LAYING PERFORMANCE OF LAYING HENS FED A FERMENTED PROTEIN SUPPLEMENTARY FEED

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Abstract

This study examined the laying performance (body weight change, egg-laying rate, feed intake, egg weight, and FCR) of Lohmann Brown hens (20-week-old) housed with a deep-litter system and fed fermented protein supplementary feed (FPS; 630 g CP/ kg DM, Integro®) as a protein source. The study lasted for 12 weeks. The hens were randomly allocated into four groups, each with four replicates of 25 hens. The control group was fed a conventional diet (C), while the other groups were fed a conventional diet with 20 (FPS20), 30 (FPS30), and 40 (FPS40) g/kg FPS. A corn–soybean meal-based conventional diet in mash form and water were provided ad libitum throughout the experimental period for all treatments. The highest feed intake value was observed in the FPS40 group, while the lowest was observed in the FPS20 and FPS30 groups. The C and FPS20 hens produced eggs with a higher weight than those produced by the FPS40 group. The FPS20 and FPS30 hens exhibited a superior feed conversion ratio (FCR) in comparison to the C and FPS40 hens. The treatments had no effect on the final body weight or egg-laying rate. The study provides compelling evidence that the addition of 30 g/kg FPS to the hen diet is beneficial without negatively impacting laying performance.

Keywords: *Fermented feed, Performance, Supplementary feeding, Layers.*

Introduction

The poultry sector is of great economic and nutritional importance to global food production and continues to be driven by consumer demands and technological innovation. To meet the animal product needs of a growing population, the search for protein-rich feed ingredients that are both cheap and reliable has accelerated. Reducing the level of soybean in laying hen diets can reduce costs, but care must be taken not to compromise hen health and production performance. In this context, fermented protein supplements offer a sustainable and efficient method of animal nutrition, enabling more efficient use of protein resources and providing both economic and environmental benefits.

Yeasts, which are widely used in bread, cakes and other food products, can also be used as growth and development promoters in animal husbandry. Yeasts used as growth factors in feeds are said to make it difficult for pathogenic micro-organisms to attach to the intestinal micro-organism flora. For this reason, yeasts are reported to have a positive effect on egg weight, egg yield, feed conversion ratio and egg quality in laying hens (Gurbuz *et al*., 2011; Cai *et al*., 2016; Li *et al*., 2016; Zhang *et al*., 2020; Park *et al*., 2020; Sjofjan *et al*., 2021). One of the important features of yeast is that industrial organic wastes and other organic waste materials can be used to produce single-celled organisms, and it is believed that such studies will assist in solving the environmental waste problem.

Because of the aforementioned benefits of yeasts in poultry nutrition, the present study will determine the effects of fermented protein supplementary feed (FPS), obtained by thermal and chemical reactions of beneficial metabolites, nitrogenous compounds and yeast cell proteins

formed during yeast fermentation, on the performance of laying hens. The by-product of the yeast industry, obtained by fermentation of vinasse with certain cereals and by-products of the milling industry, heat-treated and free of living microorganisms, has a crude protein content of 63%, whose amino acid profile is considered suitable for poultry nutrition. Therefore, our aim is to develop an economically and environmentally sustainable feed formulation by substituting the yeast industry by-product with soybean meal in certain proportions and to determine the possibilities and proportions of its use in laying hen diets.

Materials and methods

This study was carried out from March to May 2023 using the poultry facilities of the Faculty of Agriculture, Eskisehir Osmangazi University, Eskisehir, Türkiye. The experimental protocol and implemented procedures were approved by the local Ethics Committee for Experimental Animals (Protocol code HAYDEK-940/2023).

After a pre-trial period (two weeks) of adaptation to the diet, 400 Lohmann Brown layer hens (22 weeks old) were divided into four groups with four replicates of 25 hens each. The experimental period was 12 weeks. All hens were housed in floor litter pens in a curtain-sided house with mechanical ventilation and both artificial (LED bulbs) and natural lighting through the windows. Each pen (2.5 × 3 m) was equipped with a perch, individual nests (30 × 45 × 60 cm height, 1 nest/5 hens), an automatic drinker and a red circular feeder plate. During the experiment, the temperature was maintained at 20 ± 1 °C. The hens were exposed to artificial plus natural light according to the daily photoperiod to provide 16 h of light (Kop-Bozbay et al., 2021).

The control group was fed a conventional diet (C), while the other groups were fed a conventional diet supplemented with 20 (FPS20), 30 (FPS30) and 40 (FPS40) g/kg fermented protein supplementary feed (FPS; 630 g CP/ kg DM, Integro®). FPS was added to the diets to replace soybean meal in the FPS groups. Throughout the experimental period, all treatments were provided ad libitum with a corn–soybean meal-based conventional diet in mash form and water. The ingredients of the experimental diets are listed in Table 1.

Hens were weighed at the beginning of the experiment and after 12 weeks. During the experiment, feed intake (FI) was recorded at 14-day intervals, while all eggs and their individual weights were recorded on the last 3 days of each 7-day interval per replicate pen. Egg-laying rate (%), FI (total FI/number of days in the experiment) and FCR (g feed: g egg mass) were calculated. For normality and homogeneity Kolmogorov-Smirnov and Levene's test were used. One way ANOVA was performed by using IBM SPSS 25. Significant differences among the means were determined by using Duncan's multiple range test at $P<0.05$.

Results and discussion

No differences were found in final body weight, body weight change, and laying rate (Table 2). The FI of the FPS40 hens was higher than that of the C hens, whereas the C hens were higher than that of the FPS20 and FPS30 hens ($p < 0.05$). The egg weight of C and FPS20 hens was higher than that of FPS40 hens ($p < 0.05$). The FCR of the FPS20 and FPS30 groups was lower than that of the C and FPS40 hens ($p < 0.05$).

The C hens had a numerically lower laying rate compared to all FPS groups. In fact, the FPS30 group had the highest laying rate and the egg weight was the same as the control group. Although 63.4% soybean meal was less than the C group, such a result is an indication that FPS will provide an advantage in the use of diets for laying hens. In addition, in the FPS40 group, egg weight decreased despite significantly higher egg production. For this reason, it may only allow a 2% more profitable production in terms of feed costs compared to

the control group. The FPS20 group had the highest egg weight and laying rate was numerically higher than the C group. In fact, the fact that the FCR was lower in the FPS20 and FPS30 groups supports this finding. In addition, the data relating to the final body weight suggests that despite a reduction in the concentrate feed intake, the FPS20 and FPS30 promoted egg weight in the hens kept under the same rearing conditions. The findings demonstrate that the incorporation of FPS into the diet as a substitute for soybean not only improvements FCR in laying hens but also results in eggs of optimal weight, benefiting both producers and consumers. These findings align with those of previous studies, which have demonstrated the necessity of yeast culture supplementation for the detection of positive effects on livestock and poultry performance. (Gao et al., 2008; Zhang et al., 2020).

The results obtained may be due to the positive effect of FPS in poultry diets on intestinal morphology by providing an improved humoral immune response without disturbing the intestinal microbial balance (He et al., 2021). This resulted in improved performance. In addition, the fact that no mortality or health problems were recorded during the trial demonstrates that FPS can be used in laying hen diets without adversely affecting animal performance.

Table 1. The ingredients of experimental diets (as fed)

Ingredients (g/kg)	Control	FPS20	FPS30	FPS40
Wheat	224	224	224	228
Corn	357	366	371	373.5
Sunflower seed meal (36)	149.5	149.5	150	152
Fermented protein supplementary feed (FPS)	**0**	**20**	**30**	**40**
DCP	13	13	13	13
Limestone	79	79	79	79
Salt	2.5	2.5	2.5	2.5
Soybean meal	**115**	**88**	**73**	**55**
Vegetable oil	50	48	47	46
Vit-min premix[1]	2.5	2.5	2.5	2.5
L-lysine HCI, 78%	1.35	1.35	1.5	1.65
DL-methionine	1.45	1.45	1.6	1.75
L-threonine	1.2	1.2	1.4	1.6
Sodium bicarbonate	2	2	2	2
Toxin binder	1.5	1.5	1.5	1.5
Nutrient levels				
Metabolizable energy (kcal/kg)*	2797.48	2797.98	2797.30	2796.45
Crude protein (%)	16.52	16.57	16.54	16.45

*Calculated value [1]Per kilogram of diet: vitamin A (retinyl acetate) 20 000 IU, vitamin E (dl-αtocopheryl acetate) 80 mg, vitamin D3 (cholecalciferol) 6000 IU, vitamin B1 (thiamine monophosphate) 3 mg, vitamin B2 (riboflavin) 12 mg, vitamin B6 (pyridoxine hydrochloride) 8 mg, vitamin B12 (cyanocobalamin) 0.04 mg, vitamin K3 (menadione) 4.8 mg; vitamin H (D-biotin) 0.2 mg, vitamin PP (nicotinic acid) 48 mg, folic acid 2 mg, calcium pantothenate 20 mg, manganous oxide 200 mg, ferrous carbonate 80 mg, cupric sulphate pentahydrate 20 mg, zinc oxide 120 mg, basic carbonate monohydrate 0.4 mg, anhydrous calcium iodate 2 mg, sodium selenite 0.4 mg, choline chloride 800 mg, 4-6-phitase 1800 FYT, DL-methionine 2600 mg, canthaxanthin 8 mg

Table 2. Laying performance of laying hens fed on fermented protein supplementary feed (FPS)

	Control	FPS20	FPS30	FPS40	SEM	P
Initial body weight (g/hen)	1767.49	1730.41	1740.13	1746.03	9.098	0.570
Final body weight (g/hen)	1862.64	1841.20	1848.98	1837.64	8.119	0.748
Body weight change (g)	95.15	110.79	108.85	91.60	9.201	0.872
Egg-laying rate (%)	90.58	92.59	94.03	93.68	1.232	0.792
Feed intake (g/hen/day)	120.68^{b}	109.58^{c}	108.58^{c}	127.68^{a}	2.098	0.000
Egg weight (g)	61.25^{a}	61.37^{a}	60.75^{ab}	59.72^{b}	0.259	0.045
FCR (g feed: g egg mass)	2.26^{a}	1.98^{b}	1.97^{b}	2.36^{a}	0.536	0.003

SEM: Standart error of mean. Means with different lowercase letters in the same row are statistically different at $P<0.05$.

Conclusion

It is important to meet the animals' essential amino acid requirements, improve digestibility and maintain overall nutrient balance when changing the content of protein ingredients in the ration. These strategies can help maintain chicken health and production performance while reducing costs. Indeed, the study provides clear evidence of the benefits of adding 30 g/kg FPS to the hen diet without negatively affecting laying performance.

Acknowledgement

This study was supported by Integro Gıda under the P&D project entitled 'Fermented Feed and Feed Additives R&D Project Poultry and Ruminant Trials'. We thank Integro Gıda for financial support, faculty members for providing faculty facilities and bachelor and master students of the Department of Animal Science for helping with animal care during the study.

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