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Effects of Using Hemp Hearts as a Feed Additive in Broiler Chicks

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Introduction

Hemp has been used for various purposes from the past. Most commonly, it is used for fiber, animal feed, human intake, paper, degradable plastics, and biofuels (Keller, 2013). In terms of animal feeding, hemp has a rich variety of nutrients. The percentage protein digestibility and protein digestibility-corrected amino acid score (PDCAAS) values were 84.1−86.2 and 49−53% for whole hemp seed (House, Neufeld, & Leson, 2010). Hemp protein levels show higher protein content than the crude protein content of flaxseed, one of the other feed sources. Flaxseed contains about 20% crude protein (Kajla, Sharma, & Sood, 2014). In poultry nutrition, protein is one of the most important nutrients. Proteins play a variety of functions in the body of poultry, most typically in the synthesis and growth of the body (Beski, Swick, & Iji, 2015, p. 47). Hemp has a rich source of omega 3, as well as, a rich source of protein. Very recently, a study by Algawany et al. (2019) found omega-3 and omega-6 fatty acids would have a positive effect when used as a poultry feed to stimulate immune responses and improve egg nutrition, meat quality and poultry growth. Another study has also found an increase of omega-3 and omega-6 fatty acids in eggs from hemp-fed laying hens (Chae et al., 2020, unpublished manuscript). The promising protein and fatty acid profile of hemp ingredients make them worthwhile to investigate as a feed source for broilers.

Hence, the study herein tests the following null hypotheses:

- H_0: Broilers with diets supplemented by hemp hearts gain weight no differently from broilers on control diets.
- H_0: Broilers with diets supplemented by hemp hearts decrease feed conversion no differently from broilers on control diets.

The data collected and used for this test are described below.

Materials and Methods

This experiment was conducted to investigate the effects of using hemp hearts as a feed additive in broiler chickens. All materials and methods used were conducted in accordance with the Murray State University Animal Care and Use Committee. Broilers were used from June through September 2017.

Animals and Management.

This experiment consisted of Freedom Ranger broiler chicks. Broilers were allowed approximately a one-month adjustment period due to stress associated with transportation and heat during the transport to Murray State University. After the adjustment period, broilers were randomly allocated to a treatment and initial weights were taken with a calibrated poultry scale. All broilers were housed in a three-tier cage, with a tray under each cage to catch animal waste. Cages were cleaned and had fresh sawdust added on a weekly basis, water re-filled and cleaned every other day, with approximately 1 teaspoon of Apple Cider Vinegar (ACV) given in each waterer, feed weigh back taken every 24 hours and new feed weighed and placed in each cage. ACV is known to reduce Salmonella in the gastrointestinal tract of poultry (Willis, King, Iskhuemhen & Ibrahim, 2009). Each broiler was assigned a number and their perspective cage was labeled with the broiler number (51-100). The experiment lasted for 49 days, July through September of 2017.

Diets.

The treatment diets consisted of five diets, a control and four experimental diets. Broilers 51-60 comprised of the control diet (n =10), where no hemp hearts were added, 61-70 comprised the 10% hemp hearts (n =10), 71-80 comprised the 20% hemp hearts (n =10), 81-90 comprised the 30% hemps hearts (n =10), and 91-100 comprised the 40% hemp hearts (n =10). Feed

comprised of commercially available chick feed (Dumor 20% Starter/Grower) and hemp hearts (locally sourced). Grit (Dumor Poultry Grit) was supplemented for the broilers to help process food for easy digestion.

Data Collections.

Broilers were randomly allocated to treatment on day 0 of the study; at the same time, initial weights were collected. Every 7 days, broiler weights were collected and recorded. Every 24 hours, feed weigh backs were collected and fresh feed and water given. Additionally, data was cleaned and logged in both Microsoft Excel and SAS to analyze all data aspects and provide adequate results. The final sample size for broiler net weight gain was 45 broilers and 50 broilers for feed conversion.

Results

Broilers, Net Weight Gain.

50 straight-run boiler chicks were randomly assigned to one of five treatment diets. The diets contained various levels of hemp hearts as follows: 0%, 10%, 20%, 30% or 40%. The 49-day study was conducted due to the short life cycle of broilers. After the study, broilers were weighed, and a net weight calculated. Each treatment level had one bird culled due to environmental stress and disease, therefore, these observations were omitted from the final sample, thus the sample size decreased to 45 broilers. The results between all diets were statistically significant for a not equal to alternative, $F_{4,40} = 2.71$, $p = 0.04$. The broilers consuming the 20% hemp diet gained the most weight and were statistically significant

compared to the Control diet, $t(16) = 2.12$, $p < 0.05$. Therefore, a statistical significance shows the null hypothesis is rejected. See Table 1 and Figure 1 for complete results.

Table 1

49-Day Net Weight Gain by Diet (N = 45)

Diet	*Mean*	*SD*
0%, Control	5.05	0.50
10 % Hemp	5.60	0.70
20 % Hemp**	5.90	0.50
30 % Hemp*	5.80	0.71
40 % Hemp	5.50	0.52

Note. "*" represents a 5% statistical significance compared to the control diet and "**" represents a 1% statistical significance compared to the control diet.

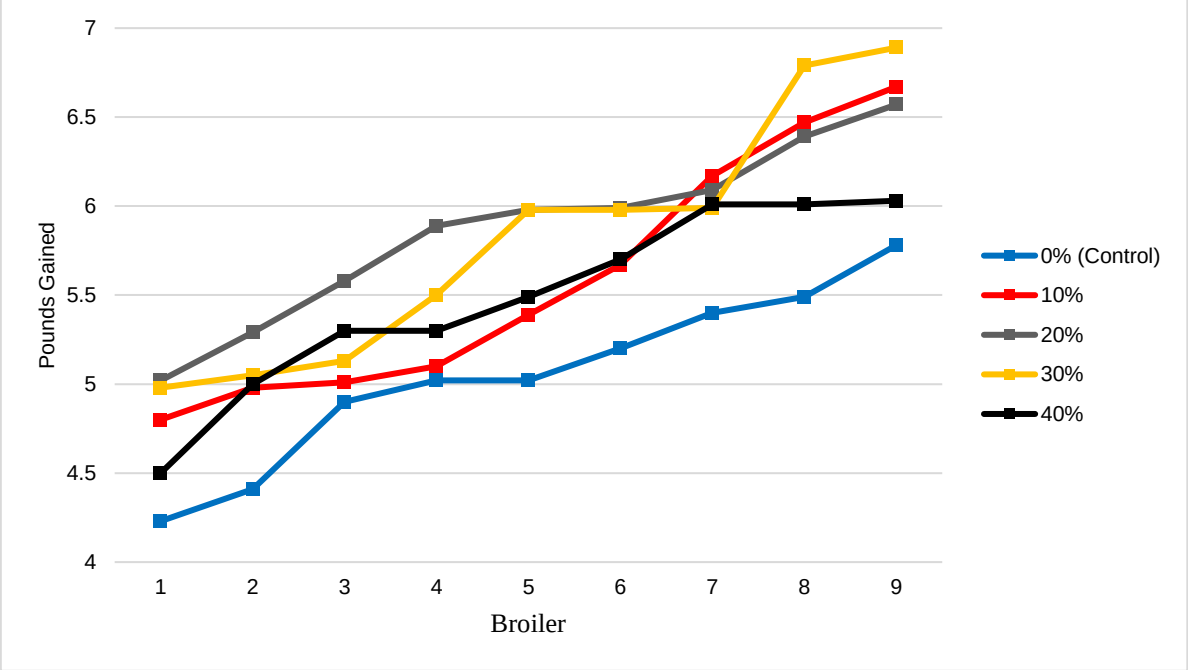

Figure 1. 49-day weight gain by diet, ordered by bird performance

Broilers, Feed Conversion.

Each broiler was individually fed a predetermined amount of feed each day. Weigh backs were completed on any feed remaining in each feeder after 24 hours. Pounds of feed consumed and net weight gained were used to calculate the feed conversion rate for each treatment. The results for the diets were statistically significant for a not equal to alternative, $F_{4,45} = 4.91$, $p = 0.0023$. The 20% diet had the lowest (best) feed conversion rate, $t(18) = 2.10$, $p < 0.01$. Therefore, the null hypothesis is rejected due to statistical significance. See Table 2 and Figure 2 for complete results.

Table 2

Pounds of Feed Consumed per Pounds Gained, by Diet (N=50)

Diet	*Mean*	*SD*
0% Control	3.28	0.40
10% Hemp	2.90	0.48
20% Hemp**	2.55	0.35
30% Hemp*	2.67	0.45
40% Hemp*	2.68	0.36

Note. "*" represents a 5% statistical significance compared to the control diet and "**" represents a 1% statistical significance compared to the control diet.

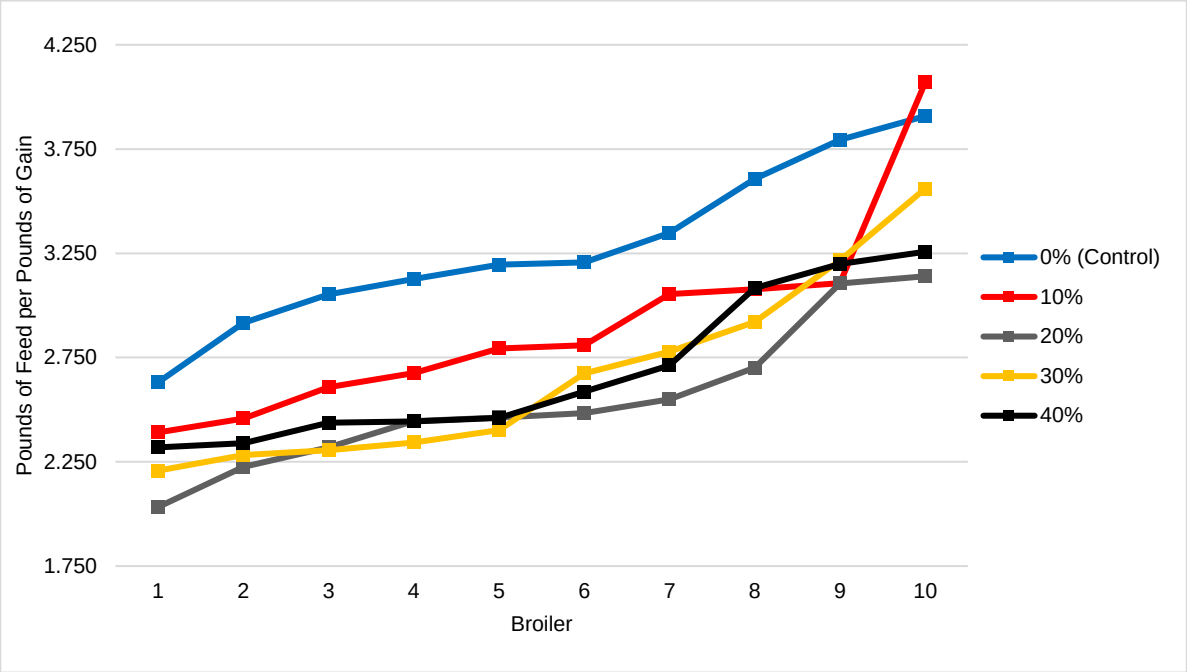

Figure 2. Feed conversion by diet, ordered by bird performance

Discussion/Conclusion

This study found the 20% hemp heart diet to be the optimal group for broiler growth and feed conversion. Compared to the control, the 20% diet had a greater statistical significance for broiler weight gain and feed conversion within 1%. The advantage to this finding is the optimism of a larger, leaner broiler with a decreased appetite. This result suggests the possibility of a diet superior to soy-fed broilers.

Additionally, the control had the lowest average weight gain and the highest (worst) feed conversion. The other hemp heart diets did not provide the same outcome, but had a similar trend in weight gain and feed conversion. These results suggest the higher concentration diets may be detrimental to broiler growth due to lack of proper supplementation.

Mir et al. (2018) stated the higher fatty acid content from 10% flaxseed in broiler feed resulted in a reduced feed conversion ratio, but the addition of broken rice did not have any effect on the broilers' growth or FCR. Similarly, the current study has shown a hemp heart diet

reduced the FCR, while also increasing the weight of broilers, due to the increase of fatty acids in the diet. Additionally, a study conducted by Jing, Zhao, & House (2017) utilizing hemp oil or HempOmega, a dietary supplement, found the use of 6% hemp oil did not negatively affect broiler performance and both treatments provided extra n-3 polyunsaturated fatty acids (PUFAs) compared to the control. However, the experiment found the 3% hemp diet decreased broiler performance (Jing, Zhao, & House, 2017). On the contrary, a study using hempseed cakes did not have a positive outcome, as the broilers had a high FCR and less weight gain than the control group. (Ondrej, et. al, 2015). This particular experiment may have benefited from using different percentages of hempseed cake, such as the current study. Also, there may have been possibility of lack of palatability for the hempseed cake due to consistency.

Another factor affecting the results of this study is the small sample size, leading to possible standard error or biased estimates. This study should be replicated with a larger sample size to determine if the 20% hemp heart diet is truly an optimal diet for broiler growth. Including hemp products in broiler feed may bring an advantage to the broiler and hemp industry, showing potential for a market in hemp-fed broilers.

For future research, it is recommended the broilers be bought as day-old chicks comprised of Cornish Rock crosses, which are known for fast growth. The study should run for approximately 6 weeks to mimic industry standard. The optimal study size per diet group would be 66 broilers, for the best statistical significance.

With the state of Kentucky being prominent in the chicken industry, it is recommended broiler chicks be bought from a Kentucky hatchery. Also, it is highly recommended an industry representative for broilers (such as Tyson Foods) be a part of planning the research project, so

industry recommendations are followed and broilers are housed and managed properly. The broilers should be housed in a free-range, small scale, industry standard broiler house.

Moreover, there should be at least 5 diets: control, 25%, 50%, 75% and 100% hemp replacement. In doing so, this will give a better understanding of what hemp can add in the broiler diet and what, if any nutrient, could be lacking and if they need to be substituted. Also, the feed needs to be a crumble, which is industry standard. The hemp added needs to be of the same consistency to ensure the broilers cannot pick around the hemp and to prevent feed wastage. During this study, the consistency of the feed was the same and the broilers did not pick through the hemp hearts.

Furthermore, at the conclusion of the study, fat pads should be harvested and labeled. Fat pads should be labeled with the corresponding broiler number so the sample can be analyzed for iron, protein, omega-3, hormone levels, density/weight and a full nutritional panel. Any broiler which consistently had poor productivity, weight gain, and feed conversion would need to be euthanized at the end of the study and a necropsy performed to determine the underlying cause.

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