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Investigation of possible use of compound feeds with different level of high-protein sunflower meal in broiler chickens nutrition

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Abstract

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The aim of the present study was to evaluate the possibility for using compound feeds with various levels of high-protein sunflower oil and its effect on main productive traits of broiler chickens. The experiment was carried out in the Experimental Base of the Faculty of Agriculture with 4 groups Ross 308 broiler chickens (30 birds in group, one control and 3 experimental). On the basis of chemical analysis of feed ingredients, isocaloric and isoprotein rations were formulated according to hybrid's requirements. The protein component of control ration was based on soybean meal as the only source of dietary protein. The birds from experimental groups were fed as follows: group I - compound feed with 5, 8 and 12% pelleted high-protein sunflower oil during the starter, grower and finisher periods, respectively; group II – as the Ist group, but with higher level of high-protein sunflower oil -15, 20 and 22%, respectively; group III - high-protein sunflower oil was the only protein feed (32.95%, 28.55% and 26.50%), respectively. The replacement of soybean meal with pelleted high-protein sunflower oil in the isocaloric/isoprotein diet of broiler chickens resulted in reduction of body weight, most pronounced in experimental group III.

Keywords: broiler chickens; high-protein sunflower meal; live weight; feed conversion ratio

Introduction

Sunflower (*Helianthus annuus L.*) is an annual technical crop from the *Asteraceae* family and one of the 67 *Helianthis* species in the world (Flagella et al., 2002). It is resistant to draughts and grows better than soybean in drier areas (Khakwani et al., 2014). It is cultured mainly for its seeds, which serve for extraction of sunflower oil (Lühs & Friedt, 1994), but is also a valuable source for biofuel production (Kondili & Kaldellis, 2007). Sunflower meal (SFM) is a by-product from the industrial processing of sunflower seeds into oil. It contains a relatively large amount of crude protein (CP) from 30 to 50%, depending on the extent of dehulling of seeds (Bau et al., 1983; Dorrell & Vik, 1997; Pinheiro et al., (2002), and lysine is the primary limiting amino acid (Gassmann, 1983; González-Pérez & Vereijken, 2007). This by-product is an attractive cheap protein source in the rations of monogastric animals, but the high fibre content is a limiting factor for its inclusion in diets (NRC 1994), thus requiring its restricted use (Senkoylu & Dale, 2006; Raza et al., 2009; Biesiada-Drzazga et al., 2010). According to Lipiec (1991) SFM could be used in compound feeds of monogastric animals at amount of 50-150 g/kg compound feed. Carellos et al. (2005) and Tavernari et al. (2008) affirm that SFM should not exceed 16% and 20% in compound feeds for broilers and pigs, respectively. Other authors report amounts up to 200 g/kg in compound feeds form broilers with negative impact on growth performance (Valdivie et al., 1982; El-Sherif et al., 1995). The main reason for the inclusion of SFM in the rations for domestic poultry is its lower cost compared to that of SBM. The high crude fibre content reduces its nutritional value and increases the deficiency of amino acids lysine and threonine. These disadvantages of SFM could be overcome by addition of fat, synthetic amino acids (lysine, threonine etc.) and enzymes (phytase, beta-glucanase, xylanase, proteases etc.) (Kocher et al., 2000, Alagawany et al., 2017a) in compound feeds based on sunflower meal. Furthermore, the modern techniques for processing of seeds before oil extraction could reduce dramatically the fibre content of SFM, and thus, eliminate some of its negative effects.

All these facts allow increasing SFM level in compound feed from 200 to 350 g/kg without negative influence (Gabriel Raj at al., 1978; Zatari & Sell, 1990; Ibrahim & Zubeir, 1991; Musharaf, 1991; Vieira et al., 1992; Reddy, 1993). In our country, a technology allowing separation of round sunflower meal into two fractions (low - and high-cellulose) is developed and implemented. The low-cellulose fractions contains 43-46% protein (high-protein sunflower meal - HiSFM) and is a suitable ingredient for poultry and pig diets. Except for lysine deficiency, the nutritional value and functional properties of sunflower proteins are comparable to those of soybean and other leguminous proteins (González-Pérez et al., 2005). The advantage of SFM compared to other protein feeds is its relatively low cost, high level of sulfur-containing amino acids (methionine and cysteine) (Gassman, 1983; Ribarova, 1987; Canibe et al., 1999), absence of antinutritional factors (ANF) (González-Pérez & Vereijken, 2007), as well as the fact that varieties cultivated in the country are not genetically modified, which makes SFM useful and safe for organic food production (Cantamutto & Poverene, 2007).

Alagawany et al. (2017) have performed an randomized experiment with one-week-old Hubbard broiler chickens, divided in 4 groups with 60 birds with 4 levels of soybean meal replacement with high-protein sunflower meal (0, 25, 50 and 75% of SBM). Feed conversion rate and weight gain were considerably improved ($P < 0.01$) when SFM content increased gradually up to replace up to 50% of SBM. Moghaddam et al. (2012) included up to 21% SFM in the rations of broiler chickens without any negative effect on feed intake, weight gain and feed conversion rate. Chobanova (2019) demonstrated that the inclusion of non-pelleted HiSFM at 10%-15% during the three stages of development had a negative effect on LBW and FCR.

Further research is needed with regard to the more rational use of different types of sunflower meal as alternative of soybean meal for optimisation of compound feeds for different species and categories of birds. It should be aimed at evaluation of their potential use, optimum dietary levels and combination with other protein feeds.

The aim of the present study was to evaluate the possibility for using compound feeds with various levels of high-protein sunflower oil and its effect on main productive traits of broiler chickens.

Materials and Methods

The experiment was carried out in the Experimental Base of the Faculty of Agriculture, Trakia University with 120 Ross 308 broiler chickens divided in 4 groups (one control and 3 experimental), each with 6 replications of 5 chickens per subgroup. The experiment lasted 42 days. The birds were reared in a premise under 24-hour light regimen, controlled microclimate, and constant access to feed and water (*ad libitum*). Air temperature and humidity were maintained in line with routine requirements for rearing Ross 308 hybrid (Aviagen, 2009). The birds from all groups (control and experimental groups - I, II, III)) were fed isoenergetic and isoprotein rations formulated according to stages of development (starter, grower, finisher) as per hybrid requirements (Aviagen, 2009). The level of pelleted sunflower meal in compound feeds was variable.

Table 1. Experimental design of the study

Groups *	Fattening periods		
	Starter ** 1-10 days	Grower ** 11-28 days	Finisher ** 28-42 days
Control	0%	0%	0%
I - Group	5%	8%	12%
II - Group	15%	20%	22%
III - Group	32.95%	28.55%	26.50%

* Number of birds per group (n = 30)
** High-protein sunfl ower meal (%)

Statistical analyses were performed using STATISTICA v. 6.0 (2001). The accuracy of the measurements was assessed by mean and standard error of the mean (Mean ± SEM).

Results and Discussion

Data about live body weight (LBW), feed conversion rate (FCR) and daily weight gain (g/day) of broiler chickens are presented in Tables 2, 3 and 4.

Table. 2. Live body weight (LBW) of broiler chickens, (g)

Parameters	Groups				Significant
	Control - a	I Group - b	II Group - c	III Group - d	
	$\bar{x}$±SE	$\bar{x}$±SE	$\bar{x}$±SE	$\bar{x}$±SE	
LBW at 10 days of age, g	209.70±36.33	244.13±40.93	260.86±41.69	208.30±39.05	a:b *** a:c ***
LBW at 28 days of age, g	1220.33±320.77	1232.66±166.50	1294.33±151.38	1195.00±203.30	NS
LBW at 42 days of age, g	2405.93±450.00	2426.33±311.84	2429.33±323.61	2296.67±392.81	NS

n=30; *- p≤0.05; ***- p≤0.001; NS – Not Significant

The analysis of results for body weight of birds until the 10th day of life showed statistically significant difference (P<0.05) between control and groups that received 5% and 15% high-protein sunflower meal, whereas the LBW of chickens from experimental group III, fed only high-protein sunflower meal as protein source was almost identical to that of controls.

At the end of the grower period, experimental groups I and II exhibited a positive tendency for higher LBW by 1% and 6.1% respectively, as compared to the control group. At the end of this period, experimental group III demonstrated slower growth by 2.0%. It can be assumed that the differences may be related to the uneven distribution in the groups of individuals with different intensity of residual yolk absorption in the first days after hatching.

At the end of fattening period (42 days of age), the same trends were found out – higher live weight in experimental groups I and II by 0.9% and 1.0% (2426.33 g and 2429.33 g) vs control birds (2405.93 g). Again, the lowest LBW was observed in experimental group III – 2296.67 g (by 4.5% lower than control group).

Our results are comparable to those of Moghaddam et al. (2012), who tested sunflower meal levels of up to 21% in diets of broiler chickens and found no negative impact on their growth performance. The results obtained by Sangsoponjit et al. (2017) are similar.

The data for feed intake per 1 kg weight gain (Table 3) showed statistically significantly better (P<0.05) feed conversion during the first 10 days of life in birds from experimental group I compared to the control group. The feed intake in the second experimental group was also lower. The highest feed intake per 1 kg weight gain was found out in experimental group III - 1.37 kg per 1 kg weight gain.

Table 3. Feed conversion ratio (FCR), kg*kg^{-1} weight gain

Parameters	Groups				Significant
	Control - a	I Group - b	II Group - c	III Group - d	
	$\bar{x}$±SE	$\bar{x}$±SE	$\bar{x}$±SE	$\bar{x}$±SE	
FCR (kg/kg) days 1-10	1.26±0.15	1.01±0.13	0.99±0.20	1.37±0.20	a:b *
FCR (kg/kg) days 11-28	1.65±0.10	1.79±0.10	1.77±0.10	1.76±0.14	NS
FCR (kg/kg) days 29-42	1.92±0.15	1.85±0.10	1.91±0.21	2.02±0.21	NS
FCR (kg/kg) days 1-42	1.78±0.07	1.75±0.08	1.74±0.10	1.86±0.14	NS

During the grower and finisher periods, no considerable differences were established between experimental and control birds with respect to this trait. The results were in line with those about feed intake.

At the end of fattening (42 days of age), chickens from experimental groups I and II showed the same feed intake per 1 kg weight gain as controls –1.75 kg, 1.74 kg and 1.78 kg, respectively. Throughout the entire fattening period (1-42 day) the tendency towards negative effect of low-cellulose sunflower meal on feed conversion was the most prominent in experimental group III, that received HiSFM as the only source of proteins: 1.86 kg per 1 kg weight gain, associated with the lower body weight of broiler chickens from this group.

In a study with one-week-old broiler chickens fed 4 dietary levels of high-protein sunflower meal (0, 25, 50 and 75% of soybean meal), Alagawany et al. (2017) demonstrated that feed conversion rate and weight gain were significantly improved (P<0.01) when up to 50% of SBM were replaced with sunflower meal, confirming our results.

Daily gain (Table 4) during the starter period was characterised with statistically significantly highest feed intake in experimental groups I and II vs control group, whereas the chickens from experimental group III showed the same feed intake. At the end of the 42-day trial, no significant between-group differences in this parameter were identified.

Table 4. Daily gain g/day

Parameters	Groups				Significant
	Control - a	I Group - b	II Group - c	III Group - d	
	$\bar{x}$±SE	$\bar{x}$±SE	$\bar{x}$±SE	$\bar{x}$±SE	
Daily gain g/day 1-10 days	16.51±3.98	19.89±4.02	21.65±4.13	16.43±3.84	a:b *** a:c ***
Daily gain g/day 11-28 days	56.15±17.80	54.92±8.62	57.42±8.65	54.89±13.00	NS
Daily gain g/day 29-42 days	81.11±30.46	79.43±23.03	79.43±27.37	82.22±29.02	NS
Daily gain g/day 1-42 days	54.19±14.94	56.69±7.40	56.79±7.69	53.61±9.30	NS

n=30; *- p≤0.05; ***- p≤0.001; NS – Not Significant

Conclusions

Under the conditions of the present experiment, high-protein sunflower meal fed at levels 5-8-12% and 15-20-22% respectively during the starter-grower-finisher periods of broiler chickens fattened until the 42nd day of life, could successfully replace soybean meal. The weight of birds and feed conversion rate did not differ from those of control when isocaloric and isoprotein rations were fed.

The inclusion of high-protein sunflower meal as the only protein source in compound feeds of broiler chickens fattened until 42 days of age exhibited a tendency towards reduction of live body weight by 4.5% compared to control birds.

Feeding compounds feeds containing only high-protein sunflower meal tended to increase significantly the feed intake per 1 kg weight gain over the 42-day fattening period by 4.5% (1.86 kg/kg) vs control birds (1.78 kg/kg).

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