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The Possibilities of Using High Oil-Sunflower Meal and Enzyme Mixture in Layer Diets

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Abstract: Two experiments were conducted using commercial layers to test the nutritive value of high oil-sunflower meal (HO-SFM) and the efficiency of an enzyme preparation with xylanase, $-glucanase and pectinase activities (Grindazym GP 5000, Danisco Ingredients, Denmark). In the 1st trial, 256 White Hy-Line layers of 37 wk of age were placed in California type cages. Dietary treatments consisted of 0%, 15%, 20% FE-SFM and 20% FE-SFM+Grindazym GP 5000 (1 g/kg feed) at the expense of full fat soybean and soybean meal. Diets were randomly assigned to each of 4 replicates (4 consecutive cages of 4 layers in each) so as to give each diet to 64 birds according to a completely randomized design. Diets and water were provided to layers *ad libitum.* Egg production (EP) was recorded daily, and egg weight (EW) and feed intake (FI) on a biweekly base. The second trial was carried out on a commercial layer farm and dietary treatments the same as in the 1st trial were fed to 1477, 1477, 1458 and 1482 layers respectively. Each of the dietary treatments was allocated to 3 replicates comprised of the three tiers of a side of an apartment type cage. Egg production was recorded daily and EW on a biweekly base while the FI could be determined only at the end of the experiment. Both the trials lasted for 8 wk. In the 1st trial EP was 83.8, 77.7, 77.4, and 81.7% and FCR values was 2.181, 2.233, 2.242 and 2.156, respectively. There were no significant differences (P>0.05) among the treatments. In the 2nd trial all levels of FE-SFM including the enzyme added group significantly (P<0.0001) decreased EP (97.12, 95.72, 95.57, and 95.39% respectively). There was no significant difference in EW (60.4, 60.3, 60.8 and 61.1 Feed intake respectively was 113, 113.2, 114.2, and 112.3 g/day. However, Grindazym GP 5000 supplementation significantly improved feed efficiency (P<0.01) compared to non-enzyme added groups (1.930, 1.962, 1.966 and 1.927), suggesting improvement in nutrient utilization in HO-SFM based diets. The results of these experiments suggest that HO-SFM could be included at 20% to replace full fat soybean. In addition, Grindazym GP 5000 improved feed efficiency and lowered feed cost per kg of egg mass in HO-SFM based commercial layer diets.

Key words: Sunflower meal, layers, enzyme

Introduction

Soybean meal has been the main protein source in poultry rations since its nutritional value has been realized worldwide. However, most of the European and Asian countries import this strategic feed ingredient. Therefore cottonseed, rapeseed, sunflower and groundnut meals have been suggested as an alternative vegetable protein sources for poultry (Ravindran and Blair, 1992).

Sunflower meal if properly processed has valuable protein with similar amino acid availability to that in SBM (Green and Kiener, 1989; Villamidae and San Juan, 1998). Nevertheless, conflicting data were reported regarding the nutritive value of SFM both in broilers (Roth-Maier and Kirchgessner, 1995; Arija *et al*., 1998) and layers (Rose *et al*., 1972; Michel and Sunde, 1985). These controversial results reported by several authors regarding the nutritive value of sunflower meal were attributed to the differences in variety, method of processing, age of birds and feed formulation techniques employed in these studies (Senkoylu and Dale, 1999).

The only apparent disadvantages of this feedstuff are that it contains relatively high level of fiber and low level of lysine. Fiber of SFM has been shown to mainly consist of non-starch polysaccharides (NSP) with cellulose, xylose, pectin and lignin contents (Carre and Brillouet, 1986). Most of these compounds are not available for poultry since they lack the related enzymes in their gastrointestinal tract.

Commercial enzymes have been extensively used since the last decade in this field to increase the utilization of these compounds. However, not many research studies have been done about the effect of enzymes on SFM utilization in layers. One of them is that of Francesh *et al*. (1995) who found improvement in the percentage of heavier eggs and the quality of excreta in layers by supplementation of an enzyme preparation. Regarding the lack of energy in SFM, Senkoylu *et al*. (1997) suggested to use a high oil-sunflower meal (HO-SFM), and some others suggested to use fats or oils with SFM (Zatari and Sell, 1990; Nir, 1998).

Therefore the aim of this study was to evaluate the nutritional value of high oil-sunflower meal and the

Table 1: Chemical composition of the layer diets (1st Experiment, 37-44 weeks)

	Test Diets			
Ingredients	0%	15%	20%	20%+Enz
HO-SFM	0	15	20	20
Grindazym GP 5000	0	0	0	0.1
Full fat soybean	15.5	7.11	3.72	3.72
SBM (44%)	10	5	5	5
Wheat	30	30	20	20
Barley	10	10	10	10
Maize	20.91	18.77	27.43	27.32
Meat and Bone Meal	1.01	3.0	3	3
Dicalciumphosphate	2.28	0.88	0.41	0.41
Limestone	9.68	9.69	10	10
Salt	0.31	0.30	0.20	0.20
Vit.and Min. Premix[A]	0.25	0.25	0.25	0.25
DL-Methionine	0.06	-	-	-
Total	100	100	100	100
Calculated AnalysisME, MJ/kg	11.50	11.50	11.50	11.50
C.Protein, %	17	17	17	17
Lysine, %	0.88	0.76	0.73	0.73
Met.+Cys.,%	0.62	0.62	0.64	0.64
Linoleic acid, %	1.90	2.59	2.94	2.94
Ca, %	4.0	4.0	4.0	4.0
P (available)	0.65	0.60	0.52	0.52

[A]provided per kg of diet: vitamin A, 8000 IU; vitamin D_3, 2500 IU; vitamin E, 30 mg; vitamin K_3, 2.5 mg; vitamin B_1, 2 mg; vitamin B_2, 5 mg; vitamin B_6, 2 mg; vitamin B_{12}, 0.01 mg; niacin, 30 mg; calcium-D-pantothenate, 8 mg; folic acid, 0.5 mg; D-biotin, 0.045 mg; choline chloride, 800 mg; vitamin C, 50 mg; Mn, 70 mg; Fe, 35 mg; Zn, 70 mg; Cu, 8 mg; I, 1 mg; Co, 0.2 mg; Se, 0.25 mg

efficacy of an enzyme preparation Grindazym GP 5000, activities in layers.

Materials and Methods

High-Oil Sunflower Meal: it is a by-product of sunflower extraction through screw pressing followed by expanding process. It consists 32% crude protein, 12 % crude fiber and 18% oil.

Grindazym GP 5000 (Danisco Ingredients, Denmark) is an enzyme preparation with 12,000 units/g xylanase (EC 3.2.1.8), 5,000 units/g $-glucanase (EC 3.2.1.6) and 10 units/g pectinase (EC 3.2.1.15) activities.

The 1st Experiment: This experiment was carried out in the layers experimental units of the Department of Animal Science of Trakya University at Tekirdag, Turkey. In this trial 256 Hy-Line white 37 wk of age layers were used. 4 layers were placed in each of California type two tier cages. The experiment was designed according to completely randomized design. 4 replicates of 16 hens (4 consecutive cage units of 4 layers in each) received one of 4 experimental diets. Three of the diets included HO-SFM at 0, 15, and 20% levels whereas the last experimental diet contained 20% FE-SFM + Grindazym GP 5000 at 1g/kg level. HO-SFM was added into experimental diets at the expense of full fat soybean and SBM (Table 1). Diets were randomly assigned to each of 4 replicates as to give each diet to 64 layers (4x4x4=64). Layers were fed the experimental diets *ad libitum*. They freely accessed to nipple drinkers. Daily egg production was recorded for each of experimental unit. Feed intake and egg weight were determined biweekly. The experiment lasted for 8 weeks.

The 2nd Experiment (Field Trial): The second trial was conducted to test the effects of HO-SFM and Grindazym GP 5000 upon layer performance basically under commercial conditions in a relatively large capacity (100 000) of egg production farm in Gonen-Balikesir, Turkey. In this experiment 5894 Lohmann LSL white commercial layers were used.

Birds were maintained in an apartment type three tier cages in which 5 layers were placed. The dietary treatments were consisted as in the 1st experiment (0%, 15, 20 and 20%+Enzyme). Diets were formulated by least cost formulation using the farm feed ingredient as usual (Table 2). Test feeds were fed to 1477, 1477, 1458 and 1482 number of layers according to the treatment groups respectively. Each treatment has 3 replications (each of three tier of one side of an apartment type battery cage), since the feeder system is automatically and simultaneously filled the troughs at all of the three tiers. For that reason, feed intake could not be determined according to the replications but only to the

Table 2: Diet compositions of the field experiment (2nd Experiment, 25-33)

	Test Diets			
Ingredients	0%	15%	20%	20%+Enz
HO-SFM	0	150	200	200
Grindazym GP 5000	0.0	0	0	1
Full-fat soybean	146.50	19.85	0	0
SBM (44%)	50	50	85.76	86.35
Maize	350.01	350	350	349
Barley	124.66	39.09	0	0
Wheat Middlings	110	110	78.24	75.86
Meat-Bone meal	46.76	48.81	0	0
Rice	43.82	105.22	141.90	142.68
Poultry Rend. Meal	35	35	30	30
Limestone	82.05	80.92	87	86.99
Others	11.20	11.11	27.10	28.12
Total	1000	1000	1000	1000
Calculated AnalysisME, MJ/kg	11.30	11.30	11.30	11.30
C.Protein, %	17	17	17	17
C.Fiber, %	3.77	4.30	4.45	4.44
Ether extract, %	6.42	6.78	6.44	6.44
Lysine, %	0.830	0.830	0.830	0.830
Methionine, %	0.414	0.406	0.404	0.405
Met.+ Cys., %	0.710	0.710	0.710	0.710
Ca, %	3.80	3.80	3.81	3.81
P (available), %	0.40	0.40	0.40	0.40
Na, %	0.150	0.150	0.150	0.150
Cl, %	0.150	0.150	0.150	0.150
C18:2, %	2.394	2.744	2.998	2.994
Feed Cost, USD/ton	221	212	211	215

treatments at the end of the experiment.

Nevertheless, egg production was recorded daily in accordance to the experimental groups and their replications. Egg weights were determined biweekly by randomly weighing 15 trays (450 eggs) from each of the replications. This experiment lasted for 8 weeks, from 25 to 33 weeks of age.

In both of the trials, collected data concerning egg production, egg weight, and feed efficiency were subjected to analysis of variance. In this case, egg mass was related to feed intake to estimate the feed conversion ratio. Egg production costs based on the feed ingredient prices were also analyzed to figure out the economical efficiency of the HO-SFM and supplementation of Grindazym GP 5000.

Results and Discussion

The results of the 1st experiment were shown in Table 3. No significant differences were observed among the dietary treatments in terms of egg production, feed intake and egg weight. Egg production tended to decrease as the level of HO-SFM was increased. However in the group fed with 20%+Enzyme, egg production slightly increased. Neither the egg weight nor the egg mass were affected by the HO-SFM level or the enzyme supplementation. Nevertheless, feed intake increased as the HO-SFM is increased in the diets.

Enzyme addition slightly increased feed intake compared to non-enzyme added counterpart group (20% HO-SFM). There were no significant differences among the dietary treatments with respect to feed efficiency. This value tended to decrease as the HO-SFM was increased, but apparently increased in enzyme supplemented group. If the last 2 treatments (20% vs. 20%+E) are to be compared, in terms of all performance parameters, it can be seen that with enzyme supplementation egg production, egg weight, egg mass and feed efficiency (P values respectively are 0.1365, 0.7041, 0.3672, 0.0857, and 0.1753) are all consistently increased. However, when all the treatments were considered, the differences among the treatments were not significant ($P > .05$).

The results of the 2nd experiment (Table 4) demonstrated that in the control group in which HO-SFM were not included, the egg production was significantly ($P < .0001$) higher than the other groups. The mean egg production of the control group for 8 weeks period was 97.05% while it was 95.74, 95.56, and 95.47% for other groups, respectively. Depressing effect on egg production might have been caused by non-balanced amino acid content

Table 3: Effects of HO-SFM and Grindazym GP 5000 upon layer performance (37-44 weeks)

	Dietary Treatments				
Performance	0%	15%	20%	20%+Enz	P-value
Egg production, g/hen/d	51.9	48.6	47.6	50.5	0.1702
Egg weight, g	61.9	62.6	61.5	61.8	0.4112
Feed Intake, g/hen/d	113.2	108.5	106.7	108.9	0.0635
FCR (g feed/g egg)	2.181	2.233	2.242	2.156	0.7017

Means in the same row did not differ significantly (P>0.05)

Table 4: Effects of HO-SFM and Grindazym GP 5000 on layer performance under field conditions (25-33 weeks)

Dietary treatments	0%	15%	20%	20%+Enz	
Numbers of layers	1477	1477	1458	1482	
Performance					P-value
Egg production (EP), g/hen/d	58.47	57.62	57.99	58.23	0.1985
Egg weight, g	60.4	60.3	60.8	61.1	0.2260
Feed Intake, g/hen/d	113.0a	113.2a	114.2b	112.3a	-
FCR (g feed/g egg)	1.930a	1.962b	1.966b	1.927a	0.0049
Feed cost, USD/ton	221	212	211	215	
Feed cost/EP (USD/ton)	426.5	415.9	414.8	414.3	

of the control group and others made in feed formulation. Feed intake increased from 113.0 g/day to 114.2 g/day as the HO-SFM was increased in the diet. However, in the last group fed with 20%+Enzyme, feed intake dropped by approximately 2 g/day compared to the group without enzyme (20%). The results suggested that feed efficiency decreased as the level of HO-SFM increased, however, enzyme supplementation significantly (P< .01) increased feed efficiency compared to non–enzyme added 15% and 20% groups and produced even lower FCR value than in the control group (FCR, 1.927). This improvement might be due to the increased nutrient availability by Grindazym GP 5000 supplementation.

Regarding to the usage of SFM in layer diets inconsistent results have been published. For example Rose *et al*. (1972) reported that 100% replacement of SBM by SFM resulted in decreased egg production. Lysine supplementation did help improve the performance. On the other hand Michel and Sunde (1985) suggested that with or without lysine or lysine + methionine supplementation SBM could be 100% replaced by SFM. More recently, Vieira *et al*. (1992) using SFM at inclusion levels from 14 to 41%, suggested that SFM could be alternative to SBM. Concerning the effects of enzymes Francesh *et al*. (1995) concluded that, supplementation of Grindazym GP 5000 to barley-SFM based diet reduced the percentage of dirty eggs, and increased egg weight by more than 1 g.

Consequently, the results of this field study suggest that using HO-SFM in layer diets could easily replace full fat soybean and SBM, practically from an economical point of view. In addition, supplementation of Grindazym GP 5000 to sunflower meal based diet, resulted in significant improvement in feed efficiency and lowered feed cost. Economical analysis of this data indicated that HO-SFM is more cost effective than SBM or full fat soybean under the condition of this study. The addition of Grindazym GP 5000 could have a further decrease in the egg production cost.

Conclusion: Further studies are required to evaluate the NSP content of HO-SFM and their effects on the nutrient utilization in chickens. However, based on the results of these two experiments the following conclusions can be proposed:

HO-SFM could practically replace soybean meal or full fat soybean and could successfully be included at 20% in laying hen rations.

Grindazym GP 5000 could significantly improve feed efficiency and lowered feed cost in sunflower meal based commercial layer rations.

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