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Research Article

Performance, some blood paremeters, fatty acid profile and TBARS value of broiler chickens fed chia seed

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ABSTRACT

This study aims to determine the effect of chia seeds added to broiler rations at the level of 5% on live weight, live weight gain, feed consumption, feed conversion ratio, breast meat fatty acid profile and meat shelf life. A total of 112 daily-aged Sasso chicks were used in the experiment. Chicks were divided into 2 groups of 56 animals. Each group is divided into 8 subgroups of 7 broilers. The experimental group ration was prepared to contain 5% chia seeds starting from the 15th day. During the experiment, feed and water were given ad libitum. Before the experiment, a 14-day initial ration was applied to all groups. The trial lasted 49 days. In the study, there was no statistical difference between the groups in terms of body weight, live weight gain, feed consumption and feed conversion rates ($P>0.05$). At the end of the experiment, the breast meat Linolenic acid ratio of the experimental group (2.02%) was significantly higher than the control group (1.07%) ($P<0.05$).The arachidonic acid ratio was found to be significantly lower in the experimental group than in the control group ($P<0.05$). While the TBARS value of breast meats kept at +4°C for seven days increased in the control group, it decreased significantly in the experimental group ($P<0.05$). As a result of this study, it can be said that chia seeds have a positive effect on the shelf life of broiler meat.

INTRODUCTION

Chia is an annual plant that grows in tropical or temperate regions. Chia seeds are about 2 mm long, oval in shape, grey, black, brown or white and have dots on them. Chia seeds contain 42.1g of carbohydrates, 30.7g of fat and 16.5g of protein per 100 grams and contain approximately 486 kcal of metabolic energy. Chia is a good source of polyunsaturated (PUFA) omega-3 fatty acids. In a study in which chia seed oil, linseed oil and fish oil were added to rations, it was observed that omega-3 fatty acids increased by 100%-200% in the eggs of chickens consuming chia seed oil (Ayerza, 2009). The Sasso chicken breed, which is made to be a durable and slow-growing poultry, is an alternative to fast-growing hybrid chickens fed a corn-based ration. Sasso is not a breed name, but the name of a French company that has been breeding chickens for decades. It is also known as French village chicken. Chia seed has been largely used as a food, oil source, and raw material for medicinal compounds. Its benefits result primarily from the high concentrations of essential fatty acids, dietary fiber, antioxidants, flavonoids, anthocyanins, vitamins, carotenoids, and minerals (Terevinto et al 2023). It is thought that chia seeds, which have many superior properties, may be effective on meat quality and shelf life, especially with their antioxidant effect. For this reason, in this study, the effect of chia seed on performance, fatty acid profile in breast meat and shelf life of breast meat was investigated.

MATERIALS and METHODS

The study was conducted with the decision and permission of Burdur Mehmet Akif Ersoy University Animal Experiments Local Ethics Committee dated 06.12.2017 and numbered 347. A total of 128 1-day-old Sasso breed chicks were used at the beginning of the study. Broiler chicks were vaccinated on the first day. In the study, broiler chicks were given two types of feed: starter and growth feed. Lighting was provided for 24 hours during the study. Daylight and fluorescent lamps were used for lighting the research unit. Three electric heaters (2200 W) were used for heating. The average temperature of the experimental room (for 49 days) was 26.5° C and the average humidity was 68.20%. The starter feed was used between days 1-14 and the growth feed was used between days 15-49. Feed and water were provided ad libitum. Feeders and drinkers were checked daily. Starter feed was used until the fourteenth day and then the experiment started. All chicks were weighed individually and feed intake (FI) was recorded at d 14, 21, 28, 35, 42 and 49 as group. Body weight gain (BWG) and feed conversion ratio (FCR) were subsequently calculat-

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ed based on the performance values. At the beginning of the study, all chicks were weighed and distributed so that there were chicks of similar weight in each group. During the study, live weight weighings were done individually every week with a UWE HGM-20K balance with ±1 g accuracy.

The chicks were weighed individually every week from the beginning to the end of the study using a UWE HGM-20K scale with ±1 g accuracy. Live weight gain determination was calculated by subtracting the weighing results of the previous week from the last weighing**.** Feed consumption during the study was calculated by subtracting the amount of feed re-

Table 1. Raw material and nutrient content of compound feeds (concentrate feed) used in the study and Chemical Analysis Results of Chia Seed and Ration (%)

Raw Materials	Starter	Magnification (without Chia)	Magnification (with Chia)
Corn	49.15	59.40	57.12
Vegetable Oil	6.50	4.95	3.50
Sunflower Meal, Unhulled (36% HP)	5.00	5.00	5.00
Soybean Meal (48%HP)	35.40	27.10	25.90
Dicalcium Phosphate	1.70	1.20	1.20
Dl-Methionine	0.20	0.20	0.20
Limestone	1.25	1.35	1.28
L-Lysine Hydrochloride	0.10	0.10	0.10
Sodium Bicarbonate	0.10	0.10	0.10
Salt	0.40	0.40	0.40
Vitamin-Mineral Mix	0.20	0.20	0.20
Chia seeds	0	0	5.00

Calculated Chemical Composition	Starter	Magnification (without Chia)	Magnification (with Chia)
Dry Matter	90.50	90.20	90.10
Crude Protein	23.00	20.00	20.00
Metabolic Energy	3201	3198	3201
Calcium	1.00	0.90	0.90
Available Phosphorus	0.45	0.35	0.36
Sodium	0.24	0.24	0.24
Chlorine	0.28	0.28	0.28
Methionine-Cystine	0.98	0.89	0.91
Lizin	1.32	1.10	1.10
Threonine	0.87	0.74	0.75
Tryptophan	0.31	0.26	0.27
Linoleic Acid	4.38	3.73	3.24

Results of the analyses	Starter	Magnification (without Chia)	Magnification (with Chia)	Chia Seeds
Crude Protein	23.2	19.42	19.87	21
Crude Fat	8.64	9.01	7.90	28.14
Crude Cellulose	4.05	4.01	4.84	34.4
Crude Ash	5.92	4.32	5.34	4.98
Dry Matter	89.68	89.32	89.64	94.45

Vitamin-Mineral composition (per kg feed): Vitamin A, 3,333 IU; Vitamin D_3, 0,833 IU; Vitamin E, 11.667 mg; Vitamin K_3, 1.333 mg; Vitamin B_1, 0.667 mg; Vitamin B_2, 2 mg; Vitamin B_3, 10 mg; Vitamin B_5, 2. 667 mg; Vitamin B_6, 1.333 mg; Vitamin B_{12}; 0.05 mg; Biotin, 0.15 mg; Folic Acid, 0.25 mg; Ascorbic Acid, 16.687 mg

maining in the following week from the amount of feed given to the animals each week. Feed weighing was done with a scale with ±1 g accuracy. Feed conversion ratio (Feed conversion ratio (g FI/g BWG) was obtained by dividing total feed consumption by live weight gain.

The experimental period using chia lasted 35 days in total. After the 14th day, 112 Sasso broiler chicks were used in the experiment. The chicks were divided into 2 groups of 56 animals. Each group was divided into 8 subgroups of 7 chicks. The experimental group ration was prepared to contain 5% chia seeds from the 14th day. Experiment diet analysis results are given in Table 1.

The feeds used in the study were analyzed in the Laboratory of the Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Mehmet Akif Ersoy University, Burdur. Dry matter (DM), crude ash (Ash), crude fiber (CF), ether extract (EE) and crude protein (CP) were analyzed. Dry matter, crude ash, ether extract, crude protein, and organic matter (OM) analyses of the feeds used in the study were carried out according to the methods reported in (AOAC, 2000) and crude fiber (CF) analysis was carried out according to (Crampton and Maynard, 1938). A total of thirty-two breast meat samples were taken from two animals with similar body weights randomly selected from each subgroup at slaughter. The experiment was terminated by decapitation on the 49th day. Blood was taken during decapitation. The brisket of the control and experimental groups was divided into two groups of eight pieces each, and the first group of the control and experimental groups were kept one hour after slaughter and the second group was kept in the refrigerator at +4 degrees Celsius for one week and then analyzed for Thiobarbiturate reactive substances (TBARS) in a spectrophotometer device (PERKIN ELMER Lambda 35) at Burdur Mehmet Akif Ersoy University Scientific and Technology Application and Research Center. The method described by (Zeb and Ullsh, 2019) was used for TBARS analysis. Fatty acids in brisket were analyzed by gas chromatography/mass spectroscopy (AGILENT 5975 C AGILENT 7890A GC).

PASW Statistics18 Independent group t-test was applied for statistical calculations of the groups, significance of the differences between the mean values of the groups and significance control of the difference between the groups. Significance was declared at $P < 0.05$

RESULTS

The effects of chia seed added to the ration at 5% level on body weight gain, feed intake and feed utilization averages are shown in Table 2. There was no difference between live weights at 14, 21, 28, 35, 42 and 49 days of the experiment.

Table 2. Average body weight gain (BWG), feed intake (FI)and feed conversion ratio of the groups during the experiment (14th day-49th day)

Parameters	Control Group ($X \pm Sx$)	Experimental Group ($X \pm Sx$)	P
Feed Consumption. g	3476.67 ± 37.58	3402.20 ± 70.51	0.519
Live weight gain. g	1615.79 ± 36.67	1648.21 ± 32.17	0.517
Feed conversion ratio (g FI/g BWG)	2.15 ± 0.06	2.06 ± 0.08	0.079

The effect of chia seed added to the ration at 5% level on the fatty acid composition of the breast meat of the animals is shown in Table 3 and the fatty acid composition of the feeds is shown in Table 4. The difference between linolenic acid and arachidonic acid values between the groups was statistically significant.

Table 3. Fatty Acid Profile Values of Meats of Experimental Groups. %

Parameters	Control Group ($\bar{x} \pm S_{\bar{x}}$)	Experimental Group ($\bar{x} \pm S_{\bar{x}}$)	p
Myristic Acid	0.90 ± 0.03	0.97 ± 0.14	0.633
Palmitic Acid	35.28 ± 1.25	37.80 ± 1.22	0.160
Palmitoleic Acid	0.47 ± 0.01	0.43 ± 0.01	0.102
Stearic Acid	5.16 ± 0.14	4.93 ± 0.14	0.290
Oleic Acid	25.81 ± 0.74	24.69 ± 0.71	0.290
Linoleic Acid	27.30 ± 0.75	26.42 ± 0.60	0.372
Linolenic Acid	1.07^{b}± 0.05	2.02^{a}± 0.27	0.002**
Arachidonic Acid	3.12^{a}± 0.23	2.11^{b}± 0.19	0.003**

**p<0.01 n=16 The difference between values with different letters in the same row is significant.

The effect of 5% chia seed supplementation to the ration on TBARS analysis results of control and experimental groups on day 1 after slaughter is shown in Table 5. The effect of chia

Table 4. Fatty Acid Composition of Feeds %

Component	Experimental feed	Control feed	Chia seeds
Myristic acid	-	-	0.253
Palmitic	14.001	11.983	8.7
Palmitoleic	0.951	0.966	0.144
Stearik	3.565	3.595	1.542
Oleic	18.252	19.452	5.033
Linoleic	53.601	60.334	20.996
Linolenic	9.335	3.245	61.484

seed supplementation on TBARS analysis results of control and experimental groups on day 7 after slaughter and TBARS analysis results between control and experimental groups on days 1 and 7 after slaughter are shown in Tables 5.

Table 5. TBARS Analysis Results of Control and Experimental Groups

MDA, nmol/g	Control ($\bar{x} \pm S_{\bar{x}}$)	Experimental ($\bar{x} \pm S_{\bar{x}}$)	p-value
d1 Post -Slaughter	10.75 ± 1.36	13.04 ± 1.78	0.326
d7 Post -Slaughter	13.01 ± 3.01	8.02 ± 0.90	0.135
p-value	0.507	0.025	

DISCUSSION

It was found that chia seed did not affect body weight, body weight gain, slaughter weight, feed intake, feed conversion ratio, carcass weight and hot carcass yield in the experimental groups.

Amela et al., 2016 reported that there was no statistical difference in terms of live weight and live weight gain in a study in which 10% chia meal and 10% chia meal+probiotic were added to broiler rations. Fernández et al., 2018 divided 96 Cobb 500 chickens into 4 groups and 16 subgroups. The first group received a control ration. The second group received 10% chia meal, the third group received 10% chia meal + hydroxytyrosol (7 mg/kg) and the fourth group received hydroxytyrosol (7 mg/kg). The incorporation of chia flour and/or hydroxytyrosol does not affected the evaluated parameters. The demucilagination or the inclusion of enzymes that degrade soluble fiber could contribute to demonstrating a positive effect on the productive performance. Peiretti and Meineri (2008) in their study on the effects of chia seed supplements on growth performance carcass characteristics, and fat and meat fatty acid profile of rabbits fed with chia seed supplements, added 0%. 10% and 15% chia seeds (*Salvia hispanica L.)* to rabbit rations and reported that there was no significant difference in terms of live weight and live weight gain. Urrutia et al. (2015) added 10.5% flaxseed and 10% chia seeds to the rations of Navaira breed lambs and reported that the additives did not affect live weight. It is seen that the findings obtained in the experiment are in agreement with the results of the above-mentioned studies (Amela et al., 2016, Urrutia et al., 2015).

Ayerza et al. (2002) reported that the addition of 10% and 20% chia seeds to Ross 308 chick rations decreased palmitic acid and increased alpha-linolenic acid in breast and thigh meat. Azcona et al. (2008) reported that the polyunsaturated fatty acid composition increased by 157% in thigh meat and 200% in breast meat in a study in which chia seeds were added to broiler rations. Salazar et al. (2009) in a study investigating the use of chia seeds in laying hen rations alpha-linolenic acid increased and palmitic acid decreased in egg yolk. As a result of the data obtained at the end of the experiment, it was observed that chia seed increased oxidative stability due to its antioxidant properties and positively affected meat shelf life. Waszkowiak and Rudzinska (2014) stated in their study that flaxseed is protective against oxidation and can increase the shelf life of products which supports the data in our study.

CONCLUSION

In conclusion numerically better results were obtained in the feed conversion ratio in the group given chia. The linolenic acid level in the meat of the group given chia seeds was statistically higher than the control group. Chia seed is a grain rich in linolenic acid. and this is reflected in the meat analysis results. The shelf life of the meat of the group given chia seed was longer than that of the control. It may be recommended to add chia seeds to meat, especially meats with a risky shelf life, such as white meat.

DECLARATIONS

Ethics approval

The study was conducted with the decision and permission of Burdur Mehmet Akif Ersoy University Animal Experiments Local Ethics Committee dated 06.12.2017 and numbered 347.

Conflict of Interest

The authors declare no competing interests.

Consent for Publication

Not applicable.

Author contribution

Idea, concept and design: FKO, OC

Data collection and analysis: OC

Drafting of the manuscript: FKO, OC

Critical review: FKO, OC

Data availability

Not applicable.

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REFERENCES

Amela, MI., Feuilles, A., Fernandez, H., Salerno, C., & Kumorkiazwick, L. (2016). Effect of Saccharomyces cerevisiae and chia flour addition in broiler ration. 4. Productive performance. Revista Argentina de Producción Animal, 36(1), 189-293.

AOAC. (2000). OfficialMethodsof Analysisof the Association of Analtytical Chemists..17. Baskı. Gaithersburg: MD. USA. Methods

Ayerza, R. (2008). Chia as a New Source of ω-3 Fatty Acids: Nutritional Comparison with Other Raw Materials and Its Advantages When Producing ω-3 Enriched Eggs. Wild-Type Food in Health Promotion and Disease Prevention: The Columbus Concept, 179-194.

Ayerza, R., Coates, W., & Lauria, M. (2002). Chia seed (Salvia hispanica L.) as an omega-3 fatty acid source for broilers: influence on fatty acid composition, cholesterol and fat content of white and dark meats, growth performance, and sensory characteristics. Poultry science, 81(6), 826-837. https://doi.org/10.1093/ps/81.6.826

Azcona, J. O., Schang, M. J., Garcia, P. T., Gallinger, C., Ayerza Jr, R., & Coates, W. (2008). Omega-3 enriched broiler meat: The influence of dietary α-linolenic-ω-3 fatty acid sources on growth, performance and meat fatty acid composition. Canadian journal of animal science, 88(2), 257-269. https://doi.org/10.4141/CJAS07081

Crampton, EW., & Maynard, L. (1938). Therelation of cellulose and lignin content tonutritive value of animal feeds. Journal of Nutrition. 15, 383-395. https://doi.org/10.1093/jn/15.4.383

Fernández, H. T., Arreghi, A., Amela, M. I., Salerno, C. M., & Couto, A. (2018). Effect of hydroxytyrosol and chia flour addition in broiler diet. 1. Productive performance.

Peiretti, P. G., & Meineri, G. (2008). Effects on growth performance, carcass characteristics, and the fat and meat fatty acid profile of rabbits fed diets with chia (Salvia hispanica L.) seed supplements. Meat Science, 80(4), 1116-1121. https://doi.org/10.1016/j.meatsci.2008.05.003

Salazar-Vega, M. I., Rosado-Rubio, J. G., Chel-Guerrero, L. A., Betancur-Ancona, D. A., & Castellanos-Ruelas, A. F. (2009). Composition in alpha linolenic acid (w3) of egg and broiler meat using chia (salvia hispanica l.) In poultry feedstuff. Interciencia, 34(3), 209-213.

Terevinto A., Marta del Puerto, Ayrton da Silva, María Cristina Cabrera and Ali Saadoun. (2023). Effect of chia seeds (Salvia hispanica l.) inclusion in poultry diet on n-3 enrichment and oxidative status of meat during retail display. CYTA – Journal Of 2023, VOL. 21, NO. 1, 93–100 Food. https://doi.org/10.1080/19476337.2022.2162975

Urrutia, O., Soret, B., Insausti, K., Mendizabal, J. A., Purroy, A., & Arana, A. (2015). The effects of linseed or chia seed dietary supplementation on adipose tissue development, fatty acid composition, and lipogenic gene expression in lambs. Small Ruminant Research, 123(2-3), 204-211. https://doi.org/10.1016/j.smallrumres.2014.12.008

Waszkowiak, K., & Rudzińska, M. (2014). Effect of flaxseed meals and extracts on lipid stability in a stored meat product. Journal of the American Oil Chemists' Society, 91, 979-987.

Zeb, A., & Ullah, F. (2016). A simple spectrophotometric method for the determination of thiobarbituric acid reactive substances in fried fast foods. Journal of analytical methods in chemistry. https://doi.org/10.1155/2016/9412767