 weeks of age and had only a 6.8 percent incidence of breast blisters. Cage rearing of toms was less successful because at 22 weeks of age, cage reared toms averaged 1.04 kg. less than floor reared controls. Furthermore, 13.5 percent of the cage reared toms had fluid filled breast blisters. Feed efficiency was significantly poorer in the cage reared birds

than in the floor reared birds. The incidence of perosis was greater in the cage reared birds.

Manley and Muller (1973) reported that caged Broad Breasted White turkey hens gained significantly ($P < .05$) more weight from 6 to 24 weeks of age than did floor managed controls. No differences in growth rate, due to cage floor type (hail screen, neoprene matting, tire link matting and Bressler polyethylene plastic) had significantly ($P < .05$) lower foot scores (foot swelling) than did birds from any other cage treatment. The floor reared birds had significantly ($P < .05$) lower foot scores than did the cage reared birds, except for the birds reared on the Bressler flooring.

## OBJECTIVES

The objectives in these experiments were fourfold.

1. To evaluate cage system as an environment for growing market turkeys with respect to the following parameters:
    a. Growth
    b. Breast blister
    c. Livability
    d. Feed conversion
2. To compare cage density for brooding and growing market turkeys.
3. To compare floor type materials for growing turkeys.
4. To compare breaking strength of bones of floor reared and cage reared turkeys.

## MATERIALS & METHODS

### EXPERIMENT 1.

Procedure

A total of 440 day-old large white turkeys (Nicholas variety) were sexed, wing banded, injected with 5 mg. apectinomycin and placed at random in cage or floor rearing pens. The room temperature at the bird level was programmed to be 32.8°C (91°F) and 35.0°C (95°F) for the cage and floor pens, respectively, during the first week and reduced 2.8°C (5°F) weekly until a 21.1°C (70°F) temperature was attained. Heat was provided by gas fired brooders.

Light intensity was maintained at 86 to 107 lux[4] (8 to 10 foot candles; depending on bird location in relation to light source) for the first two weeks; thereafter, light intensity was 5.4 to 10.8 lux (0.5 to 1.0 foot candles). This low light intensity was used as a cannibalism control tecnhique because the birds were not debeaked. Rheostats were employed to increase the light intensity to 43 to 54 lux (4 to 5 foot candles) whenever caretakers entered the rooms. During the first 10 days, continuous light was provided; after which, a 12-hour artificial light day was provided. Feed and water were supplied ad libitum.

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[4]One foot candle = 10.76 international lux.

Medication included tylosin in the water and continuous chlortetracycline (100 g./ton) in the feed. Tylosin was added to water at 2 grams per gallon for the first five days and for three days at monthly intervals thereafter. Composition of the diets used in this experiment is shown in Table 1. These diets were fed to both the males and females according to the following schedule:

Prestarter - fed until 1 kg. (2.2 lbs.) consumed per bird

Starter - fed to 8 weeks

Grower #1 - fed to 12 weeks

Grower #2 - fed to 17 weeks

Grower #3 - fed to 21 weeks

The cage and floor housing descriptions are presented in Table 2. All cage birds were started on the wire floor (Groups 2, 3, 4, 6, 7, and 8) which was covered with an absorbent, non-slip, laboratory animal paper for the first 10 days. At one week of age the cage started birds were randomly reassigned for floor space equalization. At 8 weeks of age part of the cage reared birds were transferred to the litter floor (Groups 10 and 17) and part were transferred to cages having a different type cage bottom as shown in Figure 1.

Body weights were recorded at 1 and 8 weeks of age for both sexes and again at 17 weeks of age for the females and 21 weeks of age for the males. Feed conversion was obtained for the first 8-week growing period and for

Table 1. Dietary composition

| Ingredient | Percentage of Diet | | | | |
|---|---|---|---|---|---|
| | Prestarter (Crumble) | Starter (Crumble) | Grower #1 (Pellet) | Grower #2 (Pellet) | Grower #3 (Pellet) |
| Corn | 39.175 | 43.175 | 54.675 | 61.425 | 68.075 |
| Soybean oil meal, 49% | 42.750 | 38.100 | 32.000 | 24.750 | 20.250 |
| Alfalfa meal, 17% | 3.000 | 3.000 | 2.500 | 2.500 | 2.500 |
| Fish meal, 60% | 5.000 | 5.000 | 2.500 | 2.500 | -- |
| Meat & bone meal, 50% | 2.500 | 2.500 | 2.500 | 2.500 | 2.500 |
| Whey, dried | 2.500 | 2.000 | -- | -- | -- |
| Fat, stabil., A-V | .500 | 1.500 | 2.000 | 2.500 | 3.000 |
| Salt | .250 | .400 | .400 | .400 | .400 |
| Dicalcium phos., 24% Ca, 18% P | 1.750 | 1.750 | 1.500 | 1.500 | 1.500 |
| Limestone | 1.000 | 1.000 | .500 | .500 | .700 |
| Vitamin-mineral premix[1] | .750 | .750 | .600 | .600 | .450 |
| Aurofac 10 | .500 | .500 | .500 | .500 | .500 |
| Biotin[2] | .100 | .100 | .100 | .100 | .100 |
| Vitamin E[3] | .025 | .025 | .025 | .025 | .025 |
| Choline chloride[4] | .200 | .200 | .200 | .200 | .200 |

[1]Contained/lb. premis: 600,000 U.S.P. vitamin A; 166,667 I.C.U. vitamin $D_3$; 400 mg. riboflavin; 800 mg. pantothenic acid; 3.33 g. niacin; 42.33 g. choline chloride; 116.7 mg. folic acid; 1.0 mg. vitamin $B_{12}$; 500 I.U. vitamin E; 134.0 mg. menadione sodium bisulfite; 66.0 mg. thiamine monomitrate; 6.96 g. manganese; 90.8 mg. iodine; 73.0 mg. copper; 23.2 mg. cobalt; 4.54 g. zinc; 2.27 g. iron.

[2]Contained 0.45 g. biotin/lb. premix.

[3]Contained 20,000 I.U./lb. premix.

[4]Contained 113.4 g. choline/lb. premix.

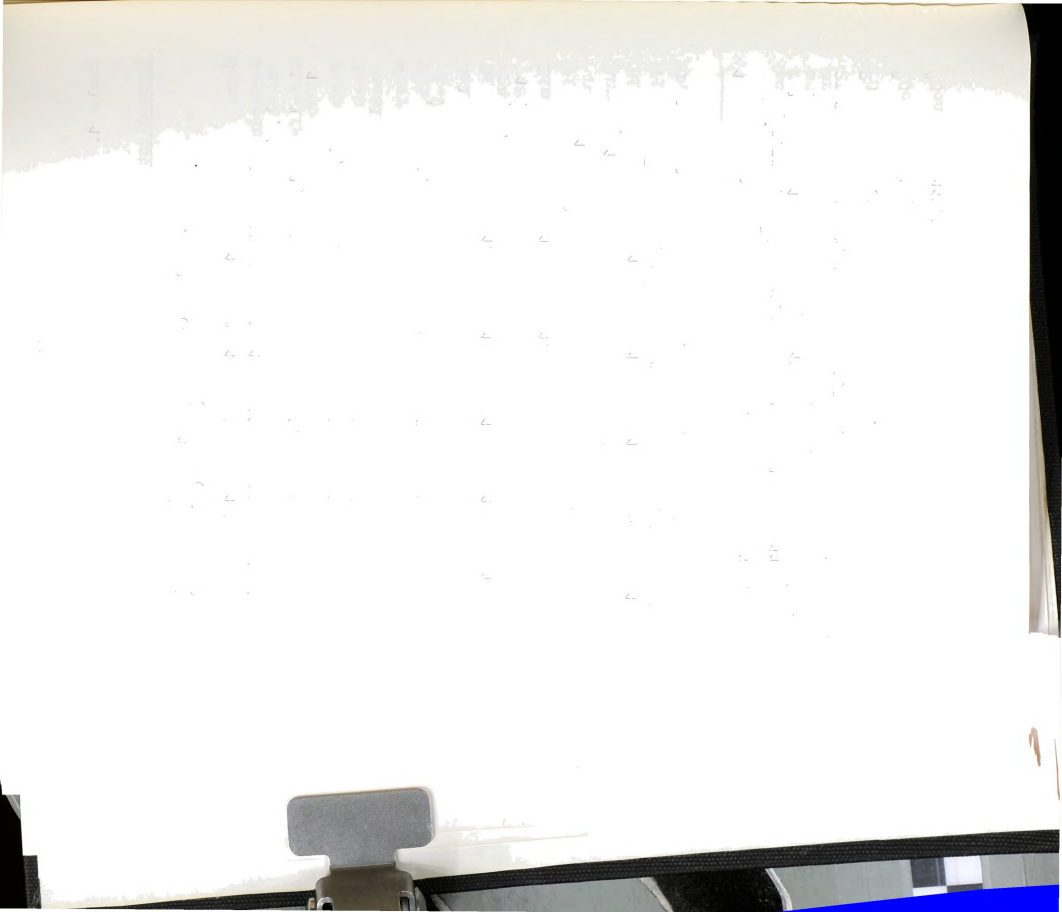


Table 2. Cage and floor housing description in experiment one

| Group | Growing System | Floor Type[1] | Pen Size (mxm)[2] | Water Cup No/ Pen | Tube-Pan Feeder Type | Tube-Pan Feeder No/ Pen | Tube-Pan Feeder Dia. (cm)[3] |
|---|---|---|---|---|---|---|---|
| 1 | Floor | Wood Shavings | 2.34x5.31 | 1 | Johnson | 2 | 40.6 |
| 2 | Cage-Wire | 1 x 1/1 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 3 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 4 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 5 | Floor | Wood Shavings | 2.34x5.31 | 1 | Johnson | 2 | 40.6 |
| 6 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 7 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 8 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 9 | Floor | Wood Shavings | 2.34x5.31 | 1 | Johnson | 2 | 40.6 |
| 10 | Cage-floor[4] | Wood Shavings | 2.29x4.93 | 1 | Johnson | 2 | 40.6 |
| 11 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 12 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 13 | Cage-Plastic | Bressler Plastic[5] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 14 | Cage-Plastic | Bressler Plastic[5] | 1.04x0.81 | 2 | Swish | 1 | 30.5 |
| 15 | Cage-Plastic | Bressler Plastic[5] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 16 | Floor | Wood Shavings | 2.34x5.31 | 1 | Johnson | 2 | 40.6 |
| 17 | Cage-floor[4] | Wood Shavings | 2.34x5.31 | 1 | Johnson | 2 | 40.6 |
| 18 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 19 | Cage-Wire | 1 x 1/2 Wire | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 20 | Cage-Plastic | Bressler Plastic[5] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |

Table 2.--Continued

| Group | Growing System | Floor Type[1] | Pen Size (mxm)[2] | Water Cup No/ Pen | Water Cup Type | Tube-Pan Feeder No/ Pen | Tube-Pan Feeder Dia. (cm)[3] |
|---|---|---|---|---|---|---|---|
| 21 | Cage-Plastic | Bressler Plastic[5] | 1.04x0.81 | 2 | Swish | 1 | 30.5 |
| 22 | Cage-Plastic | Bressler Plastic[5] | 1.04x0.81 | 2 | Swish | 1 | 30.5 |
| 23 | Cage-Plastic | Bressler Plastic[5] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 24 | Cage-Slats | Plastic Slats[6] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 25 | Cage-Slats | Plastic Slats[6] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |

[1]See Figure 1.

[2]One meter (m) = 3.28 feet.

[3]One inch = 2.54 centimeters (cm).

[4]Grown in the 1x1/2 wire floor cages to 8 weeks and on a litter floor thereafter.

[5]Bressler polyethylene self-supporting poultry flooring.

[6]Hard plastic tybes having a 3.2 centimeter flat surface and spaced 1.9 centimeters apart.

the 8 to 17-week (females) and 8 to 21-week (males) growing periods. A foot and breast blister evaluation was made at the time of the 17-week (females) and 21-week (males) body weight recording. Mortality was recorded as it occurred and all dead birds were autopsied at the Michigan State University Diagnostic Laboratory. Mortality recorded as perosis was done on the basis of visual observation while the bird was alive and confirmed at autopsy. It was assumed that the perosis incapacitation was the primary mortality problem even if another disease problem was also diagnosed in the same bird. The foot scoring system used was patterned after Manley and Muller (1973) and had the following scale:

| Score | Severity of Foot Disfigurement |
|---|---|
| 1 | Normal (No swelling) |
| 2 | Slight swelling |
| 3 | Moderate swelling |
| 4 | Severe swelling |

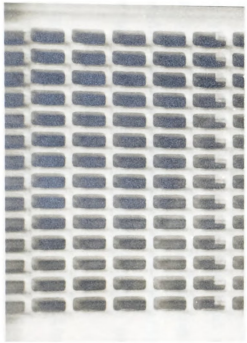
The data collected were analyzed by analysis of variance (Snedecor and Cochran, 1962) and differences between means by the multiple range and F test (Duncan, 1955).

Figure 1. Cage Floor Materials Used.

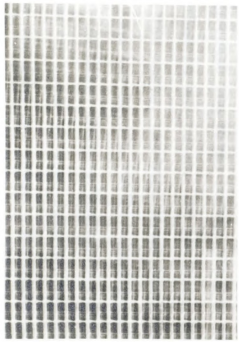
A. Bressler plastic

B. 1/2 by 1 welded wire

C. Plastic slats



A



B

C

# RESULTS

Results of body weight and livability during the first week brooding period are presented in Table 3. During the first week of age, livability was greater for the turkeys housed on the litter floor (98.5 percent) than for those in the cages (81.8 percent). Starvation and dehydration were the diagnosed mortality reasons and probably resulted because the birds became chilled immediately after placing them in the cages. At the time the birds were placed in the cages, the bird level temperature was 23.3°C (74°F), and the 32.8°C (91°F) temperature originally desired was not attained until 4.5 hours later. The birds huddled together in order to keep warm and did not move about to locate the feed and water. The light intensity (86 to 107 lux) used may have been too low and may have contributed to the problem of locating the feed and water. No attempt was made to save the birds by dipping their beaks in water or feed. It was considered more important to observe the effect of their management problem on body weight.

Body weight, feed conversion and mortality from two to eight weeks of age are presented in Table 4. Male and female body weights were not significantly ($P > .05$) affected by housing the birds on a litter floor or in cages.

Table 3. Livability and body weight of cage and floor reared turkeys during the first week of age

| Rearing System | No. Pen | Bird Density ($m^2$/bird)[1] | No. Birds Started | Livability (%) | Body Wt. (g)[2] |
|---|---|---|---|---|---|
| **Female** | | | | | |
| 1 x 1/2 Wire Cage | 2 | .039 | 66 | 86.4 | 138.1 |
| 1 x 1/2 Wire Cage | 2 | .041 | 62 | 85.5 | 146.8 |
| 1 x 1/2 Wire Cage | 4 | .085 | 60 | 75.0 | 142.3 |
| Litter Floor | 1 | .085 | 78 | 98.7 | 148.9 |
| **Male** | | | | | |
| 1 x 1/2 Wire Cage | 2 | .053 | 48 | 75.0 | 146.4 |
| 1 x 1/2 Wire Cage | 2 | .085 | 30 | 76.7 | 147.9 |
| 1 x 1/2 Wire Cage | 4 | .116 | 44 | 93.2 | 147.5 |
| Litter Floor | 1 | .116 | 52 | 98.1 | 155.3 |

[1]One square foot = 0.0929 square meter ($m^2$).

[2]One pound = 453.6 gram (g.).

Table 4. Body weight, feed conversion and mortality of cage and floor grown turkeys to 8 weeks of age

| Group | Growing System | Density ($m^2$/bird)[1] | No. Birds Initially (2 wks. age) | 8-week Body weight (kg)[2] | Feed/Gain Ratio | Livability (%) |
|---|---|---|---|---|---|---|
| Female | | | | | | |
| 1 | Floor | .194 | 64 | 2.568±.049[3] ab[4] | 2.19 | 96.9 |
| 2 | Cage-Wire | .091 | 42 | 2.715±.067 b | 2.12 | 100.0 |
| 3 | Cage-Wire | .045 | 56 | 2.588±.043 ab | 2.13 | 83.9 |
| 4 | Cage-Wire | .042 | 60 | 2.490±.057 a | 2.05 | 96.7 |
| Male | | | | | | |
| 5 | Floor | .281 | 44 | 3.112±.067 a | 2.12 | 93.2 |
| 6 | Cage-Wire | .127 | 30 | 3.216±.094 a | 2.34 | 96.7 |
| 7 | Cage-Wire | .091 | 28 | 3.223±.080 a | 2.38 | 92.9 |
| 8 | Cage-Wire | .058 | 44 | 3.109±.095 a | 2.20 | 84.1 |

[1]One square foot = 0.0929 square meter ($m^2$).

[2]One Kilogram (kg.) = 2.2 pounds.

[3]± standard error mean.

[4]Means followed by different letters are significantly different ($P < .05$). Females and males analyzed separately.

However, as the cage bird density increased, there was a trend of a body weight decrease (significant, $P<.05$, in the females and non-significant, $P>.05$, in the males). The floor and cage reared females had nearly equal body weight averages, 2.568 kg. (5.6 lbs.) vs 2.585 (5.7 lbs.), at eight weeks of age. Cage reared males averaged 3.175 (7.0 lbs.) at eight weeks of age in comparison to 3.112 kg. (6.8 lbs.) for the floor reared males.

Feed efficiency was nearly equal for the females housed in cages (2.10) and on a litter floor (2.10). However, more feed was required for the cage reared males (2.29) than for the floor reared males (2.12). Livability from two through eight weeks of age averaged 96.9 percent for the floor reared females and 93.0 percent for the cage reared females. For the males, the livability figures were 93.2 and 90.2 percent for the floor and cage reared birds, respectively. Starvation and dehydration accounted for 71.4 percent of the mortality that occurred in the cage reared birds; apparently a "carry over" of the problem encountered during the first week. Other diagnosed mortality reasons for the cage reared birds were perosis (14.3 percent), roundheart (9.5 percent), and aortic rupture (4.8 percent). Of the floor birds that died, 60 percent were diagnosed as having perosis problems and 40 percent were undetermined.

Results of 8 to 17 weeks parameters studied are presented in Table 5. Seventeen-week body weights were not

Table 5. Body weight, feed conversion, livability, foot score and breast blister incidence of cage and floor grown female turkeys to 17 weeks of age

| Group | Growing System | Density ($m^2$/bird)[1] | No. Birds Initially (8 wks. age) | 17-week Body weight (kg)[2] | Feed/ Gain Ratio | Livability (%) | Foot Score | Breast Blister (% birds) |
|---|---|---|---|---|---|---|---|---|
| 9 | Floor | .216 | 57 | 7.18±.16[3]a | 3.23 | 96.5 | 1.5±.1ab | 0.0 |
| 10 | Cage-floor | .216 | 52 | 6.93±.13 a | 3.36 | 98.1 | 1.3±.1ab | 0.0 |
| 11 | Cage-Wire | .212 | 12 | 6.98±.29 a | 3.59 | 100.0 | 1.7±.3bcd | 16.7 |
| 12 | Cage-Wire | .094 | 27 | 6.55±.18 a | 3.16 | 92.6 | 2.2±.2 d | 8.0 |
| 13 | Cage-Plastic | .212 | 12 | 6.91±.19 a | 3.43 | 100.0 | 1.8±.3 cd | 0.0 |
| 14 | Cage-Plastic | .191 | 9 | 7.31±.22 a | 4.23 | 100.0 | 1.2±.2 a | 0.0 |
| 15 | Cage-Plastic | .094 | 27 | 6.63±.15 a | 3.37 | 96.3 | 1.8±.1 cd | 0.0 |

[1]One square foot = 0.0929 square meter ($m^2$).

[2]One kilogram (kg.) = 2.2 pounds.

[3]± standard error mean.

[4]Means followed by different letters are significantly different ($p < .05$).

significantly ($P > .05$) different for turkey females grown on a litter floor or in cages which had either a wire or Bressler plastic floor. A trend for lowered body weight, although not significant ($P > .05$), was observed as bird density increased.

Breast blisters were not observed in the birds grown on the litter or in cages having the Bressler plastic floor; whereas, a 10.8 percent incidence was observed in the birds grown in cages having a wire floor. However, no detrimental bird maneuverability problems were observed. Growing turkey females from day-old to 8 weeks of age in cages and thereafter on a litter floor did not significantly ($P > .05$) alter body weight or foot score.

A better feed efficiency was observed in the litter floor housed birds; however, some feed wastage did occur in the cage system because feed depth in the feeder pan could not be positively controlled.

Perosis accounted for 66.6 percent of the female mortality. Cannibalism and liver hemorrhage were the other diagnosed mortality problems. Mortality averaged 3.1 percent for all treatments during the 8 to 17-week growing period.

Results of parameters studied from 8 to 21 weeks of age in males are presented in Table 6. Twenty-one-week body weights were not significantly ($P > .05$) different for turkey males grown on a litter floor or in cages which had either

Table 6. Body weight, feed conversion, livability, foot score and breast blister incidence of cage and floor grown male turkeys to 21 weeks of age.

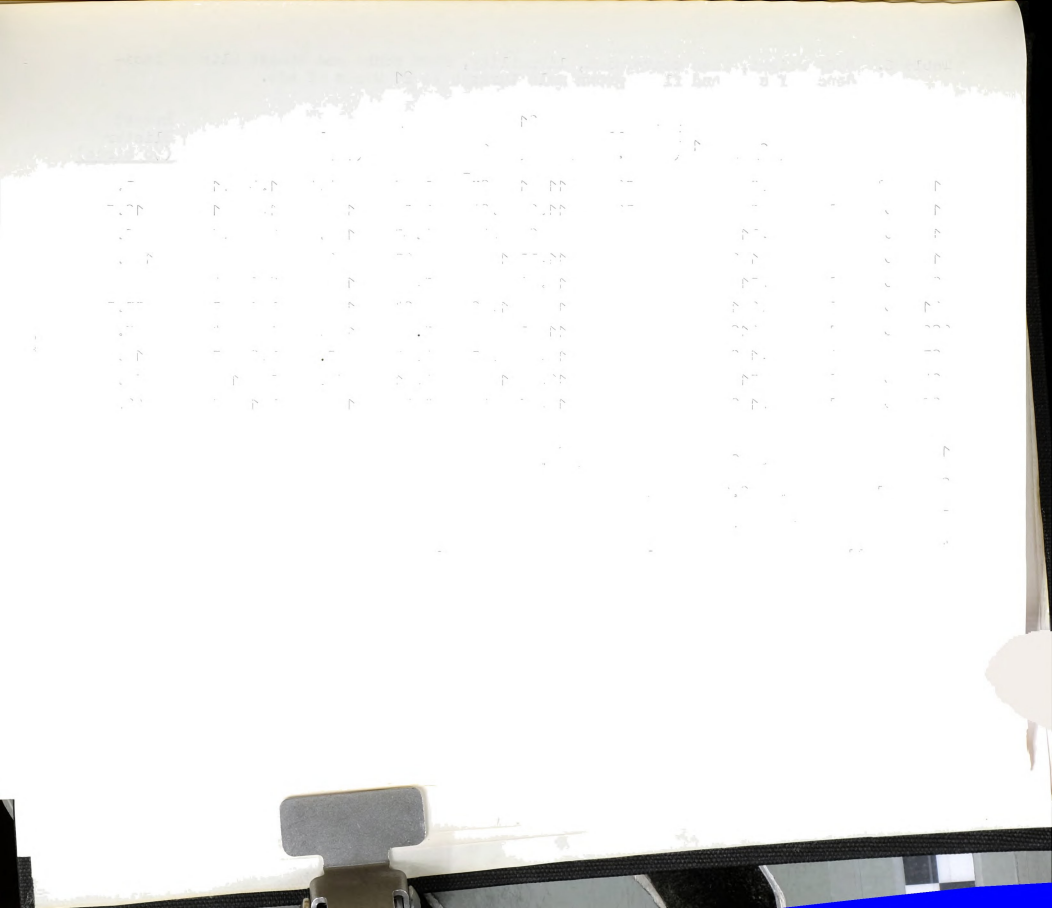
| Group | Growing System | Density ($m^2$/bird)[1] | No. Birds Initially (8 Wks. age) | 21-week Body weight (kg)[2] | Feed/ Gain Ratio | Livability (%) | Foot Score | Breast Blister (% birds) |
|---|---|---|---|---|---|---|---|---|
| 16 | Floor | .387 | 32 | 11.71±0.23[3] a[4] | 3.95 | 84.4 | 1.4±0.1a | 3.7 |
| 17 | Cage-Floor | .387 | 32 | 11.20±0.24 a | 3.36 | 100.0 | 1.4±0.1a | 12.5 |
| 18 | Cage-Wire | .319 | 8 | 9.27±0.48 a | 4.43 | 100.0 | 2.9±0.5 b | 75.0 |
| 19 | Cage-Wire | .182 | 7 | 11.33±1.00 a | 5.23 | 42.9 | 4.0±0.0 c | 100.0 |
| 20 | Cage-Plastic | .319 | 8 | 10.92±0.70 a | 3.80 | 100.0 | 2.5±0.4 b | 50.0 |
| 21 | Cage-Plastic | .281 | 6 | 10.76±1.62 a | 4.24 | 100.0 | 3.3±0.3 bc | 33.3 |
| 22 | Cage-Plastic | .212 | 8 | 11.33±0.65 a | 3.64 | 100.0 | 3.0±0.4 b | 25.0 |
| 23 | Cage-Plastic | .182 | 7 | 10.78±0.83 a | 4.73 | 85.7 | 3.2±0.3 bc | 16.7 |
| 24 | Cage-Slats | .319 | 4 | 12.78±1.56 a | 4.91 | 50.0 | 3.0±1.0 b | 50.0 |
| 25 | Cage-Slats | .182 | 7 | 10.75±0.49 a | 3.47 | 100.0 | 3.1±0.3 b | 42.9 |

[1]One square foot = 0.0929 square meter ($m^2$).

[2]One kilogram (kg.) = 2.2 pounds.

[3]± standard error mean.

[4]Means followed by a different letter are significantly different ($P < .05$).



a wire, Bressler plastic or plastic slat floor. A trend for lowered body weight, although not significant ($p > .05$), was observed as bird density increased.

Breast blister incidence was 8.5, 32.1, 44.4 and 81.8 percent for the litter, Bressler plastic, plastic slat and wire floor grown birds, respectively. Birds grown in cages had significantly ($p < .05$) higher foot scores than those grown on the litter floor. Birds having swollen foot (3 or 4 score) had maneuverability problems and sat with their breast touching the cage floor unless forced to move. Growing turkey males from day-old to 8 weeks of age in cages and thereafter on a litter floor did not significantly ($P > .05$) alter body weight or foot score.

A better feed efficiency was observed in the litter floor housed birds; however, some feed wastage did occur in the cage system because feed depth in the feeder pan could not be positively controlled.

Perosis accounted for 66.7 percent of the male mortality. Aortic rupture (35.0 percent) was the other diagnosed mortality problem. Mortality averaged 10.0 percent for the birds in all treatment groups during the 8 to 21-week growing period. Mortality averaged 12.7 and 7.8 percent for the cage and floor grown birds, respectively.

## EXPERIMENT #2

### Procedure

A total of 495 day-old large white turkeys (Nicholas variety) were obtained from a commercial hatchery. The poults had been sexed, toms desnooded and each bird injected with 0.04 ml. of a streptomycinpenicillin-vitamin B mixture. Each poult was wing-banded and placed in either cage or floor rearing pens. The room temperature at the bird level was 33.9°C (93°F) for the first three days, 32.2°C (90°F) for the fourth through the tenth days and reduced 2.8°C (5°F) weekly until a 21.1°C (70°F) temperature was attained. Heat was provided by gas-fired brooders.

Light intensity was maintained at 129 to 161 lux [4](12 to 15-foot candles), depending on bird location in relation to the light source for the first three days and 21 to 43 lux (2 to 4-foot candles) from the fourth through the tenth day. Thereafter, light intensity was 5.4 to 10.8 lux (0.5 to 1.0-foot candles). The low intensity was used as a technique to control cannibalism because the birds were not debeaked. Rheostats were used to increase the light intensity to 43-54 lux (4 to 5-foot candles) whenever the caretakers entered the rooms. During the first ten days,

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[4]One-foot candle =10.76 International Lux

continuous light was provided; thereafter, a 12-hour per day artificial light was provided.

Feed and water were provided ad libitum. Medication included tylosin in the water and continuous chlorotetracyceine (100 g./ton) in the feed. Tylosin was added to the water at 2 g. the first five days and for three days at monthly intervals thereafter. Composition of the diets used is shown in Table 1. These diets were fed to both males and females according to the following schedule:

Prestarter - Fed until 0.9 Kg. (2.0 lbs.) consumed/ bird

Starter - Fed to 8 weeks

Grower #1 - Fed to 12 weeks

Grower #2 - Fed to 17 weeks

Grower #3 - Fed to 21 weeks

The cage and floor housing descriptions are presented in Table 7. All cage birds were started on wire floors (pens 1-16) which were covered with an absorbent, non-slip, laboratory animal paper for the first ten days. The wood shavings that covered the litter floor were also covered with the same type of paper for the first ten days. At six weeks of age, the cage brooded birds were either kept in cages with wire floors or were transferred to a litter floor or to other cages with different type of floors.

Body weights were recorded for each sex at six weeks of age and at 17 weeks and 21 weeks of age for the female and males, respectively. Feed conversion (feed-gain ratio)

Table 7. Cage and floor housing description in experiment two

| Pen No. | Floor Type | Pen Size (mxm)[1] | Water Cup No./Pen | Water Cup Type | Tube-Pan Feeder No./Pen | Tube-Pan Feeder Diameter (cm)[2] |
|---|---|---|---|---|---|---|
| 1-16 | 1 x 1/2 Wire[3] | 1.04x1.22 | 3 | Hart | 1 | 30.5 |
| 17-19 | Wood Shavings | 2.34x5.31 | 1 | Johnson | 2 | 63.5 |
| 20 | Wood Shavings | 2.29x4.93 | 1 | Johnson | 2 | 63.5 |
| 21-22 | Plastic Mat[4] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 23-24 | Bressler Plas.[5] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 25-27 | Bressler Plas. | 1.04x0.81 | 2 | Swish | 1 | 30.5 |
| 28-31 | Plastic Slats[6] | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 32-34 | Bressler Plas. | 1.04x0.81 | 2 | Swish | 1 | 30.5 |
| 35-36 | Bressler Plas. | 1.04x1.22 | 2 | Swish | 1 | 30.5 |
| 37-38 | Plastic Mat | 1.04x1.22 | 2 | Swish | 1 | 30.5 |

[1]One meter (m) = 3.28 feet.

[2]One inch = 2.54 centimeters (cm).

[3]The wire floors in pens 9, 11, 13 and 15 were covered with a soft thin plastic mesh which resembled chicken wire netting between the 6 to 21 week male growing period.

[4]Soft plastic cage insert mat which was 1.4 cm. thick and had 1.6 cm. x 9.2 cm. openings (Limited Plastics, Lemon Cobe, Ga. 93244).

[5]Bressler polyethylene self-supporting flooring (Mal Farm Lab. Services, Inc., McAlisterville, PA, 17049).

[6]Hard plastic tubes having a 3.2 cm. flat surface and spaced 1.9 cm. apart.

was obtained for the first six-week growing period and for the 6 to 17-week (female) or 6 to 21-week (male) growing periods. The hock width (inside, outside hock thickness at the hock joint) was recorded each time the birds were weighed. A caliper rule was used to measure the hock width by approaching the hock dorsally and increasing the caliper rule jaw distance until the rule could be moved up and down freely.

When the birds were 17 (females) or 21 (males) weeks of age, a foot disfigurement evaluation was made. The scoring system used was the same as that employed in Experiment 1.

A breast blister evaluation was made at 17 (female) and 21 (male) weeks of age. The evaluation was made after the birds had been slaughtered and defeathered. Immediately after defeathering, the left leg of each bird was removed at the hock joint, identified and placed in a plastic bag and stored for four weeks at -17.8°C (0°F) until tested for the force required to break the leg in an Instrom Universal Testing Machine (Bourne et al., 1966) type TTEM (Instron Engineering Corp., 2500 Washington Avenue, Canton, Massachusetts) as shown in Figure 2. The leg bone was placed across two supports 10 cm. apart. A probe, 3 cm. thick with a 3.1 cm. equilateral triangular notch, was driven against the bone, about 5 cm. from each support, at a speed of 50 cm./min. The force registered during the breaking of

the bone was recorded on a printout of force versus displacement of the probe. The peak force was used as a measure of breaking strength.

Mortality was recorded and all dead birds were autopsied at the Michigan State University Diagnostic Laboratory. Mortality recorded as perosis was determined on the basis of visual observation while the bird was alive and confirmed at autopsy. It was assumed that the perosis incapacitation was the primary mortality problem even if another disease problem was also diagnosed in the same bird.

The data collected were subjected to statistical analyses, using methods of analysis of variance (Snedecor and Cochran, 1968) and differences between means by the multiple range F test (Duncan, 1955). Significant differences were assumed at ($P < .05$).

Figure 2. Instron Universal Testing Machine used to measure breaking strength of bone.

Results

Results of the first six weeks are presented in Table 8. The cage brooded turkeys had heavier body weights than did the litter floor brooded birds at six weeks of age. A bird density of .046 square meter (0.5 sq. ft.) per bird in the cage systems was satisfactory for growth when compared to the litter floor group. However, the heaviest average body weight was observed in the cage brooded females at .064 square meter (0.7 sq. ft.) per bird and in the cage brooded males at .091 square meter (1.0 sq. ft.) per bird.

Livability averaged 93.4 percent for the cage brooded birds and 96.9 percent for the litter floor brooded birds. At the end of the first week livability averaged 97.8 and 98.5 percent, respectively, for the cage and floor grown birds. Perosis accounted for 50 percent (12 or 24 birds) of the mortality observed in the cage brooded birds. The hocks of the cage brooded birds were larger than those of the litter floor brooded birds. The average difference in width was .04 cm. (.016 in.) and .07 cm. (.028 in.) for the females and males, respectively.

The feed-gain ratios (feed efficiency) averaged 1.77 and 1.74 for the cage brooded female and male turkeys, respectively. The feed-gain ratios averaged 1.65 (female) and 1.71 (male) for the litter floor brooded birds.

Table 9 shows results for females from 6 to 17 weeks

Table 8. Effect of cage and floor brooding on body weight, feed conversion, hock width and livability of market turkeys to six weeks of age

| Pen No. | Brooding System | Density ($m^2$/Bird)[1] | Birds Started No. | 6-Week Body Weight (Kg)[2] | Feed/ Gain Ratio | Hock Width (cm)[3] | Livability (%) | Mortality (No. Birds) Total | Perosis | Starveout | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Females | | | | | | | | | | | |
| 2,10 | Cage | .027 | 94 | 1.460±.015[4]a[5] | 1.76 | 2.38±.01b | 95.7 | 4 | 1 | 2 | 1 |
| 4,12 | Cage | .046 | 56 | 1.622±.018c | 1.80 | 2.42±.01c | 89.3 | 6 | 5 | 0 | 1 |
| 6,14 | Cage | .064 | 40 | 1.641±.028c | 1.72 | 2.39±.01bc | 100.0 | 0 | 0 | 0 | 0 |
| 8,16 | Cage | .091 | 28 | 1.479±.030ab | 1.83 | 2.32±.02a | 89.3 | 3 | 1 | 0 | 2 |
| 18 | Floor | .172 | 77 | 1.529±.019b | 1.65 | 2.34±.01a | 96.1 | 3 | 0 | 1 | 2 |
| Males | | | | | | | | | | | |
| 1,9 | Cage | .046 | 56 | 1.912±.032ab | 1.75 | 2.65±.02b | 91.1 | 5 | 2 | 0 | 3 |
| 3,11 | Cage | .064 | 40 | 1.969±.031c | 1.73 | 2.68±.02b | 90.0 | 4 | 2 | 1 | 1 |
| 5,13 | Cage | .091 | 28 | 2.058±.025d | 1.77 | 2.70±.02b | 92.9 | 2 | 1 | 0 | 1 |
| 7,15 | Cage | .116 | 22 | 1.944±.036bc | 1.71 | 2.67±.02b | 100.0 | 0 | 0 | 0 | 0 |
| 17 | Floor | .229 | 54 | 1.891±.029a | 1.71 | 2.60±.01a | 98.1 | 1 | 0 | 1 | 0 |

[1]One square foot = 0.0929 square meter ($m^2$).

[2]One kilogram (kg.) = 2.2 pounds.

[3]One inch = 2.54 centimeter (cm.).

[4]± standard error mean.

[5]Means followed by different letters are significantly different at $P < .05$.

Table 9. Effect of 6 to 17-week housing system on growth and leg condition of female turkeys

| Pen No. | Housing System 6-17 wk. | Housing System 0-6 wk. | Density ($m^2$/bird)[1] | No. Birds Started at 6 wks. | 17-wk. Body Weight,[2] (kg.)[4] | Feed/Gain Ratio (6-17 wks.) | Livability 6-17 wk. (%) | Breast Blisters Trimmed (% birds) | Foot Score | 17-wk. Leg Condition: Hock Width (cm.)[3] | 17-wk. Leg Condition: Breaking Force (kg.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Litter | Litter | .212 | 59 | 6.95±.07[4] a[5] | 3.34 | 98.3 | 1.7 | 1.1±.0ab | 2.67±.01a | 60.8±.4a |
| 20 | Litter | Cage | .212 | 53 | 6.86±.08a | 3.31 | 100.0 | 9.4 | 1.0±.0a | 2.70±.04abc | 61.1±.6a |
| 10,12 | Wire | Cage | .141 | 18 | 7.13±.09ab | 3.04 | 100.0 | 22.2 | 1.5±.2d | 2.75±.02c | 61.8±.6a |
| 14,16 | Wire | Cage | .212 | 12 | 7.39±.16b | 3.05 | 100.0 | 50.0 | 1.3±.1c | 2.85±.03d | 61.4±.8a |
| 23,24 | Plastic | Cage | .141 | 18 | 7.15±.14ab | 3.28 | 100.0 | 0.0 | 1.1±.1ab | 2.73±.03abc | 61.2±.6a |
| 35,36 | Plastic | Cage | .212 | 12 | 7.52±.19b | 3.22 | 100.0 | 0.0 | 1.1±.1ab | 2.70±.03abc | 61.0±.8a |
| 25,26 27 | Plastic | Cage | .141 | 18 | 7.16±.13ab | 3.23 | 100.0 | 0.0 | 1.1±.1ab | 2.74±.03bc | 60.8±.9a |
| 32,33 34 | Plastic | Cage | .212 | 12 | 7.24±.16ab | 3.25 | 100.0 | 0.0 | 1.1±.1ab | 2.66±.02a | 63.0±.4a |
| 28,29 | Slats | Cage | .141 | 18 | 6.95±.15a | 3.45 | 94.4 | 0.0 | 1.2±.1bc | 2.74±.03bc | 61.7±.5a |
| 30,31 | Slats | Cage | .212 | 12 | 7.41±.18b | 3.25 | 100.0 | 0.0 | 1.1±.1ab | 2.68±.02ab | 62.0±.4a |

[1] One square foot = 0.0929 square meter ($m^2$).

[2] One kilogram (kg.) = 2.2 pounds.

[3] One inch = 2.54 centimeters (cm.).

[4] ± Standard error mean.

[5] Means followed by different letters are significantly different at $P < .05$.

of age. Cage grown birds at a density of .212 square meter (2.3 sq. ft.) per bird had heavier 17-week body weights than litter floor grown birds at the same density or cage grown birds at a density of .141 square meter (1.5 sq. ft.) per bird. However, the average body weights of the cage grown birds at a density of .141 square meter (1.5 sq. ft.), although not significantly different, were heavier (7.10 vs 6.95 kg.) than those of the litter floor grown birds. Growing female turkeys to six weeks of age, in a wire cage and then on a litter floor, to 17 weeks of age did not significantly alter body weight in comparison to the birds grown on a litter floor throughout the entire 17 weeks. Althouth three different types of cage floor material (wire, Bressler, plastic or plastic slats) were used, the average body weights at 17 weeks of age were not significantly altered.

A lower feed/gain ratio (feed efficiency) was observed in the cage housed (3.22) birds than in the litter floor housed (3.33) birds. Livability averaged 99.1 percent for both the cage and litter floor grown birds.

The average force required to break the legs (breaking strength of bones) of females at 17 weeks of age was not significantly affected by the type of growing floor used. There was no statistical difference between the breaking strength of bones from birds that were housed in floor and those housed in cage housing systems even though they were numerically weaker. The lowest force required to

break the legs was recorded for those birds that were housed in pen numbers 18, 25, 16 and 27; and the highest force required to break the legs was registered for those birds that were housed in pen numbers 32, 33 and 34.

Foot disfigurement and hock size were greater in the birds grown in the cages with wire floors than those grown on litter floors. The highest average foot score was recorded for those birds that were grown in pen numbers 10 and 12, and the lowest average foot score was recorded for those that were grown in pen number 20. Though there were numerical differences between floor and caged birds, yet the differences were not significant statistically; however, there were significant differences ($P<.05$) between birds grown in wire cages and those grown in cages with plastic bottoms and between those grown in floor and those grown in wire cages. In terms of hock size, the highest average was that recorded for those birds grown in pen numbers 14 and 16, and the lowest for those birds grown in pen numbers 32, 33 and 34. Even though there were numerical differences between floor reared birds and cage reared birds, yet the differences were not significant statistically; however, a significant difference ($P<.05$) was observed between birds maintained in litter floor housing system from 0 to 17 weeks of age and those grown in cages from 0 to 6 weeks and later grown in cages with plastic bottoms or wire cages from 6 to 17 weeks of age.

There was a significant difference between the breaking strength of legs of males housed in cage or floor and females housed in cage or floor. Numerically, the males housed in either cage or on floor had higher foot score and hock size than comparable females.

Breast blisters were not observed in any of the birds grown in cages with either Bressler plastic or plastic slat floors. However, 33.3 percent of the birds grown in cages with wire floors had breast blisters. Of those with breast blister, the lowest incidence was observed in those maintained in pen number 18 and the highest in those grown in pen numbers 14 and 16.

Results of males grown in cages and floor from 6-21 weeks of age are presented in Table 10. Litter floor grown birds at a density of .319 square meter (3.4 sq. ft.) per bird had heavier 21-week weights than birds grown in wire floor cages at a density of .182 (2.0 sq. ft.) or .319 (3.4 sq. ft.) square meter. However, birds grown in cages, which had a soft plastic mat over the wire floor, at a density of .319 square meter (3.4 sq. ft.) had heavier (13.78 vs 13.40 kg.), although not significantly different, body weights than the litter floor grown birds. The average body weights of the birds grown in wire cages to 6 weeks of age and then on a litter floor to 21 weeks of age were lower (12.55 vs 13.40 kg.) than those for the birds grown on a litter floor throughout the entire 21 weeks.

Table 10. Effect of 6 to 21-week housing system on growth and leg condition of male turkeys

| Pen No. | Housing System 6-21 wk. | Housing System 0-6 wk. | Density ($m^2$/bird)[1] | No. Birds Started at 6 wks. | 21-wk. Body weight (kg.)[2] | Feed/Gain Ratio (6-21 wk.) | Livability 6-21 wk. (%) | Breast Blisters Trimmed (% birds) | Foot Score | 21-wk. Leg Condition: Hock Width (cm.)[3] | 21-wk. Leg Condition: Breaking Force (kg.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Litter | Litter | .319 | 39 | 13.40±.17[4]c[5] | 3.64 | 84.6 | 3.0 | 1.2±.1a | 3.41±.02a | 147.4±6.6a |
| 19 | Litter | Cage | .319 | 39 | 12.55±.19b | 3.98 | 87.2 | 29.4 | 1.8±.1b | 3.39±.02a | 160.7±5.1a |
| 9,11 | Wire | Cage | .182 | 14 | 11.71±.27a | 4.16 | 85.2 | 41.7 | 3.3±.3d | 3.55±.11a | 141.5±8.4a |
| 13,15 | Wire | Cage | .319 | 8 | 12.08±.39ab | 3.32 | 100.0 | 37.5 | 3.3±.2d | 3.46±.04a | 145.1±9.7a |
| 37,38 | Plastic | Cage | .182 | 14 | 12.62±.25b | 3.86 | 92.9 | 23.1 | 2.7±.1c | 3.50±.04a | 135.4±12.8a |
| 21,22 | Plastic | Cage | .319 | 8 | 13.78±.31c | 3.37 | 100.0 | 12.5 | 2.1±.4b | 3.48±.11a | 162.7±7.1a |

[1]One square foot = 0.0929 square meter ($m^2$).

[2]One kilogram (kg.) = 2.2 pounds.

[3]One inch = 2.54 centimeters (cm.).

[4] ± Standard error mean.

[5]Means followed by different letters are significantly different at $P < .05$.

A lower feed/gain ratio (feed efficiency) was observed in the cage housed (3.32 and 3.37) birds at a density of .319 square meter (3.4 sq. ft.) than in the litter floor housed (3.64) birds. However, at a density of .182 square meter (2.0 sq. ft.) the cage housed (3.86 and 4.16) birds required more feed than the litter floor housed (3.64) birds. Livability averaged 85.9 percent for the litter floor housed birds and 93.2 percent for the cage housed birds. Of the mortality observed in the litter floor housed birds, 72.7 percent (8 of 11 birds) was diagnosed as being due to perosis, 18.1 percent (2 of 11 birds) was diagnosed as being due to roundheart disease, and 9.2 percent (1 of 11 birds) was diagnosed as caused by aortic rupture. Of the mortality observed in the cage grown birds, 66.7 percent (2 of 3 birds) was diagnosed as being due to perosis, and 33.3 percent (1 of 3 birds) was diagnosed as caused by aortic rupture.

Breaking strength of legs for males was not significantly affected by the type of growing floor used. The average force required to break the legs of caged birds was not significantly different ($P > .05$) from those maintained in the floor housing systems; however, the cage reared birds had weaker leg breaking strength numerically than floor reared birds. The greatest average force required to break the legs was recorded for those birds housed in pen numbers 21 and 22, and the weakest force was recorded for those in pen numbers 37 and 38.

Numerically, birds grown on floor had a lower foot score in comparison to those grown in cages. The lowest average foot score was recorded for birds in pen number 17, and the highest average foot score was recorded for those in pen numbers 9, 11, 13 and 15. There were statistical differences ($P < .05$) between cage reared birds and floor reared birds and between birds reared in wire cages and those reared in cages with plastic bottoms. Birds reared in pen number 19 had the narrowest hock size while those reared in pen numbers 9 and 11 had the widest hock size. Floor reared birds had narrower hock size in comparison to cage reared birds; however, there was no significant difference ($P > .05$) between floor reared birds and cage reared birds.

Generally, hock size was not significantly altered by the type of housing system.

Breast blisters, which were trimmed at the time the birds were processed, were observed in 3 percent of the birds grown on a litter floor for the entire 21 weeks of age and in 19 percent of the birds grown on the soft plastic mat. Of the birds housed in the cages with wire floors, 4 percent had breast blisters which were trimmed at the time the birds were processed. A breast blister percentage of 29.4 was observed in the birds grown in wire cages to six weeks of age and then on a litter floor to 21 weeks of age.

## DISCUSSION

The results of the first experiment in the study were generally not consistent with the finding of Manley and Muller (1973) regarding body weight of birds grown in cages and on the floor, but were consistent in terms of foot score. Manley and Muller (1973) reported that caged, Broad Breasted White turkey hens gained significantly ($P < .05$) more weight than did floor managed controls. The floor reared birds had significantly ($P < .05$) lower foot scores than did the cage reared birds, except for the birds reared on the Bressler flooring. In this study, 17-week body weights in Experiment 1 were not significantly ($P > .05$) different for turkey females grown on a litter floor or in cages which had either a wire or Bressler plastic floor. Birds grown in cages had significantly ($P < .05$) higher foot scores than those grown on the litter floor. In terms of feed efficiency, the finding of Carson et al. (1973) is in agreement with that observed in Experiment 1 of the study; i.e., a better feed efficiency was observed in the litter floor housed birds.

The cage environment did not adversely affect the growth of female turkeys to 17 weeks of age or male turkeys to 21 weeks of age. Market quality in terms of breast blister incidence was acceptable for the cage grown females; however, the high incidence observed in the cage grown

males would make the cage floors used in the study an uneconomical practice for the commercial turkey producer.

A cage brooding system to 8 weeks of age, followed by a litter floor growing system thereafter, has potential as a commercial practice. The body weights attained at 17 (female) or 21 (male) weeks of age demonstrate that body weight should not be adversely affected by a cage rearing environment. In view of the data collected in a subsequent experiment (unpublished), the first week mortality problem could have been eliminated by maintaining a 35°C (95°F) temperature and a light intensity of 161 to 215 lux (15 to 20 f.c.) at bird level. Other possible factors which may have influenced mortality could be heat and water source location. Water may have to be available on both the inside and outside cage partition rather than just on the outside partition, as in this study. Likewise, heat may have to originate from the house wall rather than the center of the pen, as was the case in this study. The management technique of low light, 5.4 to 10.8 lux (0.5 to 1.0 f.c.), intensity was successfully employed in this study to prevent cannibalism. The low light intensity was used in place of the typical debeaking technique employed by the commercial turkey industry.

In experiment two, livability of the cage brooded birds during the first week was considerably better (97.8 versus 81.8 percent) than previously observed in the first experiment. The two managerial differences of the two

experiments were a greater light intensity, 129 to 161 lux (12 to 15 f.c.), a better control of environmental temperature, 33.9°C (93°F) for the first three days followed by 32.2°C (90°F) for the next four days. Based on the observations in the two experiments, light intensity and environmental temperature play an important role in getting cage brooded poults "off-to-a-fast-start."

It is the author's observation that debeaking was eliminated as a management procedure in this study by controlling light intensity. Light intensity was 129 to 161 lux (12 to 15 f.c.), depending on bird location in relation to the light source for the first three days and 21 to 43 lus (2 to 4 f.c.) from the fourth through the tenth day. Thereafter, light intensity was 5.4 to 10.8 lux (0.5 to 1.0 f.c.). Rheostats were employed to increase the light intensity to 43 to 54 lux (4 to 5 f.c.) whenever caretakers entered the rooms. However, an observant caretaker is necessary if this program is to operate effectively because a greater light intensity than that listed, even if for only three or four hours, resulted in some toe and feather-picking in this study.

Based on the results of this study, commercial female turkeys can be successfully brooded and grown in cages that have either Bressler plastic or hard plastic slats as flooring material. The use of wire floor cages would appear to be uneconomical because of the breast blister incidence observed in the first and second experiments.

Cage growing of commercial male turkeys shows promise because using a soft plastic mat as a floor material in wire cages resulted in heavier 21-week body weight than that of litter grown birds. This is in agreement with the result reported by Manley and Muller (1973). In addition, a lower feed/gain ratio was observed in these cage grown birds. However, a slightly higher breast blister incidence (12.5 versus 3.0 percent) was observed in the cage grown birds.

Of particular concern in this study was the lower 21-week male body weight and greater incidence of breast blisters observed in the cage floor grown birds in comparison to the litter floor grown birds. A visual observation was made which may offer an explanation of greater incidence (44.1 versus 9.1 percent) of leg lameness in this study. This lameness was very similar to that described by McCapes (1967). The birds were reluctant to walk and upon being forced to walk, a hobbling or limping gait was observed. As soon as possible, the birds would sit; however, when continually forced to walk, they would use their wings to continue forward motion. Quivering of the legs was a common symptom. The majority (70 percent) of the birds with breast blisters which were trimmed when the birds were processed exhibited the leg lameness. Since the cage grown birds did not exhibit the lameness to any greater incidence than the litter floor grown birds, it would seem that cage brooding per se was not the problem.

Further, the problem has been recognized by the commercial industry for several years (McCapes, 1967).

The data from the second experiment indicated that there was a significant difference between floor grown and cage grown birds when a comparison was made between the breaking strength of legs. No sex difference in breaking strength existed between the type of flooring material used and the control treatment; however, the control had a lower breaking force than any of the treatment groups. No difference in hock size in the males was found between the flooring materials used and the controls; but, there were differences between the type of flooring materials and control for the females. In both males and females, there were significant differences ($P < .05$) between controls and types of flooring materials used (floor versus cage reared turkeys) in foot disfigurement. This is in contrast to the findings reported by Manley and Muller (1973). Foot disfigurement is considered a contributing factor to overall performance (Woodward et al., 1961).

## SUMMARY AND CONCLUSION

Two experiments were conducted to evaluate the cage system as an environment for growing turkeys to market age with respect to growth, cage density, type of flooring materials and bone characteristics.

In experiment one, 440 day-old commercial large white turkeys (Nicholas variety) were utilized as experimental birds. The birds were brooded in a wire cage or on a litter floor from 1 to 8 weeks of age. From 8 to 17 (females) or 8 to 21 (males) weeks of age the birds brooded on a litter floor were continued on litter floor; whereas, the cage birds were kept in the wire cage.

Male and female 8-week body weights were not significantly ($P > .05$) affected by housing the birds on a litter floor or in cages. The average body weights for females reared in either cage or floor housing system were almost identical, 2.568 kg. (5.6 lbs.) versus 2.585 kg. (5.7 lbs.) at 8 weeks of age. Cage reared males averaged 3.175 kg. (7.0 lbs.) at 8 weeks of age in comparison to 3.112 kg. (6.8 lbs.) for the floor reared males.

There was no significant ($P > .05$) effect on the 17 or 21-week body weights when the females were grown to 17 weeks and the males to 21 weeks of age, respectively, in cages, on a litter floor, or in cages to 8 weeks and then

on a litter floor thereafter. The average 17-week female body weights were 6.77 kg. (14.9 lbs.), 6.93 kg. (15.2 lbs.) and 7.18 kg. (15.8 lbs.) for the cage, cage floor, and floor grown birds, respectively. The average 21-week male body weights were 10.75 kg. (23.7 lbs.), 11.20 kg. (24.6 lbs.), and 11.71 kg. (25.8 lbs.) for the cage, cage floor and floor grown birds, respectively.

The incidence of breast blisters was not a problem in the female turkeys grown to 17 weeks of age on a litter floor or in cages having a Bressler plastic floor; however, a 10.8 percent incidence was observed in the females grown in cages with wire floors. Males grown in cages with wire floors had an 81.8 percent incidence of breast blisters; however, the incidence was considerably lower (32.1 percent) in the males grown on the Bressler plastic floor. Despite this difference, the economic considerations obviously dictate different type of cage floors than any used in this experiment.

In experiment two, 495 commercial turkeys (Nicholas variety) were brooded to 6 weeks of age in a wire cage or on a litter floor. From 6 to 17 (females) or 6 to 21 (males) weeks of age, the cage brooded birds were either kept in cages with wire floors or were transferred to a litter floor or to other cages with different types of floor bottoms. Cage brooded turkeys had heavier body weights than did the litter floor brooded birds at 6 weeks of age. Livability for the first 6 weeks averaged 93.4 percent for the cage

brooded birds and 96.9 percent for the litter floor brooded birds. A bird density of 0.046 square meter (0.5 sq. ft.) per bird in the cage's system was satisfactory for growth to 6 weeks of age when caged birds were compared to the litter floor brooded birds.

The 17-week body weight of cage grown female turkeys was heavier, 7.39 kg. (16.3 lbs.), than that of comparable litter grown females, 6.95 kg. (15.3 lbs.), when housed at 0.212 square meter (2.3 sq. ft.) per bird. The average body weights of birds grown in cages at 0.141 square meter (1.5 sq. ft.) per bird or in cages to 6 weeks of age and then on a litter floor to 17 weeks were not significantly ($P > .05$) altered when compared to those of the litter floor brooded and grown birds. All turkeys grown on a litter floor at a density of 0.319 square meter (3.4 sq. ft.) per bird had heavier 21-week body weights than birds grown on wire floor cages at a density of 0.182 (2.0 sq. ft.) or 0.319 (3.4 sq. ft.) square meter. The average 21-week body weights were 13.40 kg. (29.5 lbs.), 12.55 kg. (27.6 lbs.), 11.86 kg. (26.1 lbs.), and 13.06 kg. (28.7 lbs.) for birds on litter floor, cage floor, wire cage floor, and soft plastic mat cage floor, respectively.

A lower feed/gain ratio (feed efficiency) was observed in the cage housed (3.22) females than in the litter floor housed (3.33) females from 6 to 17 weeks of age. Feed efficiency for the males (6 to 21 weeks of age) was lower for the cage housed (3.32 and 3.27) birds at a density

of 0.319 square meter than in the litter floor housed (3.64) birds.

The average force required to break the legs was not significantly affected by the type of growing floor used. Breaking strength of legs of both sexes grown in cages was not substantially different from that of birds grown in floor pens. Bone breakage was numerically weaker for the cage reared birds in comparison to the floor reared birds. Foot disfigurement was greater in the cage grown birds than in comparable litter floor grown birds and was greater in birds housed on the wire than for those on the soft plastic mat cage. Hock size was not significantly altered by the type of housing system; however, it was greater numerically in the cage grown birds than in the control (litter floor grown) birds.

Breast blisters were not observed in the birds grown in cages that had either Bressler plastic or plastic slats as flooring material. Breast blisters, which were trimmed at the time the birds were processed, were observed in 3.0, 29.4, 40.0 and 19.0 percent of the litter floor, cage floor, wire cage floor, and soft plastic mat cage floor birds, respectively.

These experiments have shown that cage brooding systems to 8 weeks of age followed by a litter floor growing system has potential as a commercial practice and that commercial female turkeys can be successfully brooded and grown

in cages that have either Bressler plastic or hard plastic slats as flooring material. This practice also shows promise for the males except for the high incidence of breast blister.

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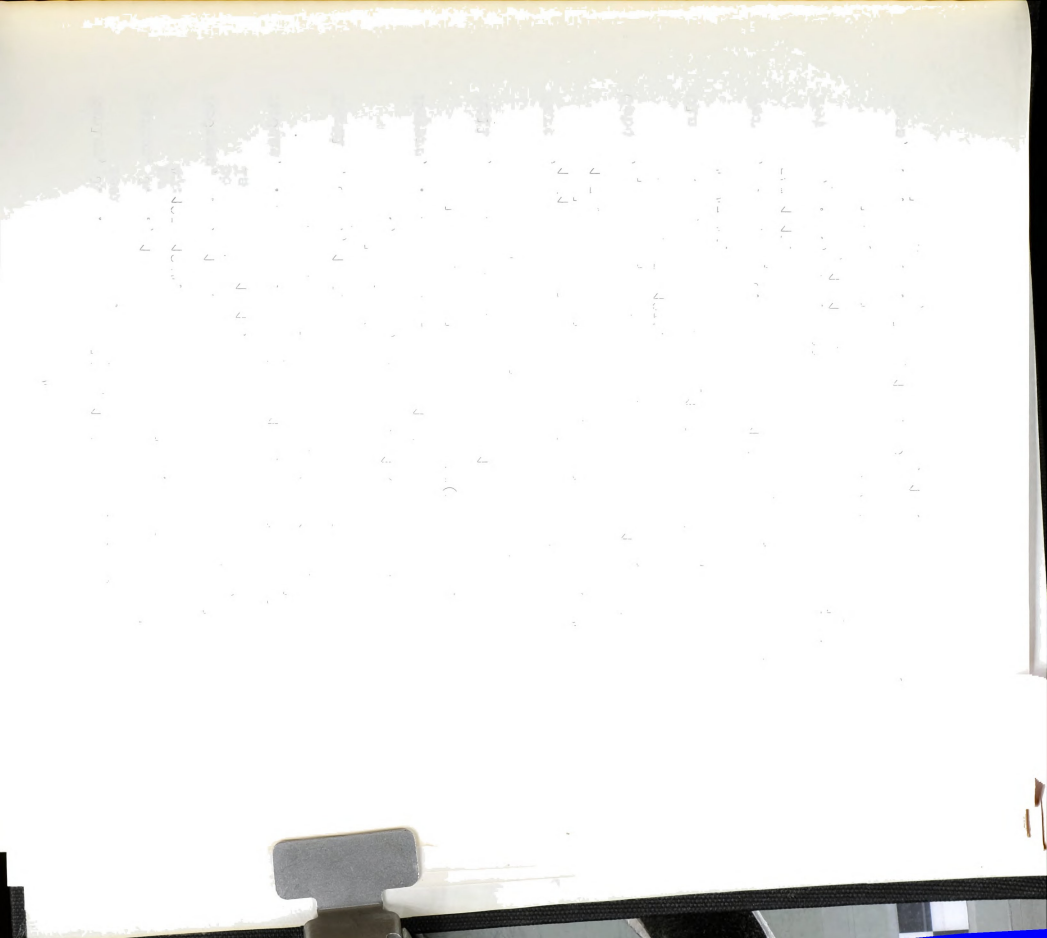

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