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Effect of Dietary Replacement of Soybean Meal with Faba Beans (*ViciaFaba* L.) on the Performance of Broilers

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ABSTRACT

This study was conducted to assess the effect of replacement of soybean meal with faba beans (*Viciafaba* L.) on the performance of broilers. One hundred twenty, one-day old, commercial broiler chicks were randomly distributed into three treatment groups having four replicates and each replicate had ten birds. A standard soybean-maize based basal ration was formulated and fed to the chicks for a period of six weeks in three different growth phases i.e. pre starter (0-7 d), starter (8-21 d) and finisher (22-42 d). The first group was kept as a control (T1) and was given the basal diet while 25 and 50% of soybean meal protein was replaced with faba beans protein in the second (T2) and third (T3) treatment group, respectively. The body weight gain and feed intake were recorded weekly. A metabolism trial was conducted at the end of the experiment. The body weight gain and feed intake amongst different dietary treatments did not vary significantly. Feed conversion ratio and metabolizability of nutrients viz., gross energy,nitrogen and dry matter did not vary significantly amongst different treatment groups. No statistical difference was observed amongst treatment groups with respect to the dressed weight, eviscerated weight, drawn weight, giblets weight and abdominal fat of the carcasses of broiler birds. Findings of this study revealed that 50% replacement of soybean meal with faba beans was economically better without affecting the growth performance and nutrient metabolizability of broiler chicken.

Key words: Broiler, Carcass, Faba beans, Growth Performance, Soybean meal

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INTRODUCTION

Feed accounts for approximately 70% of the cost of broiler meat production. Due to high levels of protein in grain legumes, they are considered as potent meal to meet the demand of plant proteins for poultry diets. Soybean meal is the most commonly used protein ingredient in poultry diets, but its high cost implies consideration of alternative cheaper protein sources that are more economical in formulating least cost rations. Faba bean (*Viciafaba* L.) is considered an interesting ingredient in diets of non-ruminant species such poultry (Bosco et al., 2013). Moreover, faba bean contains significant amounts of protein and energy, and its amino acids content is nearly comparable to SBM (Fru-Nji et al., 2007). So, it can be used as a substitute for conventional protein feedstuffs in broiler ration. Faba bean originated from the Middle-East in the prehistoric period (McVicar et al., 2013). Faba bean is now widespread in Europe, North Africa, Central Asia, China, South America, the USA, Canada and Australia. Faba bean production for food and feed was 4.5 million tonnes worldwide during year 2012 (Heuzé et al., 2021). Faba bean being incredible and crop complete food, unfortunately some part of world including India, it is still underutilized crop and not fully exploited so far, though it is seen as an agronomically viable alternative crop to cereal, with a potential of fixing free nitrogen upto 300 kg N ha. Faba bean is rich source of crude protein (28%) and starch (Crepon et al., 2010). Slow digestible starch present in faba bean

(Hejdysz et al., 2016) can contribute to the improvement of gut health and thereby possibly aid in reducing the need of antibiotics for therapeutic use (Regassa and Nyachoti, 2018). Feeding faba bean presents an opportunity to poultry farmers to reduce feed cost by replacing higher priced ingredients such as soybean meal. In general, there is little information on feeding pulses to poultry in comparison with other traditional feedstuffs (e.g., corn, soybean meal and fish meal), however, in Europe Faba beans have been suggested as an alternative protein source to soybean for livestock (Smith et al., 2013; Jezierny et al., 2010; Blair, 2007). Its use as a feed ingredient is limited due to its lower protein content in comparison with SBM. Additionally, Faba bean also contains anti-nutritional substances like tannins, trypsin inhibitors, lectins, vicine, convicine, and saponins (Jezierny et al., 2010). The presence of these anti-nutritional substances in poultry ration can reduce feed intake and consequently performance of birds (Crepon et al., 2010). However, lectin and trypsin inhibitor (Jezierny et al., 2010) as well as saponins (Makkar et al., 1997) are substantially lower in faba bean than soybean meal. Lowtannin faba bean cultivars showed greater apparent ileal digestibility of amino acids than tannin-containing cultivars and may therefore be a better source of dietary protein for broiler chickens (Woyengo and Nyachoti, 2012). Limited information is available on inclusion of faba bean in broiler rations. Therefore, this study was planned to evaluate the effect of feeding faba beans at different inclusion levels on growth performance, carcass traits and meat composition of broilers.

MATERIALS AND METHODS

One hundred twenty, one-day old, broiler chicks were obtained from a commercial hatchery. The chicks were individually weighed upon arrival and randomly distributed into three treatment groups having four replicates and each replicate had ten birds. A soybean-maize based basal ration was formulated (BIS, 2007) and fed to the chicks for a period of six weeks in three different growth phases i.e. pre starter (0-7 d), starter (8-21 d) and finisher (22-42 d). The first group was kept as a control (T1) and was given the basal diet while 25 and 50% of soybean meal protein was replaced with faba beans protein in the second (T2) and third (T3) treatment group, respectively. The birds were offered weighed amount of feed on paper sheets for first 3 days and thereafter, in automatic feeders up to 21 days of age. Afterwards, the feed was offered through hanging feeders maintained at appropriate heights. During the experiment, feed in the troughs was pushed down by hand 2 to 3 times per day so that birds could consume more feed. Broilers also had continuous access to clean water. The body weight and feed intake were recorded at weekly interval. A metabolism trial was conducted towards the end of the experiment, for which one bird from each replicate was randomly selected and transferred to metabolic cages. A preliminary period of three days was given for adaptation to the birds to new system of housing and management, followed by a collection period of three days. The birds were kept off feed and water withdrawn for 3 hours prior to their sacrifice. Immediately after recording their live weights, the birds were killed by severing the jugular vein and allowed to bleed completely following scientific method of slaughter. Their heads were removed at the atlanto-occipital joint and shank at hock joint. Broilers were then scalded, defeathered, and eviscerated. Dressed birds were than eviscerated by removing the crop, trachea and viscera as a whole.Separate weights of heart, liver and gizzard were also recorded after washing and bloating. Samples of breast and thigh muscles were taken from each of the slaughtered birds and stored in deep-freeze separately for further analysis. These samples were analyzed for moisture, protein and ether extract as per AOAC (2013). Feed ingredients used for ration formulations were also analysed for proximate nutrients (AOAC, 2013). The ingredient and nutrient composition of experimental diets during different phases of growth has been presented in Table 1-3.The data generated were analysed using suitable statistical tools (Snedecor and Cochran, 1994).

Table 1. Nutrient composition of feed ingredients

Feed	CP	EE	CF	Total ash
Maize	9.10	3.44	2.44	2.25
Soybean meal	45.2	1.16	4.93	6.47
Faba beans	29.4	1.22	9.78	3.84
Fish meal	44.8	6.5	1.79	29.6

Table 2. Ingredient composition (%) of experimental rations during different phases of growth

Feeds ingredient	Pre-starter Ration			Starter Ration			Finisher Ration		
	Treatment			Treatment			Treatment		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
Maize	53.4	48.0	42.5	54.8	48.0	42.5	59.2	55.0	51.0
Soybean	34.6	26.0	17.5	32.2	26.0	17.5	26.8	20.1	13.5
Faba beans	0	14.0	28.0	0	14.0	28.0	0	10.8	21.5
Fish meal	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
MM	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Veg. Oil	3.75	4.12	4.54	4.95	5.12	5.54	5.82	6.10	6.30
Feed additives (g/100kg)									
Spectromix	10	10	10	10	10	10	10	10	10
Spectro BE	20	20	20	20	20	20	20	20	20
Veldot	50	50	50	50	50	50	50	50	50
Antibiotic	30	30	30	30	30	30	30	30	30
Choline chloride	50	50	50	50	50	50	50	50	50
Lysine	40	40	40	-	-	-	-	-	-
DL-Methionine	150	150	150	150	150	150	140	140	140

Table 3. Nutrient composition(%) of experimental rations during different phases of growth

Attribute	Pre-starter Ration			Starter Ration			Finisher Ration		
	Treatment			Treatment			Treatment		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
CP	23.1	22.9	22.9	22.0	22.0	21.9	20.0	20.0	20.0
EE	6.29	6.24	6.31	7.11	7.08	7.10	7.21	7.20	7.16
CF	3.12	3.86	4.54	3.06	3.90	4.41	3.02	3.62	4.34
Total Ash	3.41	3.32	3.26	3.25	3.34	3.42	3.40	3.22	3.18
ME* (kcal/kg)	3002	3000	3003	3105	3102	3100	3200	3198	3199

*calculated value

RESULTS AND DISCUSSION

The body weight gain and feed intake amongst different dietary treatments did not vary significantly (Table 4).

Table 4. Feed intake of experimental birds under different dietary treatments

Treatment	Feed intake (g/b)			
	Prestarter	Starter	Finisher	0-42d
T1	168± 4.0	1133± 23.1	3243 ± 29.0	4540 ± 28.7
T2	164± 4.8	1121± 17.7	3288± 52.4	4566± 53.8
T3	164± 2.5	1094± 10.8	3282 ± 57.0	4541 ± 46.4

Similarly, in the study conducted by Nolte et al. (2020) revealed that no influence of faba bean feeding was observed on daily feed intake and feed efficiency. A non-significant effect was observed in the body weight gain in different growth phases (Table 5).

Table 5. Nutrient composition(%) of experimental rations during different phases of growth

Treatment	Body weight gain (g/b)				Feed conversion ratio			
	Pre-starter	Starter	Finisher	0-42 d	Pre-starter	Starter	Finisher	0-42 d
T1	119± 2.7	657± 9.5[a]	1628±20.8	2405 ±13.4	1.42± 0.01	1.72± 0.05	1.99± 0.01	1.89± 0.01
T2	116± 2.1	646± 10.9[a]	1659±26.6	2422± 16.6	1.41± 0.02	1.73± 0.03	1.98± 0.04	1.88± 0.03
T3	112± 5.5	619± 5.1[b]	1668±23.1	2400 ± 25.4	1.46± 0.03	1.76± 0.04	1.97± 0.02	1.89± 0.02

Mean values bearing different superscripts within column different significantly (P<0.5)

The previous studies conducted on broiler chickens by Laudadio et al. (2011), Usayran et al. (2014) and Kopmel et al. (2020) also found that neither faba bean cultivars nor inclusion levels had an effect on overall growth phase,feed intake, gain:feed intake. The results of earlier studies indicated that the content of faba bean in broiler starter and finisher diets should be limited to 150–200 g/kg due to the possible negative effect of tannins on feed intake and body weight gain of birds (Farrell et al., 1999). Bosco et al. (2013) reported lower growth rate and feed efficiency in broiler chickens fed diets containing 16% extruded faba bean. Ivarsson and Wall (2017) showed that broiler growth performance was maintained by feeding pelleted diets with 20% zero-tannin faba bean inclusion, but reduced ADFI and BW was observed at an inclusion level of 30%.

Feed conversion ratio during pre-starter, starter and finisher phases did not show any significant difference amongst treatments. Metabolizability of nutrients viz. gross energy and dry matter metabolizability did not vary significantly amongst different treatment groups (Table 6).

Table 6. Dry matter digestibility, nitrogen retention and gross energy metabolizability under different dietary treatme nts

Treatment	DM digestibility (%)	Nitrogen retention (%)	Gross energy metabolizability (%)
T1	65.8 ± 0.92	63.6 ± 1.08	64.1 ± 0.69
T2	66.1 ± 1.39	64.2 ± 0.72	63.9 ± 0.88
T3	65.6 ± 0.78	63.8 ± 0.82	63.7 ± 0.62

Tufarelli and Laudadio (2015) also found that body weight, feed intake and feed efficiency of the birds fed the soyabean meal-based diet were not different from those fed the dehulled-micronized faba bean meal diet. Likewise, Farrell et al. (1999) showed that feeding 200 g / kg faba bean to broilers grown to 21 days of age had similar growth response and feed efficiency as those fed control diet. Whereas, Koivunen et al. (2014) found that in grower period apparent total tract digestibility of ash, nitrogen retention, apparent ileal digestibility of organic matter, and the nitrogen-corrected apparent metabolizable energy increased, with increased FB inclusion @ 0, 80, 160, and 240 g/kg in the wheat- and SBM-based diets. In the present study, nitrogen retention (%) also did not differ significantly between the treatment groups. According to the study of Ayed (2011), digestibility coefficients and nitrogen retention were comparable between control and faba bean diets .

No statistical difference was observed amongst the dressed weight, eviscerated weight, drawn weight and giblets weight percentage of birds fed dietary treatments differing in the dietary protein source (Table 7).

Table 7. Dressed, eviscerated, drawn yield and weight of giblets under different dietary treatments

Treatment	Dressed wt (%)	Eviscerated wt.(%)	Drawn wt(%)	Giblets wt (%)	Abdominal fat (%)
T1	72.4 ± 0.42	60.7 ± 0.16	65.4 ± 0.27	4.62 ± 0.03	1.38 ± 0.01
T2	72.0 ± 0.24	60.5 ± 0.17	65.1 ± 0.56	4.66 ± 0.05	1.36 ± 0.02
T3	72.0 ± 0.29	60.9 ± 0.09	65.6 ± 0.18	4.67 ± 0.03	1.35 ± 0.01

Tufarelli and Laudadio (2015) also observed similar eviscerated carcass yield, breast,thigh plus drumstick and abdominal fat yields. Laudadio et al. (2011) on feeding dehulled and micronized zero-tannin faba bean as replacement for SBM at the 31% inclusion level did not find any affect on dressing percentage, breast or drumstick yield (Table 8).

Table 8. Composition (%) of breast and thigh muscles in experimental birds under different dietary treatments

Treatment	Breast muscles			Thigh muscles		
	Moisture	CP	Fat	Moisture	CP	Fat
T1	71.5 ± 1.18	20.7 ± 0.92	6.98 ± 0.26	69.8 ± 0.81	20.1 ± 0.23	7.90 ± 0.42
T2	71.3 ± 1.92	20.9 ± 0.87	6.91 ± 0.49	70.2 ± 0.65	19.7 ± 0.42	7.91 ± 0.34
T3	71.4 ± 1.66	20.6 ± 0.78	7.00 ± 0.18	70.2 ± 0.78	19.8 ± 0.19	7.82 ± 0.38

There were no differences in the growth rate, feed intake, and feed conversion rate, irrespective of FB form used (Shargh et al., 2010). Métayer et al. (2003) have shown similar performance in broiler chickens fed low-tannin FB seeds at 250 g/kg to those obtained with the control diet. The cost of feeding per chick and total production cost was highest in the treatment T1 and lowest in T3 (Table 9).

Table 9. Economics of broilers production under different dietary treatments

Attribute		Treatments		
		T1	T2	T3
Chick Cost (Rs)		42.0	42.0	42.0
Cost of feed				
Pre-starter Phase	Feed intake (g)	168	164	164
	Feed cost(Rs)	5.78	5.47	5.25
Starter Phase	Feed intake (g)	1133	1121	1094
	Feed cost(Rs)	40.4	38.7	36.2
Finisher Phase	Feed intake (g)	3243	3288	3282
	Feed cost(Rs)	117.4	113.3	108.9
Total feed cost (Rs)		163.7	157.5	150.4
Total prod. cost (Rs)		205.7	199.5	192.4
Live weight at 6 week of age (g)		2452	2468	2446
Gross return (Rs/bird)		294	296	293
Profit (Rs/bird)		88.55	96.65	101.13
Relative profit or loss/bird (Rs)			+8.10	+12.58

The highest profit per bird was obtained in case of T3 group suggested that 50% replacement with faba beans was more economical in rearing broiler birds.

CONCLUSION

It can be concluded that 50% replacement of soybean meal with faba beans was found to be economically better without affecting the growth performance in broiler chicken.

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