USE OF SUNFLOWER MEAL IN FEED MIXTURES FOR LAYING HENS

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Abstract

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The nutritional effects of using decorticated sunflower meal (44 % protein) as the protein supplement in the laying hens feed mixture on egg production were investigated. The trial was performed on 75 laying hens (line hybrid Issa brown) during the first 150 days of lay. The hens were divided in five groups: control, and four experimental groups (15 hens in each). The control group (C) was fed on a commercial complete feed mixture (corn-soybean meal and fish meal). The experimental feed mixtures contained sunflower meal (E_1), sunflower meal with correction of energy value by addition of sunflower oil (E_2), sunflower meal with correction of lysine (E_3) and sunflower meal with correction of energy value and lysine (E_4).

The highest egg production was found in groups E_3 and E_4. The lowest consumption of feed was established in group E_1, while the highest consumption was found in groups E_3 and C. The highest increase in body mass was achieved in group E_4. The deficiency of lysine in sunflower meal (E_1) contributed to lower body mass, feed consumption and egg mass. Feed mixtures containing sunflower meal as the protein supplement (all experimental groups) had no influence on the health or mortality of laying hens.

The results of this experiment indicate the possibility of a successfull use of sunflower meal in the nutrition of laying hens if sunflower meal is balanced with lysine and energy value.

Laying hens, sunflower meal, lysine, energy balance

Depending on local market, decorticated sunflower meal, obtained as a by-product in the sunflower seed oil production, might be a cheaper source of protein for poultry production than soybean meal and fish meal. However, low energy value and amino acid deficiency make the wider use of this feedstuff questionable.

Use of sunflower meal in feed mixtures in the production of laying hens has been the subject of numerous researches, but the results of this research differ greatly.

Ramirez et al. (1974) found that feed mixtures with 50 and 100 % sunflower meal, as the only source of protein, increased feed consumption and decreased the laying capacity of Leghorn hens. Suljoti et al. (1986) concluded that substitution of fish meal with a mixture of soy and sunflower meal (25, 50 and 100 %) reduces egg production. In research reported by Kashani and Carlson (1988), 19 and 38 % sunflower meal in the feed mixture decreased the body weight of 19-week-old pullets and delayed the onset of egg laying compared to control pullets fed on commercial feed mixture. Deaton et al. (1979) observed that substituting soybean meal with sunflower meal increased the mass of the muscular gizzard but had no effect on change in body mass, egg production, egg mass, shell-breaking strength or mortality. Šokarovski et al. (1988) found that substituting soybean meal with sunflower meal had no negative effects on laying capacity, although it increased feed consumption per egg and decreased egg mass. According to Vieira et al. (1992) substitution of soybean meal with sunflower meal (13-45 %) in feed mixtures had no effect on laying capacity, egg mass, body mass and mortality of Issa brown hens. Addition of lysine in feed mixture (0.07-0.22 %) had a beneficial effect only on body mass gain. Investigating the potential for protein phase-feeding of laying hens, Nathanael and Sell (1980) found

that daily intakes of 700 mg of lysine were required for optimum performance (egg production, egg mass). Michel and Sunde (1985) evaluated sunflower meal as a replacement for soybean meal in pullet developer diets. In their experiment two sunflower meals (28 and 34 % protein) with or without lysine completely replaced soybean meal. The addition of lysine to either of the two sunflower meals failed to improve growth and feed efficiency. When birds were housed in cages, the diets utilising 28 % protein meal produced pullets smaller and less efficient than did the other diets. This effect was not observed when the floor management system was used. Cuca et al. (1973) found that in formulating rations containing sunflower meal for hens, lysine is the most limiting amino acid. Therefore in laying hen diets containing at least 5 % sunflower meal, synthetic lysine must be used to provide the hen's daily requirements.

The purpose of this investigation was to evaluate the effect of sunflower meal as dietary protein source on laying hens (Issa brown) production performances (laying capacity, egg mass, feed consumption, body mass). Standard protein components (soybean and fish meal) were substituted by decorticated sunflower meal (44 % protein). Due to high portion of decorticated sunflower meal, necessary to obtain the desired protein level in the mixture, the lysine content and energy value of the experimental mixtures were lower than those of the commercial one. Therefore, the amino acid deficiency of sunflower meal was overcome by supplementing lysine (two experimental groups) and the energy deficiency was made up (two experimental groups) by addition of sunflower oil to the diet.

Materials and Methods

Animals and diets

A total of 75 laying hens of the line hybrid Issa brown were divided into five groups (control and four experimental groups with 15 hens in each). Twenty-two-week-old laying hens were kept in cages (one hen to a cage) during the first five months of lay (150 days). The daily light and microclimatic conditions (temperature, air humidity and concentration of NH_3 and CO_2) met the technological and zoohygienic requirements for this line throughout the investigation. The health state of the hens was checked daily. All hens were included in the regular vaccination programme for laying hens of the line hybrid Issa brown.

Table 1
Composition of the feed mixtures used in the trial

Compounds %	GROUPS				
	C	E_1	E_2	E_3	E_4
Maize	65.50	62.30	57.80	62.00	58.50
Soybean meal (44 % CP)	17.50	–	–	–	–
Fish meal	4.00	–	–	–	–
Sunflower meal (44 % CP)	–	24.00	24.80	24.00	24.00
Dehydrated Alfalfa meal	3.00	3.00	3.00	3.00	3.00
Limestone	7.00	7.00	7.00	7.00	7.00
Sunflower oil	0.70	0.70	4.40	0.70	4.20
Dicalcium phosphate	1.50	2.10	2.10	2.10	2.10
Salt	0.30	0.40	0.40	0.40	0.40
Premix*	0.50	0.50	0.50	0.50	0.50
Lysine	–	–	–	0.30	0.30
Total	100	100	100	100	100

*Premix contained:
Feed grade premix for hens provided the following per kilogram: vitamin A, 2,000.000 IU; vitamin D_3, 300,000 IU; vitamin E, 4,000 mg; vitamin K_3, 400 mg; B_1, 400 mg; B_2, 1,000 mg; B_6, 400 mg; B_{12} 2,400 mcg; vitamin C, 2,000 mg; niacin, 6,000 mg; D-pantothenic acid, 1,500 mg; choline chloride, 95,000 mg; folic acid, 80 mg; Fe, 6,000 mg; Cu, 600 mg; Mn, 16,000 mg; J, 150 mg; Zn, 10,000 mg; Co, 20 mg; Se, 20 mg; methionine, 40,000 mg; BHA

Feed and water were provided ad libitum. Composition of feed mixtures is given in Table 1. The control group (C) was fed a commercial complete feed mixture, whereas the mixtures for the experimental groups contained sunflower meal (44 % crude protein, 3.36 % crude fat, 8.42 % crude fibre, 7370 kJ ME/kg) as protein supplement. The experimental group E_1 received a feed mixture containing sunflower meal (without amino-acid and energy correction), E_2 sunflower meal with correction of energy value by addition of sunflower oil, E_3 sunflower meal with correction of amino-acid composition by addition of lysine, and E_4 sunflower meal with correction of both energy value and amino-acid composition.

Nutritive value and chemical composition of the control and experimental diets are given in Table 2.

Table 2
Nutritive values and chemical composition of the feed mixtures used in the trial

Analysis as fed*	GROUPS				
	C	E_1	E_2	E_3	E_4
Dry matter ($g.kg^{-1}$)	880.0	878.0	878.8	875.5	880.0
Crude protein ($g.kg^{-1}$)	160.5	160.5	160.4	163.2	160.4
Crude fat ($g.kg^{-1}$)	36.4	40.0	75.4	39.9	73.5
Crude fibre ($g.kg^{-1}$)	35.7	43.3	42.7	43.2	42.3
Ash ($g.kg^{-1}$)	113.2	121.1	121.2	121.1	120.6
Calcium ($g.kg^{-1}$)	33.8	34.7	34.7	34.7	34.7
Phosphorus ($g.kg^{-1}$)	6.4	6.5	6.4	6.5	6.4
Natrium ($g.kg^{-1}$)	1.7	1.7	1.7	1.7	1.7
Arginine ($g.kg^{-1}$)**	9.4	11.2	11.3	11.2	11.1
Methionine ($g.kg^{-1}$)**	3.5	3.7	3.8	3.7	3.7
Cystine ($g.kg^{-1}$)**	2.5	2.7	2.7	2.7	2.7
Methionine + Cystine ($g.kg^{-1}$)**	6.0	6.4	6.5	6.4	6.4
Lysine**	8.3	5.4	5.6	8.3	8.3
Tryptophan**	1.6	1.6	1.6	1.6	1.6
ME (MJ/kg)	11.45	10.63	11.44	10.64	11.45

* Official methods were used throughout (A.O.A.C., 1984)
** Values of amino acids were calculated

Measuring of production results

The effect of sunflower meal in feed mixtures on laying capacity, egg mass, feed consumption, body mass and health of hens were observed.

Eggs were collected and weighed daily, with laying capacity being recorded for each month.

The feed consumption of each group was measured monthly, with results averaged per group, per hen and per egg.

Body mass was checked on the first day of the trial and subsequently every 30 days (5 measurements during the course of the trial) by individual weighing of all hens.

All results were subjected to statistical analysis (Spatz 1997). The mean values of measured indices of each experimental group were compared with corresponding values of the control group; the significance of differences was assessed by Student's t-test ($P<0.05$).

Results

Feeding variables

Average final body mass and average body mass gain (Table 3) show that the best results in body mass gain (expressed in percentage as related to control group), were obtained in experimental group E_4 (114.81 %). Hens in experimental groups E_2 and E_3 had approximately the same body mass gain as the control group (102.88 and 103.7 %), while the lowest gain was recorded in experimental group E_1 (82.30 %). These values are shown in Fig. 1.

The highest average total feed consumption (Table 4) per group was recorded in experimental group E_3 (258.30 kg). Average total feed consumption in group E_4 (249.00 kg)

was similar to that of the control group (249.60 kg). The smallest average total feed consumption was observed in groups E_1 (238.80 kg) and E_2 (240.60 kg).

Feed consumption per egg in groups E_1 (118.16 g), E_4 (121.46 g) and E_2 (121.91 g) was smaller than in the control group (124.49 g), while the highest value was found in group E_3 (125.75 g).

Differences between control and experimental groups presented in Tables 3 and 4 were not statistically significant (P>0.05).

Table 3

Average body mass (g) and total body mass gain of laying hens during the trial

Day of trial	Stat. data	Groups				
		C (n = 15)	E_1 (n = 15)	E_2 (n = 15)	E_3 (n = 15)	E_4 (n = 15)
1	x	1844	1820	1800	1828	1804
	s	180.55	192.50	179.40	173.21	158.17
30	x	1865	1855	1876	1848	1858
	s	204.66	198.99	136.53	152.65	155.69
60	x	1953	1887	1927	1967	1930
	s	192.23	208.33	168.89	181.92	161.25
90	x	2027	1943	1933	2027	1997
	s	207.77	227.75	237.64	221.09	191.30
120	x	2117	1953	2042	2086	2023
	s	257.51	266.27	216.49	231.81	212.02
150	x	2087	2020	2050	2080	2083
	s	291.22	264.44	251.92	256.91	228.87
Average total body mass gain per hen (g)		243	200	250	252	279
Index %		100	82.30	102.88	103.70	114.81

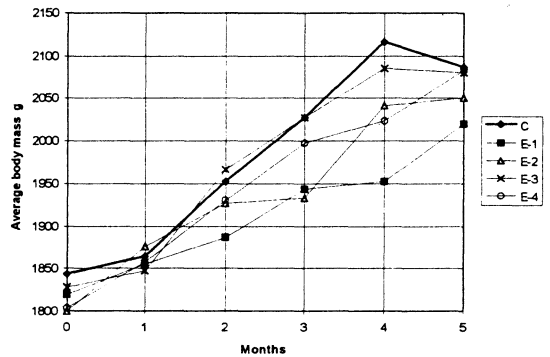

Fig. 1

Average body mass (g) of laying hens during the trial

Table 4
Average total feed consumption during the trial

Groups	Total feed consumption		Feed consumption	
	per group (kg)	per hen (kg)	per egg (g)	per egg mass (kg/kg)
C	249.60	16.64	124.49	2.02
E_1	238.80	15.92	118.16	1.92
E_2	240.60	16.04	121.91	1.90
E_3	258.30	17.22	125.75	1.97
E_4	249.00	16.60	121.46	1.89

Egg production

Average number of eggs per hen (Table 5) and average laying capacity (Table 6) during the trial were about the same in experimental groups E_3 (average number of eggs 136.93; laying capacity 91.74%) and E_4 (136.67; 91.48%). Control (C) and E_1 groups produced a similar number of eggs (133.67 and 134.73) and had a similar laying capacity (89.44% and 90.35 %), while the poorest values were found in group E_2 (131.57; 88.01%). The differences between control and experimental groups were statistically non-significant ($P>0.05$).

Average egg mass (Table 7) in experimental groups E_4 (64.36 g), E_2 (64.13 g) and E_3 (63.82 g) was significantly higher ($P<0.05$) than in the control group (61.65 g). Average egg mass in experimental group E_1 was about the same (61.43 g) as the control group.

Table 5
Average number of eggs during the trial/per hen

Day of trial	Stat. data	Groups				
		C (n = 15)	E_1 (n = 15)	E_2 (n = 15)	E_3 (n = 15)	E_4 (n = 15)
30	x	21.27±1.48	24.40±1.83	20.53±1.45	23.60±1.27	22.27±1.35
	s	5.71	7.08	5.60	4.90	5.24
60	x	28.60±0.67	28.73±0.50	28.60±0.51	28.67±0.50	29.20±0.30
	s	2.61	6.77	1.99	1.92	1.15
90	x	28.67±0.57	28.06±0.57	26.87±1.80	28.40±0.53	29.40±0.47
	s	2.19	2.19	6.96	2.06	1.80
120	x	30.13±0.70	28.07±1.36	30.14±0.70	30.33±0.59	30.20±0.61
	s	2.72	5.25	2.60	2.29	2.37
150	x	25.00±0.73	25.47±0.81	25.43±0.61	25.93±0.77	25.60±0.84
	s	2.83	3.14	2.28	2.99	3.25
Average	x	133.67	134.73	131.57	136.93	136.67
	s	7.06	14.02	12.34	8.51	8.66

Table 6
Average laying capacity (%) during the trial

Day of trial	Stat. data	Groups				
		C (n =15)	E_1 (n = 15)	E_2 (n = 15)	E_3 (n = 15)	E_4 (n = 15)
30	x	75.95	87.14	73.33	84.29	79.52
	s	20.41	25.29	20.03	17.46	18.74
60	x	92.25	92.69	92.26	92.47	94.19
	s	8.52	6.23	6.37	6.23	3.77
90	x	95.56	93.56	89.56	94.67	98.00
	s	7.25	7.23	23.17	6.84	6.03
120	x	97.20	90.54	97.24	97.84	97.42
	s	8.85	16.94	8.32	7.51	7.64
150	x	86.26	87.82	87.68	89.43	88.28
	s	9.73	10.79	7.90	10.26	11.18
Average	x	89.44	90.35	88.01	91.74	91.48

Table 7
Average egg mass mass (g) during the trial

Day of trial	Stat. data	Groups				
		C (n = 15)	E_1 (n = 15)	E_2 (n = 15)	E_3 (n = 15)	E_4 (n = 15)
30	x	56.32	57.41	59.60	58.76	58.80
	s	4.90	4.18	3.95	2.63	5.20
60	x	61.23	62.04	64.19	64.30	64.88
	s	4.61	3.80	3.98	4.30	3.87
90	x	63.17	62.53	64.87	64.66	65.53
	s	4.85	5.92	4.40	3.20	3.07
120	x	63.92	62.53	65.94	65.64	66.11
	s	5.20	4.04	3.69	2.94	4.77
150	x	63.60	62.66	66.04	65.76	66.47
	s	4.91	5.00	4.20	5.31	4.72
Average	x	61.65	61.43	64.13*	63.82*	64.36*
	s	30.77	24.63	21.22	20.53	26.37

* $P<0.05$

Average total egg production per hen (number of eggs, laying capacity, egg mass) and per group (number of eggs and total mass of eggs) during the 150 days of trial is presented in Table 8.

Discussion

Results related to average body mass and to average body mass gain (Table 3) show that the differences between control and experimental groups were statistically non-significant ($P>0.05$). The highest body mass gain was found in experimental group E_4 (index 114.81 %), fed on sunflower meal with the addition of lysine and energy. Hens fed on energy-balanced

Table 8
Average production of eggs during the trial (150 days)

		Average per hen		
Groups	n	Number of eggs	Laying capacity %	Weight of eggs g
C	15	133.67	89.44	61.65
E_1	15	134.73	90.35	61.33
E_2	15	131.57	88.01	64.13
E_3	15	136.93	91.74	63.82
E_4	15	136.67	91.48	64.39

sunflower meal (E_2 102.88 %), amino acid balanced sunflower meal (E_3 103.70 %) and the control group (100 %), demonstrated approximately the same body mass gain. Laying hens fed on sunflower meal without amino acid and energy correction (E_1) had a 17.7 % smaller body mass gain than the control group, and smaller than the other experimental groups.

Results related to body mass gain are in complete accordance with the published data (Aleandri and Olivetti 1978; Kwayjan et al. 1983; Karunajeewa et al. 1989). Similar results were obtained in a number of experiments carried out on chicks (Valdivie et al. 1976, 1977; Valdivie and Hernandez 1980; Ologhobo 1991; Šerman et al. 1996).

Average total feed consumption of the group fed on sunflower meal with added lysine and energy (249.00 kg) was about the same as in the control group (249.60 kg) - Table 4. Experimental groups fed on sunflower meal without any correction (E_1) or with only energy correction (E_2) had an average feed consumption of 4.3 % and 3.6 % less than the control group. Hens fed on sunflower meal with the addition of lysine (E_3) consumed 3.5 % more feed than the control group. Feed consumption per egg was highest in this group also. The lowest feed consumption was recorded in the group of hens fed on sunflower meal without corrections (E_1). Similar results related to feed consumption was found by Karunajeewa et al. (1987) with White Leghorn hens.

All groups of hens had a similar average number of eggs (or average laying capacity), although the differences in average egg mass were statistically significant ($P<0.05$). Laying hens fed on sunflower meal without correction of energy and with no addition of lysine (E_1), as well as the control group, had similar average egg mass (61. 43 and 61.65 g), but differences between all other experimental groups and the control group were statistically non-significant ($P>0.05$). These results are in accordance with similar trials made by other authors (Srichai and Balnave 1981; Karunajeewa et al. 1989). However, results of research reported by Rose et al. (1972), show that the use of 50 and 100 % sunflower meal in feed mixtures significantly decreased laying capacity and egg mass. Conversely, Mirza and Sial (1993) found that the use of sunflower meal in feed mixtures for laying hens had no significant effect on production results (laying capacity, egg mass, shell quality, mortality).

During the whole duration of the experiment no sickness or death was diagnosed.

Využití slunečnicové moučky v krmných směsích pro nosnice

Bylo sledováno nutriční využití proteinového přídavku slunečnicových pokrutin (44 % bílkovin) ve krmné směsi pro nosnice na produkci vajec. K pokusu bylo použito 75 nosnic (hybridní linie Issa brown) v průběhu prvých 150 dnů snůšky. Nosnice byly rozděleny do pěti skupin: kontrolní a 4 pokusných po 15 kusech. Kontrolní skupina byla krmena

kompletní komerční směsí s obsahem kukuřice, soji a rybí moučky. Pokusné krmení směsi obsahovaly slunečnicové pokrutiny (moučku) s korekcí obsahu energie přidáním slunečnicového oleje (E_2), slunečnicové moučky s lyzinem (E_3) a slunečnicové moučky s úpravou obsahu energie i lyzinu.

Nejvyšší produkce vajec byla ve slupinách E_3 a E_4. Nejnižšší konzum krmiva byl zjištěn ve skupině E_1, zatímco nejvyšší byl nalezen ve skupinách E_3 a C. Největší přírůstky hmotnosti byly ve skupině E_4. Deficience lyzinu ve slunečnicové moučce (E_1) se projevila nižší hmotností, konzumem krmiva a hmotností vajec. Zkrmování směsi s obsahem kukuřičné moučky jako přídavkem bílkovin nemhlo vliv na zdravotní stav ani mortalitu nosnic. Výsledky pokusu ukazují, že kukuřičnou moučku lze úspěšně využít ve výživě nosnic, je-li v krmné směsi vyvážen obsah energie a lyzinu.

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