EFFECT OF SAND, WHEAT STRAW AND DRIED GRASS AS BEDDING MATERIALS ON GROWTH PERFORMANCE AND FINAL WEIGHT OF BROILERS

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COMMITMENT DISCIPLINE
B U S E
EXCELLENCE

A thesis submitted to Bindura University of Science Education, Department of Animal Science in partial fulfilment of the requirements for the Bachelor of Science Honours degree in Animal Science

Dedication

I dedicate this study to my family whose unwavering support and love fueled my academic journey , I dedicate this to my supervisor whose guidance and expertise shaped this dissertation, to my loved one , who endured late nights , early mornings and endless conversations about my research. Last but not least I dedicate this study to my colleagues who offered support, advice and camaraderie throughout this research

APPROVAL FORM

The signatories confirm that they have read and recommended to the Bindura University of Science Education for acceptance of the project title: Effect of sand, wheat straw and dried grass as materials on growth performance and final weight of broilers

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Acknowledgements

I would like to thank my supervisor for guiding me during my study and research. I also want to thank my family and friends for their support. I also want to thank the owners of plot for supporting me during my research trials.

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Abstract

The study focused on the evaluation of three different broiler bedding materials in order to assess their effect on growth and final weights of birds. Most broiler farmers in Zimbabwe produce broilers under deep litter system and this is resulting in broiler diseases and high cost of treatment drugs. This is caused by inadequate bedding material in the broiler house and use of unsuitable bedding material. Such diseases include foot rot, water belly and respiratory related diseases. Most small-scale farmers are also experiencing low final broiler weights even after prolonged 6 weeks period of broiler production. There is little knowledge available for farmers on the effects of different bedding materials used in broiler production. The study assessed the weekly feed intake, weight gain and mortality of 90 broilers which were randomly assigned to three treatments, which were wheat straw bedding, (treatment 1), dried grass bedding, (treatment 2) and sand bedding (treatment 3) and each of the treatment was assigned 30 broilers. The study revealed that the broilers which were subjected to wheat straw bedding resulted in high intake, weight gain and final weights followed by those which were housed in dried grass bedding and the least being those in sand. In conclusion, it was noted that there was no a significant difference in intake, weekly weight gain and final weight of broilers, reared under wheat straw and dried grass as bedding in broiler house though a significant difference was noted on chickens in sand bedding. The study recommended that wheat straw and dried grass can be used as bedding material when rearing broilers from day old up to six weeks as well as further study on frequency of change of bedding in broiler houses.

Contents

Chapter 1

1.0 Introduction and background

Litter quality is of great importance to the welfare of broiler chicken, as they generally spend their entire life in contact with litter (Kuleile et al., 2019). Litter serves several functions that include thermal insulation, moisture absorption, protective barrier from the ground and it also allows for natural scratching behaviour of chickens. The quality of the in-house environment is highly dependent upon litter quality (Kuleile et al., 2019). An effective bedding material must be readily available, absorbent, lightweight, inexpensive and non-toxic (Kuleile et al., 2019). The litter environment is ideal for bacterial proliferation and ammonia production and there are two factors that influence litter conditions most which are manure and moisture (Li et al., 2017).

The ideal litter material should have a moisture content of 20 - 25%, a pH of 8 -10, and ammonia content should not exceed 25 ppm (Farghly et al., 2021; Kuleile et al., 2019). Excess moisture in the litter increases the incidence of breast blisters, skin bums, scabby areas, bruising, condemnations and downgrades (Diarra et al., 2021, Jordan 2022). Wet litter is the primary cause of ammonia emissions, one of the most serious performance and environmental factors affecting broiler production today. Controlling litter moisture is the most important step in avoiding ammonia problems.

Globally, the poultry industry is witnessing a rapid growth to meet the demand of the ever increasing world population with higher income and better food choices (Phiri et al., 2023). The rapid growth rate in broiler production and the gradual ban of the cage system for layers will mean more litter materials for the poultry industry. Several factors including unavailability, increasing cost, and possible health and safety risks of conventional materials have been the major forces driving research into new bedding materials for commercial poultry. Wood shavings (WS) and sawdust (SD) are becoming scarce and expensive due to their increasing use. The past decades have seen increased research in alternative litter materials for poultry (ScholarWorks et al., 2022). Several alternatives to wood by-products have been used with varying outcomes on broiler performance.

In view of differences in the availability of bedding materials commonly used in Zimbabwe such as dried grass, wood shavings, sawdust, sand, and wheat straw, it is important to evaluate on their effectiveness in improving the performance of broilers. It is against this background where this project seek to evaluate on the effect of different bedding materials commonly used by small-scale farmers in Zimbabwe, which are wheat straw, dried grass and sand, on the growth and final weight of broilers.

1.1 Problem statement

Most broiler farmers in Zimbabwe produce broilers under deep litter system and this is resulting in broiler diseases and high cost of treatment drugs. This is caused by inadequate bedding material in the broiler house and use of unsuitable bedding material. Such diseases include foot rot, water belly and respiratory related diseases. Most small-scale farmers are also experiencing low final broiler weights even after prolonged 6 weeks period of broiler production. There is little knowledge available for farmers on the effects of different bedding materials used in broiler production (Kaya et al., 2024).

Several factors, including unavailability, increased cost, and possible health and safety risks of conventional materials have been the major forces driving research into new bedding materials for commercial poultry (Prišenk & Brus, 2022). Wood shavings and sawdust are becoming scarce and expensive to most small scale farmers in Zimbabwe and the provision of suitable bedding for rearing broilers is an ongoing challenge for producers (ScholarWorks et al., 2022).

1.3 Justification

Broilers are in continuous contact with the bedding throughout the production time from day old up to 6 weeks of production hence the bedding material must be comfortable and produce low emissions of harmful gasses as well as providing a smooth surface. Nevertheless, there is little information documented and readily available for Zimbabwean farmers to use on the locally cheap available bedding material, which they can use in order to achieve greater broiler performances. Apart from that, the traditionally recommended sawdust bedding materials by companies such as Charles Stewart and Irvines are expensive and beyond reach of most small-scale broiler farmers in Zimbabwe. It is against this background also need this research to generate information on the performance of broilers when reared under sand, wheat straws and dried natural grass as bedding material. Besides, the sand, wheat straws and dried natural grass are locally available and affordable by any broiler farmer for use in broiler production.

1.4 Objectives

The main objective of the study was to evaluate the effect of different bedding materials on growth performance and final weight of broilers

1.5 Specific objectives

1. To determine the daily intake of broilers provided with sand, wheat straws and dried grass as bedding for six weeks

2. To determine the weekly weight gain of the broilers provided with sand, wheat straws and dried grass as bedding for six weeks

3. To determine the feed conversion ratio of broilers provided with sand, wheat straws and dried grass as bedding for six weeks

1.6 Research Hypothesis

In order to test the effect of sand, wheat straws and dried grass as bedding material on growth performance and final weight of broilers, the following hypothesis was tested:

H_0: Sand, wheat straws and dried grass have low impact on broiler feed intake, weekly weight gain and conversion efficiency when provided as bedding in broiler houses

H_1: Sand, wheat straws and dried grass have high impact on broiler feed intake, weekly weight gain and conversion efficiency when provided as bedding in broiler houses

CHAPTER 2: Literature Review

2.0 Introduction

Bedding type can influence the growth of broilers since it plays a critical role in heat retention and influencing the feeding behaviour of broilers (Kaya et al., 2024). Bedding restricts movement laterally and via upward pressure on the feet resulting in the bird shifting its weight and altering its movement accordingly within the confines of a pen (Farghly et al., 2021). Broilers and their waste generate different forms of pollutants - including ammonia, carbon dioxide, methane, hydrogen sulfide, and nitrous oxide - that can cause air pollution and significantly affecting the broiler feeding behaviour (Diarra et al., 2021; Farghly et al., 2021). Growth of broilers might be negatively affected by the increase in caking rate of the bedding, where caking restricts movement in terms of adduction and abduction of the legs thus presenting an incorrect posture for pecking grain or other feed off the ground (Kuleile et al., 2019).

2.1 Effect of bedding material on broiler performance

The condition of the bedding material, the productivity of the animals, the growth of animals and the welfare on animals are closely related factors of production (Kaya et al., 2024). For the chicken to feel comfortable and feed to fulfil their growth potential, the following must be complied:

i. Protect broilers from damage and provide a dry warm covering to the floor by using adequate quantities of a good - quality litter material.
ii. Avoid nutritional causes of wet litter.
iii. Ensure adequate ventilation and avoid excess moisture on bedding material.
iv. Choose a litter material that is absorbent, non-dusty and clean.
v. Litter should be readily available from a reliable source.
vi. Use fresh litter for each crop to prevent reinfection by pathogens.
vii. Litter storage facilities should be protected from the weather and secure from access by vermin and wild birds (ScholarWorks et al., 2019).

High moisture of the bedding material increases ammonia build-up through increased microbial metabolism, resulting in respiratory and eye lesions, which negatively affect birds' welfare and productivity. Dustiness from extremely dry bedding materials or very fine particles may also predispose birds to respiratory problems, resulting in higher mortality.

2.2 Effect of bedding on intake

Many diseases causing enteritis and consequently diarrhoea can rapidly decrease litter condition because of excess moisture on bedding (Diarra et al., 2021). The scours developed significantly reduce the bird digestibility capacity and low intake. Broilers subjected to poor bedding material also suffer leg problems, which affect ability to move and feed. The results of scientific experiments differ in the effects of different materials in terms of improving or reducing intake by broilers.

2.3 Attributes of litter materials

For a product to qualify as litter material, it must be readily available, cheap, absorbent, and free from dust and contaminants; must have low thermal conductivity; and should not cake or compact (Ali et al., 2020). The type of bedding material exerts direct effects on productive performance, health, product quality (carcass and eggs), and poultry welfare. A good litter material should be able to absorb and release moisture to the environment as quickly as possible (Ly, 2018). Several chemical characteristics including the cellulose, silica, and lignin contents influence the quality of litter materials. Cellulose and silica are capable of absorbing water due to their high hydrophilic groups and higher surface area due to smaller particle size (21– 23), respectively (Ly, 2018). The initial moisture content is also an important factor to consider in the choice of any bedding material. High moisture in the bedding increases ammonia build-up through increased microbial metabolism, resulting in respiratory and eye lesions, which adversely affect birds' welfare and productivity (Diarra et al 2021,.Jordan 2022).

Wet litter predisposes to breast blisters and hock burns, which reduce carcass quality in meat birds. Litter moisture and source may also encourage the multiplication of Salmonella, Campylobacter, and Listeria species and Eimeria species, the causative agent of coccidiosis (ScholarWorks et al., 2022). In addition to bird health and product quality, nitrogen (N) loss through ammonia volatilization is a major air pollutant with severe environmental health consequences. Because poultry may consume a significant proportion (as much as 4%) of their feed in litter or forage directly on the litter material, the bedding substrate must be free from possible contaminants that could be taken up in the tissues (ScholarWorks et al., 2022).

The quality of the litter is determined by the litter moisture, pH, ammonium nitrate content, caking level, and water holding capacity (Diarra et al., 2021; Kuleile et al., 2019). Dustiness from extremely dry bedding materials or very fine particles may predispose birds to respiratory problems, resulting in higher mortality. Very large and coarse bedding materials may however downgrade carcass quality due to their abrasive effects (Diarra et al., 2021, Jordan 2022). From the foregoing discussion, several characteristics of the bedding material affect broiler welfare, growth, weight gain and productivity (Iyasere & Serah, 2015).

2.4 Types of bedding materials

2.4.1 Rice Hulls

Rice hull (RH) is an important by-product of the rice milling process, representing about 25% of rice paddy (Hussein & Hasan, 2021). This will translate to about 179 million tons of hulls from the estimated 715 million tons of paddy produced globally per year (Hussein & Hasan, 2021). RH is still a waste in many regions, posing disposal problems, and this has increased research interest in alternative uses. RH is burnt onsite to provide energy for mechanical rice milling, used in the ceramic and construction industries or livestock and poultry feeding, but its high silica and lignin contents limit its full utilization as feed, making it available as bedding material in many rice-growing regions (Mutibvu, 2016).

2.4.2 Corn Cob

Corn or maize (Zea mays) is the most important cereal with the global production estimated at about 875 million tons (Diarra et al., 2021). Corncob (CC), a by-product of corn processing for grain, accounts for 180–200 kg per ton of grains produced (Diarra et al., 2021). Currently, this residue has a number of limited applications including building material and activated carbon and still regarded as waste in many producing regions, posing environmental problems (Warwick Bauer, 2020). CC has high holo-cellulose (cellulose and hemicellulose) and low lignin contents (Diarra et al., 2021). The ready availability and high absorbency make CC a potential litter material for poultry.

2.4.3 Sand

The annual global consumption of sand is estimated to be 15 billion tons (Diarra et al., 2021). Sand is increasingly used by several industries, including the building industry (houses and roads), electronics (computer chips and microprocessors), cosmetics, and detergents, among others (Diarra et al., 2021). River sand is clean and has high water absorbing capacity but desert sand is too fine and smooth, high in clay, iron oxides, and lime but lacks silicon dioxide, making the former a better litter material than the latter (Ly, 2018). The poor absorbency of desert sand and the increasing demand of river sand for bedding and the construction industry may however exacerbate the already existing environmental consequences of sand mining. According to Diarra et al., (2021), using sand as litter can help poultry producers reduce pollution, improve production, lower costs and create a side product to sell. Sand can work well, but birds have difficulty moving about if spread to deep (Diarra et al., 2021).

2.4.4 Straws/Hays

Straw is the fibrous residue from grain crop harvest. As the global production of cereals such as rice, wheat, and barley continues to increase, straws from the harvest of these crops become readily available (Diarra et al., 2021). Straws are however high in lignin and low in hydrophilic groups which reduce their ability to absorb and release moisture. Hay from grasses, although lower in lignin compared to straws, is also not very absorbent probably due the relatively high initial moisture content in cured HA (10–15%) (Diarra et al., 2021). Straw and hay beddings may therefore compact rapidly, predisposing birds to fungal infection and increasing the incidence of breast blisters. Where straw and hay are cheap, however, they may be used as bedding materials to save cost, provided the litter is renewed regularly. The ease to compost straw could be an environmental incentive as this will reduce disposal problems of straw-based bedding materials (Diarra et al., 2021).

2.4.5 Sugar Cane Bagasse

Sugar cane bagasse, a by-product of sugar refining, amounts to about 140 kg per ton of sugar cane processed (Dhillon & Moncur, 2023; Mutibvu et al., 2016). SCB has high water absorbing ability due to its residual sugar content. However, SCB cakes easily and this calls for more research to improve its utilization as bedding material for poultry (Dhillon & Moncur, 2023).

2.4.6 Shredded Newspapers

Newspapers have long been used as animal bedding. Despite the rapid adoption of soft copies, papers are available and may pose disposal problems. Paper is absorbent, is easy to decompose, and has minimal health risks (free from dust, contaminants, and pathogenic organisms), but does not release moisture to the environment as quickly as possible (Diarra et al., 2021; Ly, 2018). Processing newspapers into chips improves its moisture holding capacity and evaporative loss. However, the growing trend of the paper recycling industry may not spare this for use as economic bedding material. Paper recycling increased from 5 million tons in 1960 to 44 million tons in 2017. Consumption of newspapers printed with inks based on petroleum-laden or heavy metals may, however, pose health concerns (Diarra et al., 2021; Prišenk & Brus, 2022).

2.4.7 Peanut Hulls

Globally, peanut (Arachis hypogaea) occupies, on average, 22.2 million hectares, with a share of 16.3 million hectares, 7.39 million hectares, and 0.7 million hectares in Asia, Africa, and South and Central America, respectively (Diarra et al., 2021). Peanut yield ranges from 3 to 4 ton/ha, but yields as high as 9.6 tons/ha have been reported. Global peanut production was estimated at 40 million tons in 2015 (Diarra et al., 2021). With the estimated 25% hull, this will amount to about 10 million tons of peanut hull consisting of variable amount of broken kernels. In most peanut producing countries, the hulls are burned on farm, dumped, or allowed to deteriorate naturally, making this by-product readily available for various uses.

2.4.8 Gypsum

Gypsum is a carbonaceous material used in the wallboard and cement industries as well as for agricultural production (Kaoud & Yosseif, 2016). However, global gypsum production is reported to exceed the capacity of these industries. This has increased research into alternative uses for gypsum to minimize problems of storage and disposal. Because of its ability to absorb moisture and reduce litter pH, the application of gypsum in litter amendment has been receiving research attention (Farghly et al., 2021).

2.5 Bedding Materials and Poultry Welfare and Performance

The quality of bedding materials has the greatest influence on ammonia production, which adversely affects the performance of birds. Studies have shown that high levels of ammonia in the house decrease the efficiency of feed utilization, weight gain, and egg production (Li et al., 2017). The mode of action of ammonia on poultry performance is directly related to its damaging effect on the respiratory tissues and impairment of the bird's immune response. Microbial activity on wet litters is a major factor in ammonia production in the house. It is therefore evident that the quality of the bedding material, mainly its ability to absorb moisture, is important in maintaining a healthy house environment and better performance of poultry. As different bedding substrates produce different conditions in the poultry house choosing the right litter materials is important for maximum poultry welfare and productivity (Li et al., 2017). Because litter moisture is an important factor encouraging the multiplication of pathogenic organisms, it follows that bedding materials with low water holding capacity would quickly predispose to disease outbreak (Kaya et al., 2024; Ly, 2018).

2.6 Ammonia produced from bedding

Broilers do not perform to their genetic potential in a poor environment. Dust is a big problem especially in bedding material like sawdust or fine grinded/ chopped wheat straw or hay (Farghly et al., 2021). Another problem with wheat straw chopped longer than 30 mm is breast blisters during the first two weeks. The factor that influences bedding material conditions the most is moisture (Diarra et al., 2021; Prišenk & Brus, 2022). Excess moisture in the bedding material increases the incidence of breast blisters, skin burns, scabby areas, bruising, condemnations and downgrades (Prišenk & Brus, 2022). Wet bedding material is also the primary cause of one of the most serious environmental factors affecting broiler production today and resulted in excessive ammonia production (ScholarWorks et al., 2019). High ammonia levels have been proven to cause increased susceptibility to Newcastle disease, as well as depressing growth rates while allowing E.coli organisms to proliferate. Prolonged exposure to high levels (50 to 100 ppm) is the cause of keratoconjunctivitis (blindness) observed in some broiler flocks reared during the cooler months of the year (Forghani et al., 2015). When levels are as high as this, production is seriously affected. Ammonia levels of just 25 ppm have been found to depress growth and increase feed conversion in broilers (Kuleile et al., 2019).

Chapter 3. Method and Materials

3.0 Study area

The project was carried out at plot number 68 in Chivhu, Chikomba district. The region lies in Mashonaland East province which is located on the North Eastern side of Zimbabwe. The plot had an altitude of 1450m above sea level and a latitude of 18.8885° S, and longitude of 31.0975° E. The annual rainfall ranges from 750mm to 1000 mm while minimum and maximum temperatures ranges 09 – 15 °C and 25 to 30 °C respectively.

3.1 Animal sample size

Ninety (90) broilers were used for the research study. The broilers were purchased as day old chicks from Irvines Zimbabwe Pvt Ltd. The experiment had three treatments, which were wheat straw bedding, as treatment 1, dried grass bedding, as treatment 2 and sand bedding as treatment 3 – hence each treatment was allocated 30 birds. The broiler feeding programme was a two phase feeding of first four weeks starter and last two weeks finisher phase. The commercial feed was purchased from Capital Foods Ltd.

3.2 Data Collection

In order to determine the assess the effect and influence on wheat straw, dried grass and sand as bedding materials for broiler houses, on growth performance and final weight of broilers reared for a period of 6 weeks from day old, the following parameters were assessed:

- Daily weight gain - measured on a weekly basis out of the total of 6 weeks rearing period while using a digital scale.
- Feed intake - measured on a daily basis during feeding times using a digital scale for measuring feed offered and feed refused in the morning.

The daily feed intake was determined through measuring the quantity offered in troughs and the quantity refused. The weekly weight gain of a six weeks rearing period was collected and measured by taking the weight on the first day of the week and on a seven day interval thereafter. The collected weekly weight gain and daily intake was used to determine the weekly feed conversion ratio of the broilers, both batches under experimental feed and those on commercial feed. The feed conversion ratios were determined by dividing the weekly weight gain by the weekly intake. The weekly weight gain was determined the difference in weight of broilers from the current and previous week.

3.3 Data analysis

The collected data of weekly weight gain, daily intake and feed conversion was analysed using mixed procedures of SAS, version of 2004.

3.4 Experimental design

The study is used a total of ninety (90) broilers in order to analyse the effect and influence of wheat straw, dried grass and sand as bedding material on growth performance of broilers. The design of the experiment was a Completely Randomized Design (CRD) since 30 broilers were randomly assigned to each treatment. However, each treatment was replicated 3 times and each replica having 10 birds.

3.5 Statistical model

The model of the study of treatment effect with time is as is as follows:

$$Y_{ijk} = \mu + T_i + K_j + (T_i{*}K_j) + E_{ijk}$$

Where:

Y_{ijk} = response variable (weight gain, feed intake, Feed Conversion Ratio);

μ = overall mean (constant);

T_i = effect of bedding (Wheat straw, Dried grass, Sand);

K_j = effect of week (j= 1, 2, 3, 4, 5, 6);

$(T_i{*}K_j)$ = effect of time and treatment interaction; and

E_{ijk} = random residual error associated with the observations

Chapter 4: Results

4.0 Effect of bedding on feed intake

Table 4.1 shows that the feed intake of broilers in week 1, week 2 and week 3 for all the three treatments were not significantly different (P>0.05). However, there was a significant difference in intake for treatment 3 in week 4 (P<0.05) but intake in treatment 1 and 2 were not significantly different (P>0.05), similar to intake of the broilers in week in week 5. The broilers have not shown a significant difference in intake among all the three treatments in week 6 (P>0.05). On the other hand, treatment 1 had shown a low mortality percentage of 10% compared to treatment 2 and treatment 3, which had both a mortality of 11.6% as shown in Table 4.3 and causes appearing similar for all treatments.

Table 4.1: Least square means of treatment × week interaction on feed intake

Week	Treatment 1 Estimate (kg)	Treatment 2 Estimate (kg)	Treatment 3 Estimate (kg)	s.e
1	0.05^{a}	0.05^{a}	0.04^{a}	0.09
2	0.46^{a}	0.49^{a}	0.41^{a}	0.09
3	1.66^{a}	1.79^{a}	1.72^{a}	0.09
4	6.91^{a}	6.96^{a}	6.55^{b}	0.09
5	8.47^{a}	8.57^{a}	8.01^{b}	0.09
6	9.22^{a}	9.29^{a}	9.06^{a}	0.09

^{ab} Values with different letters in the same row are significantly different (P<0.05)

4.2 Effect of bedding on average daily weight gain

Table 4.2 of treatment × week interactions on weekly weight gain shows that week 1 had no significant difference for all the three treatments (P>0.05). There was also no significant difference in weight gain for all the treatments in week 2 (P>0.05). Broilers under treatment 1 and treatment 2 did not show a significant difference in weight gain (P>0.05) whereas broilers under treatment 3 shows a significant difference in week 3, this was also similar in week 6. In week 4 the broiler weight gain were all significantly different (P<0.05) among the three treatments. However there were no significant differences in weight gain of the broilers recorded in week 5 (P>0.05) across all treatments.

Table 4.2: Least square means of treatment × week interaction on weekly weight gain

Week	Treatment 1 Estimate (kg)	Treatment 2 Estimate (kg)	Treatment 3 Estimate (kg)	s.e
1	0.009[a]	0.010[a]	0.008[a]	0.0008
2	0.038[a]	0.041[b]	0.036[c]	0.0008
3	0.118[a]	0.117[a]	0.125[b]	0.0008
4	0.06[a]	0.418[b]	0.409[c]	0.0008
5	0.590[a]	0.588[a]	0.589[a]	0.0008
6	0.715[a]	0.717[a]	0.713[b]	0.0008

[abc] Values with different letters in the same row are significantly different (P<0.05)

Table 4.3: Effect of treatment on mortality

Week	Treatment 1 Number Cause	Treatment 2 Number Cause	Treatment 3 Number Cause
1	2 chilling and sudden death	2 chilling and sudden death	4 chilling and sudden death
2	1 stress related	0	2 ascites
3	1 respiratory failure	3 respiratory failure	0
4	0	0	1 respiratory failure
5	2 heat stress	1 heat stress	0
6	0	1 respiratory failure	0

4.3 Feed conversion ratio of broilers

The results as shown in table 4.4 below indicated that there was no significant difference in the FCR of broilers who were raised in wheat straw bedding and those raised in dried grass bedding. However, a significant difference was noted to be in those broilers reared under sand bedding.

Table 4.4: Effect of bedding material on FCR of broilers

Week	Wheat straw	Dried grass	Sand
1	0.18^{a}	0.12^{b}	0.02^{c}
2	0.08^{a}	0.08^{a}	0.06^{c}
3	0.10^{a}	0.07^{b}	0.02^{c}
4	0.05^{a}	0.06^{b}	0.04^{c}
5	0.07^{a}	0.07^{a}	0.05^{b}
6	0.08^{a}	0.08^{a}	0.06^{b}

^{abc} Values with different letters in the same row are significantly different (P<0.05)

Chapter 5: Discussion

5.1 Broiler feed intake

The results revealed that there was no significant difference in feed intake of broilers provided with wheat straw bedding and those provided with dried grass bedding material; from first week of age up to the third week. This can be attributed to the fact that the broilers were still adapting to the diets and could not show any significant differences in intake. Nonetheless, the broilers were consuming almost similar quantities of feed since their sizes in weight as shown in table 4.2 above in during also the same period. The other reason for the similarity could be also attributed to the fact that bedding characteristics such as moisture and ammonia accumulation had not yet come into effect. Generally, the sensory aspects of feed intake can be categorized in three basic stages of food ingestion which are: 1. food recognition; 2. food prehension and ingestion; and 3. gastrointestinal activity. Food recognition in poultry primarily involves vision.

Newly hatched birds have an innate preference for food of certain colours (Sanusi et al., 2015). Also the broilers when feeding have an innate preference for food with certain shape and size (Iyasere & Serah, 2016). Sand bedding material showed a significant difference in broiler intake in the first 3 weeks of broiler age. This could be the fact that it easily got wet and accumulated moisture as well as producing gases that affected the respiratory capacity of birds (Bajgai et al., 2020). The differences in intake of broilers from week 4 and 5 could be attributed to the fact that broilers had developed in age and size and had a strong bias to use visual (shape and colour) when feeding. In addition to that, the moisture absorption capacity of the three bedding materials differs and wheat straws resulted in broilers having high intake followed by dried grass and sand.

5.2 Weight gain and FCR of broilers

The results showed a similar trend to the daily feed intake, in weight gain of broilers provided with wheat straw (treatment 1) and those housed with dried grass bedding (treatment 2). This could be the fact that the both the bedding materials have good absorption capacity of moisture. Wet bedding result in the production of ammonia gas which damage the lung tissue and reduce growth of the birds (Gous, 2017). The only significant difference in weight gain was observed to be in week 4 of production. In addition to this, Kuleile et al., (2019) observed that the bedding material when kept dry and in correct depth range of 10 to 15 cm thickness, will have less negative impact on live body weight, average daily weight gain, feed conversion ratio.

The broilers housed with sand as bedding material were observed to have the least feed conversion ratios in comparison to those with wheat straws and dried grass bedding. This could be the fact that bedding material plays a major role in the absorption of moisture and heat. Cold stress reduces growth, in take and performance of broilers. Sand can work well, but birds have difficulty moving about if spread to deep (Diarra et al., 2021)

5.3 Mortality

The major causes of death to the broilers were chilling and sudden deaths caused by cold stress in the first week of age of broilers. Apart from that, the broiler chicks were still adapting to the new treatment environment. The other factors were respiratory failure and heat stress. Much of the mortalities in all the three treatments had been experienced in early life during the brooding stage up to 4 weeks of age. Abd El-Hack et al., (2022) also attributed the early poultry age mortalities to cold stress, failure to adapt to environment and sudden deaths.

CHAPTER 6: Conclusion and recommendation

6.1 Conclusion

The results obtained from this study indicated that there was no a significant difference in intake, weekly weight gain and final weight of broilers, reared under wheat straw and dried grass as bedding in broiler house. However, a significant difference in intake, gain and final weight of broilers, was observed in those chickens provided with sand bedding.

6.2 Recommendations

- It can be recommended from this study that wheat straw and dried grass can be used as bedding material when rearing broilers from day old up to six weeks
- It can also be recommended to control factors in broiler production that lead to early age of broiler mortality.
- It can also be recommended for further study on frequency of change of bedding in broiler houses

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APPENNDICES

Appendix 1: Type 3 Tests of Fixed Effects on weight gain

Effect	Num DF	Den DF	F Value	Pr > F
trt	2	54	9.73	0.0002
week	5	54	459273	<.0001
trt*week	10	54	15.02	<.0001

Appendix 2: LSMeans of treatments on weekly weight gain

Effect	trt	week	Estimate	Error	DF	t Value	Pr > |t|
trt	1		0.3143	0.000314	54	1000.56	<.0001
trt	2		0.3153	0.000314	54	1003.87	<.0001
trt	3		0.3134	0.000314	54	997.64	<.0001
week		1	0.008750	0.000444	54	19.70	<.0001
week		2	0.03842	0.000444	54	86.48	<.0001
week		3	0.1206	0.000444	54	271.45	<.0001
week		4	0.4140	0.000444	54	931.96	<.0001
week		5	0.5890	0.000444	54	1325.90	<.0001
week		6	0.7153	0.000444	54	1610.10	<.0001
trt*week	1	1	0.008500	0.000769	54	11.05	<.0001
trt*week	1	2	0.03800	0.000769	54	49.39	<.0001
trt*week	1	3	0.1188	0.000769	54	154.34	<.0001
trt*week	1	4	0.4150	0.000769	54	539.36	<.0001
trt*week	1	5	0.5900	0.000769	54	766.81	<.0001
trt*week	1	6	0.7155	0.000769	54	929.92	<.0001
trt*week	2	1	0.01000	0.000769	54	13.00	<.0001
trt*week	2	2	0.04100	0.000769	54	53.29	<.0001
trt*week	2	3	0.1178	0.000769	54	153.04	<.0001

trt*week	2	4	0.4180	0.000769	54	543.26	<.0001
trt*week	2	5	0.5880	0.000769	54	764.21	<.0001
trt*week	2	6	0.7173	0.000769	54	932.19	<.0001
trt*week	3	1	0.007750	0.000769	54	10.07	<.0001
trt*week	3	2	0.03625	0.000769	54	47.11	<.0001
trt*week	3	3	0.1252	0.000769	54	162.78	<.0001
trt*week	3	4	0.4090	0.000769	54	531.57	<.0001
trt*week	3	5	0.5890	0.000769	54	765.51	<.0001
trt*week	3	6	0.7130	0.000769	54	926.67	<.0001

Appendix 3: Differences of LSMeans of treatments on weekly weight gain

Effect	trt	week	_trt	_week	Estimate	Error	DF	t Value	Pr > |t|
trt	1		2		-0.00104	0.000444	54	-2.34	0.0227
trt	1		3		0.000917	0.000444	54	2.06	0.0439
trt	2		3		0.001958	0.000444	54	4.41	<.0001
week		1		2	-0.02967	0.000628	54	-47.22	<.0001
week		1		3	-0.1118	0.000628	54	-178.01	<.0001
week		1		4	-0.4053	0.000628	54	-645.06	<.0001
week		1		5	-0.5803	0.000628	54	-923.62	<.0001
week		1		6	-0.7065	0.000628	54	-1124.6	<.0001
week		2		3	-0.08217	0.000628	54	-130.79	<.0001
week		2		4	-0.3756	0.000628	54	-597.84	<.0001
week		2		5	-0.5506	0.000628	54	-876.40	<.0001
week		2		6	-0.6768	0.000628	54	-1077.4	<.0001
week		3		4	-0.2934	0.000628	54	-467.05	<.0001
week		3		5	-0.4684	0.000628	54	-745.61	<.0001
week		3		6	-0.5947	0.000628	54	-946.57	<.0001
week		4		5	-0.1750	0.000628	54	-278.56	<.0001
week		4		6	-0.3013	0.000628	54	-479.52	<.0001
week		5		6	-0.1262	0.000628	54	-200.96	<.0001
trt*week	1	1	1	2	-0.02950	0.001088	54	-27.11	<.0001

trt*week	1	1	1	3	-0.1102	0.001088	54	-101.32	<.0001
trt*week	1	1	1	4	-0.4065	0.001088	54	-373.58	<.0001
trt*week	1	1	1	5	-0.5815	0.001088	54	-534.40	<.0001
trt*week	1	1	1	6	-0.7070	0.001088	54	-649.74	<.0001
trt*week	1	1	2	1	-0.00150	0.001088	54	-1.38	0.1737
trt*week	1	1	2	2	-0.03250	0.001088	54	-29.87	<.0001
trt*week	1	1	2	3	-0.1092	0.001088	54	-100.40	<.0001
trt*week	1	1	2	4	-0.4095	0.001088	54	-376.33	<.0001
trt*week	1	1	2	5	-0.5795	0.001088	54	-532.56	<.0001
trt*week	1	1	2	6	-0.7087	0.001088	54	-651.35	<.0001
trt*week	1	1	3	1	0.000750	0.001088	54	0.69	0.4936
trt*week	1	1	3	2	-0.02775	0.001088	54	-25.50	<.0001
trt*week	1	1	3	3	-0.1167	0.001088	54	-107.29	<.0001
trt*week	1	1	3	4	-0.4005	0.001088	54	-368.06	<.0001
trt*week	1	1	3	5	-0.5805	0.001088	54	-533.48	<.0001
trt*week	1	1	3	6	-0.7045	0.001088	54	-647.44	<.0001
trt*week	1	2	1	3	-0.08075	0.001088	54	-74.21	<.0001
trt*week	1	2	1	4	-0.3770	0.001088	54	-346.47	<.0001
trt*week	1	2	1	5	-0.5520	0.001088	54	-507.29	<.0001
trt*week	1	2	1	6	-0.6775	0.001088	54	-622.63	<.0001

Effect trt week _trt _week Estimate Error DF t Value Pr > |t|

trt*week	1	2	2	1	0.02800	0.001088	54	25.73	<.0001
trt*week	1	2	2	2	-0.00300	0.001088	54	-2.76	0.0079
trt*week	1	2	2	3	-0.07975	0.001088	54	-73.29	<.0001
trt*week	1	2	2	4	-0.3800	0.001088	54	-349.22	<.0001
trt*week	1	2	2	5	-0.5500	0.001088	54	-505.45	<.0001
trt*week	1	2	2	6	-0.6793	0.001088	54	-624.24	<.0001
trt*week	1	2	3	1	0.03025	0.001088	54	27.80	<.0001
trt*week	1	2	3	2	0.001750	0.001088	54	1.61	0.1136
trt*week	1	2	3	3	-0.08725	0.001088	54	-80.18	<.0001
trt*week	1	2	3	4	-0.3710	0.001088	54	-340.95	<.0001
trt*week	1	2	3	5	-0.5510	0.001088	54	-506.37	<.0001
trt*week	1	2	3	6	-0.6750	0.001088	54	-620.33	<.0001
trt*week	1	3	1	4	-0.2963	0.001088	54	-272.26	<.0001
trt*week	1	3	1	5	-0.4713	0.001088	54	-433.08	<.0001
trt*week	1	3	1	6	-0.5967	0.001088	54	-548.42	<.0001
trt*week	1	3	2	1	0.1087	0.001088	54	99.94	<.0001
trt*week	1	3	2	2	0.07775	0.001088	54	71.45	<.0001
trt*week	1	3	2	3	0.001000	0.001088	54	0.92	0.3622
trt*week	1	3	2	4	-0.2992	0.001088	54	-275.01	<.0001
trt*week	1	3	2	5	-0.4693	0.001088	54	-431.24	<.0001
trt*week	1	3	2	6	-0.5985	0.001088	54	-550.03	<.0001
trt*week	1	3	3	1	0.1110	0.001088	54	102.01	<.0001
trt*week	1	3	3	2	0.08250	0.001088	54	75.82	<.0001
trt*week	1	3	3	3	-0.00650	0.001088	54	-5.97	<.0001

trt*week	1	3	3	4	-0.2903	0.001088	54	-266.74	<.0001
trt*week	1	3	3	5	-0.4703	0.001088	54	-432.16	<.0001
trt*week	1	3	3	6	-0.5943	0.001088	54	-546.12	<.0001
trt*week	1	4	1	5	-0.1750	0.001088	54	-160.83	<.0001
trt*week	1	4	1	6	-0.3005	0.001088	54	-276.16	<.0001
trt*week	1	4	2	1	0.4050	0.001088	54	372.20	<.0001
trt*week	1	4	2	2	0.3740	0.001088	54	343.71	<.0001
trt*week	1	4	2	3	0.2973	0.001088	54	273.17	<.0001
trt*week	1	4	2	4	-0.00300	0.001088	54	-2.76	0.0079
trt*week	1	4	2	5	-0.1730	0.001088	54	-158.99	<.0001
trt*week	1	4	2	6	-0.3023	0.001088	54	-277.77	<.0001
trt*week	1	4	3	1	0.4073	0.001088	54	374.27	<.0001
trt*week	1	4	3	2	0.3788	0.001088	54	348.07	<.0001
trt*week	1	4	3	3	0.2898	0.001088	54	266.28	<.0001
trt*week	1	4	3	4	0.006000	0.001088	54	5.51	<.0001
trt*week	1	4	3	5	-0.1740	0.001088	54	-159.91	<.0001
trt*week	1	4	3	6	-0.2980	0.001088	54	-273.86	<.0001
trt*week	1	5	1	6	-0.1255	0.001088	54	-115.34	<.0001
trt*week	1	5	2	1	0.5800	0.001088	54	533.02	<.0001
trt*week	1	5	2	2	0.5490	0.001088	54	504.54	<.0001
Effect	**trt**	**week**	**_trt**	**_week**	**Estimate**	**Error**	**DF**	**t Value**	**Pr > |t|**
trt*week	1	5	2	3	0.4723	0.001088	54	434.00	<.0001
trt*week	1	5	2	4	0.1720	0.001088	54	158.07	<.0001

trt*week	1	5	2	5	0.002000	0.001088	54	1.84	0.0716
trt*week	1	5	2	6	-0.1272	0.001088	54	-116.94	<.0001
trt*week	1	5	3	1	0.5823	0.001088	54	535.09	<.0001
trt*week	1	5	3	2	0.5538	0.001088	54	508.90	<.0001
trt*week	1	5	3	3	0.4648	0.001088	54	427.11	<.0001
trt*week	1	5	3	4	0.1810	0.001088	54	166.34	<.0001
trt*week	1	5	3	5	0.001000	0.001088	54	0.92	0.3622
trt*week	1	5	3	6	-0.1230	0.001088	54	-113.04	<.0001
trt*week	1	6	2	1	0.7055	0.001088	54	648.36	<.0001
trt*week	1	6	2	2	0.6745	0.001088	54	619.87	<.0001
trt*week	1	6	2	3	0.5977	0.001088	54	549.34	<.0001
trt*week	1	6	2	4	0.2975	0.001088	54	273.40	<.0001
trt*week	1	6	2	5	0.1275	0.001088	54	117.17	<.0001
trt*week	1	6	2	6	-0.00175	0.001088	54	-1.61	0.1136
trt*week	1	6	3	1	0.7077	0.001088	54	650.43	<.0001
trt*week	1	6	3	2	0.6793	0.001088	54	624.24	<.0001
trt*week	1	6	3	3	0.5902	0.001088	54	542.44	<.0001
trt*week	1	6	3	4	0.3065	0.001088	54	281.68	<.0001
trt*week	1	6	3	5	0.1265	0.001088	54	116.25	<.0001
trt*week	1	6	3	6	0.002500	0.001088	54	2.30	0.0255
trt*week	2	1	2	2	-0.03100	0.001088	54	-28.49	<.0001
trt*week	2	1	2	3	-0.1077	0.001088	54	-99.02	<.0001
trt*week	2	1	2	4	-0.4080	0.001088	54	-374.96	<.0001
trt*week	2	1	2	5	-0.5780	0.001088	54	-531.19	<.0001

trt*week	2	1	2	6	-0.7072	0.001088	54	-649.97	<.0001
trt*week	2	1	3	1	0.002250	0.001088	54	2.07	0.0435
trt*week	2	1	3	2	-0.02625	0.001088	54	-24.12	<.0001
trt*week	2	1	3	3	-0.1152	0.001088	54	-105.92	<.0001
trt*week	2	1	3	4	-0.3990	0.001088	54	-366.68	<.0001
trt*week	2	1	3	5	-0.5790	0.001088	54	-532.11	<.0001
trt*week	2	1	3	6	-0.7030	0.001088	54	-646.06	<.0001
trt*week	2	2	2	3	-0.07675	0.001088	54	-70.53	<.0001
trt*week	2	2	2	4	-0.3770	0.001088	54	-346.47	<.0001
trt*week	2	2	2	5	-0.5470	0.001088	54	-502.70	<.0001
trt*week	2	2	2	6	-0.6763	0.001088	54	-621.48	<.0001
trt*week	2	2	3	1	0.03325	0.001088	54	30.56	<.0001
trt*week	2	2	3	2	0.004750	0.001088	54	4.37	<.0001
trt*week	2	2	3	3	-0.08425	0.001088	54	-77.43	<.0001
trt*week	2	2	3	4	-0.3680	0.001088	54	-338.19	<.0001
trt*week	2	2	3	5	-0.5480	0.001088	54	-503.62	<.0001
trt*week	2	2	3	6	-0.6720	0.001088	54	-617.57	<.0001
trt*week	2	3	2	4	-0.3002	0.001088	54	-275.93	<.0001

Effect	**trt**	**week**	**_trt**	**_week**	**Estimate**	**Error**	**DF**	**t Value**	**Pr > |t|**
trt*week	2	3	2	5	-0.4703	0.001088	54	-432.16	<.0001
trt*week	2	3	2	6	-0.5995	0.001088	54	-550.94	<.0001
trt*week	2	3	3	1	0.1100	0.001088	54	101.09	<.0001
trt*week	2	3	3	2	0.08150	0.001088	54	74.90	<.0001

trt*week	2	3	3	3	-0.00750	0.001088	54	-6.89	<.0001
trt*week	2	3	3	4	-0.2913	0.001088	54	-267.66	<.0001
trt*week	2	3	3	5	-0.4713	0.001088	54	-433.08	<.0001
trt*week	2	3	3	6	-0.5953	0.001088	54	-547.04	<.0001
trt*week	2	4	2	5	-0.1700	0.001088	54	-156.23	<.0001
trt*week	2	4	2	6	-0.2993	0.001088	54	-275.01	<.0001
trt*week	2	4	3	1	0.4103	0.001088	54	377.02	<.0001
trt*week	2	4	3	2	0.3818	0.001088	54	350.83	<.0001
trt*week	2	4	3	3	0.2928	0.001088	54	269.04	<.0001
trt*week	2	4	3	4	0.009000	0.001088	54	8.27	<.0001
trt*week	2	4	3	5	-0.1710	0.001088	54	-157.15	<.0001
trt*week	2	4	3	6	-0.2950	0.001088	54	-271.11	<.0001
trt*week	2	5	2	6	-0.1292	0.001088	54	-118.78	<.0001
trt*week	2	5	3	1	0.5803	0.001088	54	533.25	<.0001
trt*week	2	5	3	2	0.5518	0.001088	54	507.06	<.0001
trt*week	2	5	3	3	0.4628	0.001088	54	425.27	<.0001
trt*week	2	5	3	4	0.1790	0.001088	54	164.50	<.0001
trt*week	2	5	3	5	-0.00100	0.001088	54	-0.92	0.3622
trt*week	2	5	3	6	-0.1250	0.001088	54	-114.88	<.0001
trt*week	2	6	3	1	0.7095	0.001088	54	652.04	<.0001
trt*week	2	6	3	2	0.6810	0.001088	54	625.84	<.0001
trt*week	2	6	3	3	0.5920	0.001088	54	544.05	<.0001
trt*week	2	6	3	4	0.3083	0.001088	54	283.28	<.0001
trt*week	2	6	3	5	0.1282	0.001088	54	117.86	<.0001

trt*week	2	6	3	6	0.004250	0.001088	54	3.91	0.0003
trt*week	3	1	3	2	-0.02850	0.001088	54	-26.19	<.0001
trt*week	3	1	3	3	-0.1175	0.001088	54	-107.98	<.0001
trt*week	3	1	3	4	-0.4013	0.001088	54	-368.75	<.0001
trt*week	3	1	3	5	-0.5813	0.001088	54	-534.17	<.0001
trt*week	3	1	3	6	-0.7053	0.001088	54	-648.13	<.0001
trt*week	3	2	3	3	-0.08900	0.001088	54	-81.79	<.0001
trt*week	3	2	3	4	-0.3728	0.001088	54	-342.56	<.0001
trt*week	3	2	3	5	-0.5528	0.001088	54	-507.98	<.0001
trt*week	3	2	3	6	-0.6768	0.001088	54	-621.94	<.0001
trt*week	3	3	3	4	-0.2838	0.001088	54	-260.77	<.0001
trt*week	3	3	3	5	-0.4638	0.001088	54	-426.19	<.0001
trt*week	3	3	3	6	-0.5878	0.001088	54	-540.15	<.0001
trt*week	3	4	3	5	-0.1800	0.001088	54	-165.42	<.0001
trt*week	3	4	3	6	-0.3040	0.001088	54	-279.38	<.0001
trt*week	3	5	3	6	-0.1240	0.001088	54	-113.96	<.0001

Appendix 4: Type 3 Tests of Fixed Effects on feed intake

Effect	Num DF	Den DF	F Value	Pr > F
trt	2	54	9.24	0.0004
week	5	54	5581.56	<.0001
trt*week	10	54	1.69	0.1060

Appendix 5: LSMeans of treatments on feed intake

Effect	trt	week	Estimate	Standard Error	DF	t Value	Pr > |t|
trt	1		4.4621	0.03927	54	113.62	<.0001
trt	2		4.5296	0.03927	54	115.34	<.0001
trt	3		4.2975	0.03927	54	109.43	<.0001
week		1	0.04417	0.05554	54	0.80	0.4300
week		2	0.4542	0.05554	54	8.18	<.0001
week		3	1.7250	0.05554	54	31.06	<.0001
week		4	6.8108	0.05554	54	122.63	<.0001
week		5	8.3533	0.05554	54	150.40	<.0001
week		6	9.1908	0.05554	54	165.48	<.0001
trt*week	1	1	0.04500	0.09620	54	0.47	0.6418
trt*week	1	2	0.4600	0.09620	54	4.78	<.0001
trt*week	1	3	1.6600	0.09620	54	17.26	<.0001
trt*week	1	4	6.9150	0.09620	54	71.88	<.0001
trt*week	1	5	8.4750	0.09620	54	88.10	<.0001
trt*week	1	6	9.2175	0.09620	54	95.82	<.0001
trt*week	2	1	0.05000	0.09620	54	0.52	0.6054
trt*week	2	2	0.4950	0.09620	54	5.15	<.0001
trt*week	2	3	1.7950	0.09620	54	18.66	<.0001
trt*week	2	4	6.9650	0.09620	54	72.40	<.0001
trt*week	2	5	8.5775	0.09620	54	89.17	<.0001

trt*week	2	6	9.2950	0.09620	54	96.62	<.0001
trt*week	3	1	0.03750	0.09620	54	0.39	0.6982
trt*week	3	2	0.4075	0.09620	54	4.24	<.0001
trt*week	3	3	1.7200	0.09620	54	17.88	<.0001
trt*week	3	4	6.5525	0.09620	54	68.11	<.0001
trt*week	3	5	8.0075	0.09620	54	83.24	<.0001
trt*week	3	6	9.0600	0.09620	54	94.18	<.0001

Appendix 6: Differences of LSMeans of treatments on feed intake

Effect	trt	week	_trt	_week	Estimate	Standard Error	DF	t Value	Pr > |t|
trt	1		2		-0.06750	0.05554	54	-1.22	0.2295
trt	1		3		0.1646	0.05554	54	2.96	0.0045
trt	2		3		0.2321	0.05554	54	4.18	0.0001
week		1		2	-0.4100	0.07855	54	-5.22	<.0001
week		1		3	-1.6808	0.07855	54	-21.40	<.0001
week		1		4	-6.7667	0.07855	54	-86.15	<.0001
week		1		5	-8.3092	0.07855	54	-105.79	<.0001
week		1		6	-9.1467	0.07855	54	-116.45	<.0001
week		2		3	-1.2708	0.07855	54	-16.18	<.0001
week		2		4	-6.3567	0.07855	54	-80.93	<.0001
week		2		5	-7.8992	0.07855	54	-100.57	<.0001
week		2		6	-8.7367	0.07855	54	-111.23	<.0001
week		3		4	-5.0858	0.07855	54	-64.75	<.0001
week		3		5	-6.6283	0.07855	54	-84.39	<.0001
week		3		6	-7.4658	0.07855	54	-95.05	<.0001
week		4		5	-1.5425	0.07855	54	-19.64	<.0001
week		4		6	-2.3800	0.07855	54	-30.30	<.0001
week		5		6	-0.8375	0.07855	54	-10.66	<.0001
trt*week	1	1	1	2	-0.4150	0.1360	54	-3.05	0.0035

trt*week	1	1	1	3	-1.6150	0.1360	54	-11.87	<.0001
trt*week	1	1	1	4	-6.8700	0.1360	54	-50.50	<.0001
trt*week	1	1	1	5	-8.4300	0.1360	54	-61.97	<.0001
trt*week	1	1	1	6	-9.1725	0.1360	54	-67.42	<.0001
trt*week	1	1	2	1	-0.00500	0.1360	54	-0.04	0.9708
trt*week	1	1	2	2	-0.4500	0.1360	54	-3.31	0.0017
trt*week	1	1	2	3	-1.7500	0.1360	54	-12.86	<.0001
trt*week	1	1	2	4	-6.9200	0.1360	54	-50.87	<.0001
trt*week	1	1	2	5	-8.5325	0.1360	54	-62.72	<.0001
trt*week	1	1	2	6	-9.2500	0.1360	54	-67.99	<.0001
trt*week	1	1	3	1	0.007500	0.1360	54	0.06	0.9562
trt*week	1	1	3	2	-0.3625	0.1360	54	-2.66	0.0101
trt*week	1	1	3	3	-1.6750	0.1360	54	-12.31	<.0001
trt*week	1	1	3	4	-6.5075	0.1360	54	-47.83	<.0001
trt*week	1	1	3	5	-7.9625	0.1360	54	-58.53	<.0001
trt*week	1	1	3	6	-9.0150	0.1360	54	-66.27	<.0001
trt*week	1	2	1	3	-1.2000	0.1360	54	-8.82	<.0001
trt*week	1	2	1	4	-6.4550	0.1360	54	-47.45	<.0001
trt*week	1	2	1	5	-8.0150	0.1360	54	-58.91	<.0001
trt*week	1	2	1	6	-8.7575	0.1360	54	-64.37	<.0001
trt*week	1	2	2	1	0.4100	0.1360	54	3.01	0.0039
trt*week	1	2	2	2	-0.03500	0.1360	54	-0.26	0.7979

Standard

Effect	trt	week	_trt	_week	Estimate	Error	DF	t Value	Pr > |t|
trt*week	1	2	2	3	-1.3350	0.1360	54	-9.81	<.0001
trt*week	1	2	2	4	-6.5050	0.1360	54	-47.82	<.0001
trt*week	1	2	2	5	-8.1175	0.1360	54	-59.67	<.0001
trt*week	1	2	2	6	-8.8350	0.1360	54	-64.94	<.0001
trt*week	1	2	3	1	0.4225	0.1360	54	3.11	0.0030
trt*week	1	2	3	2	0.05250	0.1360	54	0.39	0.7011
trt*week	1	2	3	3	-1.2600	0.1360	54	-9.26	<.0001
trt*week	1	2	3	4	-6.0925	0.1360	54	-44.78	<.0001
trt*week	1	2	3	5	-7.5475	0.1360	54	-55.48	<.0001
trt*week	1	2	3	6	-8.6000	0.1360	54	-63.21	<.0001
trt*week	1	3	1	4	-5.2550	0.1360	54	-38.63	<.0001
trt*week	1	3	1	5	-6.8150	0.1360	54	-50.09	<.0001
trt*week	1	3	1	6	-7.5575	0.1360	54	-55.55	<.0001
trt*week	1	3	2	1	1.6100	0.1360	54	11.83	<.0001
trt*week	1	3	2	2	1.1650	0.1360	54	8.56	<.0001
trt*week	1	3	2	3	-0.1350	0.1360	54	-0.99	0.3255
trt*week	1	3	2	4	-5.3050	0.1360	54	-38.99	<.0001
trt*week	1	3	2	5	-6.9175	0.1360	54	-50.85	<.0001
trt*week	1	3	2	6	-7.6350	0.1360	54	-56.12	<.0001
trt*week	1	3	3	1	1.6225	0.1360	54	11.93	<.0001
trt*week	1	3	3	2	1.2525	0.1360	54	9.21	<.0001
trt*week	1	3	3	3	-0.06000	0.1360	54	-0.44	0.6609

trt*week	1	3	3	4	-4.8925	0.1360	54	-35.96	<.0001
trt*week	1	3	3	5	-6.3475	0.1360	54	-46.66	<.0001
trt*week	1	3	3	6	-7.4000	0.1360	54	-54.39	<.0001
trt*week	1	4	1	5	-1.5600	0.1360	54	-11.47	<.0001
trt*week	1	4	1	6	-2.3025	0.1360	54	-16.92	<.0001
trt*week	1	4	2	1	6.8650	0.1360	54	50.46	<.0001
trt*week	1	4	2	2	6.4200	0.1360	54	47.19	<.0001
trt*week	1	4	2	3	5.1200	0.1360	54	37.63	<.0001
trt*week	1	4	2	4	-0.05000	0.1360	54	-0.37	0.7147
trt*week	1	4	2	5	-1.6625	0.1360	54	-12.22	<.0001
trt*week	1	4	2	6	-2.3800	0.1360	54	-17.49	<.0001
trt*week	1	4	3	1	6.8775	0.1360	54	50.55	<.0001
trt*week	1	4	3	2	6.5075	0.1360	54	47.83	<.0001
trt*week	1	4	3	3	5.1950	0.1360	54	38.19	<.0001
trt*week	1	4	3	4	0.3625	0.1360	54	2.66	0.0101
trt*week	1	4	3	5	-1.0925	0.1360	54	-8.03	<.0001
trt*week	1	4	3	6	-2.1450	0.1360	54	-15.77	<.0001
trt*week	1	5	1	6	-0.7425	0.1360	54	-5.46	<.0001
trt*week	1	5	2	1	8.4250	0.1360	54	61.93	<.0001
trt*week	1	5	2	2	7.9800	0.1360	54	58.66	<.0001
Effect	**trt**	**week**	**_trt**	**_week**	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
trt*week	1	5	2	3	6.6800	0.1360	54	49.10	<.0001

trt*week	1	5	2	4	1.5100	0.1360	54	11.10	<.0001
trt*week	1	5	2	5	-0.1025	0.1360	54	-0.75	0.4545
trt*week	1	5	2	6	-0.8200	0.1360	54	-6.03	<.0001
trt*week	1	5	3	1	8.4375	0.1360	54	62.02	<.0001
trt*week	1	5	3	2	8.0675	0.1360	54	59.30	<.0001
trt*week	1	5	3	3	6.7550	0.1360	54	49.65	<.0001
trt*week	1	5	3	4	1.9225	0.1360	54	14.13	<.0001
trt*week	1	5	3	5	0.4675	0.1360	54	3.44	0.0011
trt*week	1	5	3	6	-0.5850	0.1360	54	-4.30	<.0001
trt*week	1	6	2	1	9.1675	0.1360	54	67.39	<.0001
trt*week	1	6	2	2	8.7225	0.1360	54	64.12	<.0001
trt*week	1	6	2	3	7.4225	0.1360	54	54.56	<.0001
trt*week	1	6	2	4	2.2525	0.1360	54	16.56	<.0001
trt*week	1	6	2	5	0.6400	0.1360	54	4.70	<.0001
trt*week	1	6	2	6	- 0.07750	0.1360	54	-0.57	0.5713
trt*week	1	6	3	1	9.1800	0.1360	54	67.48	<.0001
trt*week	1	6	3	2	8.8100	0.1360	54	64.76	<.0001
trt*week	1	6	3	3	7.4975	0.1360	54	55.11	<.0001
trt*week	1	6	3	4	2.6650	0.1360	54	19.59	<.0001
trt*week	1	6	3	5	1.2100	0.1360	54	8.89	<.0001
trt*week	1	6	3	6	0.1575	0.1360	54	1.16	0.2521
trt*week	2	1	2	2	-0.4450	0.1360	54	-3.27	0.0019
trt*week	2	1	2	3	-1.7450	0.1360	54	-12.83	<.0001
trt*week	2	1	2	4	-6.9150	0.1360	54	-50.83	<.0001

Effect	trt	week	_trt	_week	Estimate	Standard Error	DF	t Value	Pr > |t|
trt*week	2	1	2	5	-8.5275	0.1360	54	-62.68	<.0001
trt*week	2	1	2	6	-9.2450	0.1360	54	-67.96	<.0001
trt*week	2	1	3	1	0.01250	0.1360	54	0.09	0.9271
trt*week	2	1	3	2	-0.3575	0.1360	54	-2.63	0.0112
trt*week	2	1	3	3	-1.6700	0.1360	54	-12.28	<.0001
trt*week	2	1	3	4	-6.5025	0.1360	54	-47.80	<.0001
trt*week	2	1	3	5	-7.9575	0.1360	54	-58.49	<.0001
trt*week	2	1	3	6	-9.0100	0.1360	54	-66.23	<.0001
trt*week	2	2	2	3	-1.3000	0.1360	54	-9.56	<.0001
trt*week	2	2	2	4	-6.4700	0.1360	54	-47.56	<.0001
trt*week	2	2	2	5	-8.0825	0.1360	54	-59.41	<.0001
trt*week	2	2	2	6	-8.8000	0.1360	54	-64.68	<.0001
trt*week	2	2	3	1	0.4575	0.1360	54	3.36	0.0014
trt*week	2	2	3	2	0.08750	0.1360	54	0.64	0.5228
trt*week	2	2	3	3	-1.2250	0.1360	54	-9.00	<.0001
trt*week	2	2	3	4	-6.0575	0.1360	54	-44.53	<.0001
trt*week	2	2	3	5	-7.5125	0.1360	54	-55.22	<.0001
trt*week	2	2	3	6	-8.5650	0.1360	54	-62.96	<.0001
trt*week	2	3	2	4	-5.1700	0.1360	54	-38.00	<.0001
trt*week	2	3	2	5	-6.7825	0.1360	54	-49.86	<.0001
trt*week	2	3	2	6	-7.5000	0.1360	54	-55.13	<.0001

trt*week	2	3	3	1	1.7575	0.1360	54	12.92	<.0001
trt*week	2	3	3	2	1.3875	0.1360	54	10.20	<.0001
trt*week	2	3	3	3	0.07500	0.1360	54	0.55	0.5837
trt*week	2	3	3	4	-4.7575	0.1360	54	-34.97	<.0001
trt*week	2	3	3	5	-6.2125	0.1360	54	-45.67	<.0001
trt*week	2	3	3	6	-7.2650	0.1360	54	-53.40	<.0001
trt*week	2	4	2	5	-1.6125	0.1360	54	-11.85	<.0001
trt*week	2	4	2	6	-2.3300	0.1360	54	-17.13	<.0001
trt*week	2	4	3	1	6.9275	0.1360	54	50.92	<.0001
trt*week	2	4	3	2	6.5575	0.1360	54	48.20	<.0001
trt*week	2	4	3	3	5.2450	0.1360	54	38.55	<.0001
trt*week	2	4	3	4	0.4125	0.1360	54	3.03	0.0037
trt*week	2	4	3	5	-1.0425	0.1360	54	-7.66	<.0001
trt*week	2	4	3	6	-2.0950	0.1360	54	-15.40	<.0001
trt*week	2	5	2	6	-0.7175	0.1360	54	-5.27	<.0001
trt*week	2	5	3	1	8.5400	0.1360	54	62.77	<.0001
trt*week	2	5	3	2	8.1700	0.1360	54	60.05	<.0001
trt*week	2	5	3	3	6.8575	0.1360	54	50.41	<.0001
trt*week	2	5	3	4	2.0250	0.1360	54	14.88	<.0001
trt*week	2	5	3	5	0.5700	0.1360	54	4.19	0.0001
trt*week	2	5	3	6	-0.4825	0.1360	54	-3.55	0.0008
trt*week	2	6	3	1	9.2575	0.1360	54	68.05	<.0001
trt*week	2	6	3	2	8.8875	0.1360	54	65.33	<.0001
trt*week	2	6	3	3	7.5750	0.1360	54	55.68	<.0001

Effect	trt	week	_trt	_week	Estimate	Standard Error	DF	t Value	Pr > |t|
trt*week	2	6	3	4	2.7425	0.1360	54	20.16	<.0001
trt*week	2	6	3	5	1.2875	0.1360	54	9.46	<.0001
trt*week	2	6	3	6	0.2350	0.1360	54	1.73	0.0898
trt*week	3	1	3	2	-0.3700	0.1360	54	-2.72	0.0088
trt*week	3	1	3	3	-1.6825	0.1360	54	-12.37	<.0001
trt*week	3	1	3	4	-6.5150	0.1360	54	-47.89	<.0001
trt*week	3	1	3	5	-7.9700	0.1360	54	-58.58	<.0001
trt*week	3	1	3	6	-9.0225	0.1360	54	-66.32	<.0001
trt*week	3	2	3	3	-1.3125	0.1360	54	-9.65	<.0001
trt*week	3	2	3	4	-6.1450	0.1360	54	-45.17	<.0001
trt*week	3	2	3	5	-7.6000	0.1360	54	-55.86	<.0001
trt*week	3	2	3	6	-8.6525	0.1360	54	-63.60	<.0001
trt*week	3	3	3	4	-4.8325	0.1360	54	-35.52	<.0001
trt*week	3	3	3	5	-6.2875	0.1360	54	-46.22	<.0001
trt*week	3	3	3	6	-7.3400	0.1360	54	-53.95	<.0001
trt*week	3	4	3	5	-1.4550	0.1360	54	-10.70	<.0001
trt*week	3	4	3	6	-2.5075	0.1360	54	-18.43	<.0001
trt*week	3	5	3	6	-1.0525	0.1360	54	-7.74	<.0001