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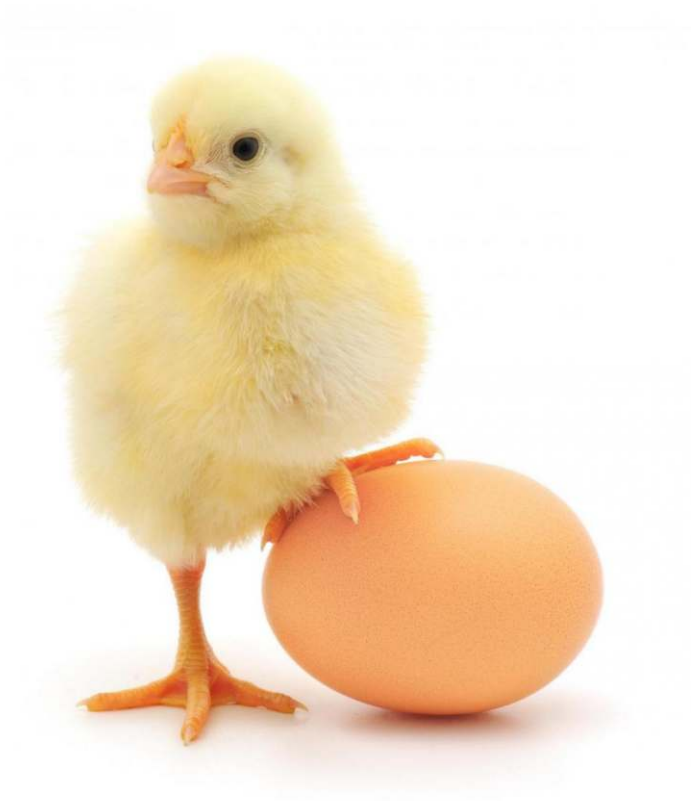

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Use of Samh Seeds (*Mesembryanthemum forsskalei* Hochst) in the Laying Hen Diets

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Abstract: Samh plant is grown wildly in the northern part of Saudi Arabia. This study was conducted to determine the chemical analysis and the True Metabolizable energy of the Samh seeds and the possibilities of using this feed ingredient in the diets of layers. The chemical analysis of the Samh showed that it contained 22.16% protein, 3.09% fat, 10.62% fiber, 6.93% moisture, 0.05% Ca, 0.17% P and 2.49% Ash. The amino acid profile showed higher levels of non-essential amino acids and lower essential amino acids than SBM. The AME of the seeds, calculated from the TME, was found to be 2976 Kcal/Kg. A trial was conducted for 24 weeks using 0, 5, 10, 20 and 30% Samh seeds in layer diets, showed that including up to 10% Samh seeds in the layer diet improved egg weight, production rate and egg mass of the layer. However, feed consumption and conversion were deteriorated as level of Samh seeds increased beyond 5% level. Birds, fed Samh seeds produced lighter color yolk than the control birds. Yolk index was better in the control birds comparing to those fed the Samh seeds. It was concluded that until more research is conducted in this area, no recommendations can be drawn in favor of the Samh seeds, however, there was some indications that Samh seeds can replace part of corn, but in this case the diet should be fortified with yolk coloring agent.

Key words: Samh seeds, egg production, layers, poultry

Introduction

Yellow corn and soybean Meal (SBM) are not grown in Saudi Arabia, due to the unfavorable conditions. Several ingredients have been tested in this region such as date (Najib *et al*., 1994) and Salicornia Bigelovii Torr (Alsobayel *et al*., 2002; Al-Batshan *et al*., 2001; Al-Batshan *et al*., 2000), however, none was excellently performed or feasible to use.

A new ingredient has been tested lately in Saudi Arabia, *Mesembryanthemum forsskalei* Hochst seeds, also known as, Samh. Seeds of this plant are palatable and high in protein (22%) (Aljassir *et al*., 1995) and it's ME is close to that of the yellow corn (3480 kcal/kg) (Bhattacharya, 1988) which makes them the most appropriate feeds for poultry.

Flour of the seeds was used in making cookies as a partial replacement to the wheat (30%) (Mustafa *et al*., 1995), also mixed with minced meat as a substitute for SBM (3,5%) to make beef patties (Elgasim and Al-Wesali, 2000). The microbial load of Samh seeds was determined by Al-jassir *et al*. (1995) who found that bacterial count and total spore formers of seeds were $19X10^7$ and $5\ X10^4$ cfu/g, respectively, thus enterobacteropeae, B cereus and yeast and molds were $5X10^2$, $1X10^2$ and $7\ X\ 10^2$, respectively. They contributed the presence of these microorganisms to the unsatisfactory handling during drying and storage. While the absence of Staphylococcus aureus, the low number of Enterobacteriaceae and low number of the confirmed B. cereus indicated to the safety of these seeds for the health. They further reported.

This study was conducted to determine the True Metabolizable Energy (TME) of Samh seeds and their proximate analysis including the Amino Acids profile. Also to assess the possibility of using Samh seeds, as a partial replacement of corn and/or SBM in the rations of layers

Materials and Methods

Chemical Analysis of the seeds: Samples of ground Samh seeds were subjected to proximate analysis according to the method of American Association of Cereal Chemists (AACC, 1994). Moisture content was determined according to (AACC, 44-16) using (Memmert D-91126 Schwabach FRG drying oven, Germany), Ash content was determined according to (AACC, 08-01) using (gallenkamp, FR612 muffle furnace, England). Crude Protein (CP) digestion was done according to (AACC, 46-10) using Gerhadt Bonn Kieldatherm Karl Kolb (D-6072) of West Germany while Ammonia was distilled using Buchi 321 of Germany. Ether extract (EE) was determined according to (AACC, 30-25) using Gold Fish Lab Conco Corporation, Kansas City Missouri and Crude Fiber (CF) was determined according to (AACC, 32-10) using Fibertec system 1021 cold extractor. Calcium was determined using Perkin-Elmer 2380

Atomic Absorption Spectrophotometer while phosphorus level in Samh was determined using Spectronic 20 D of USA. The amino acid analysis was conducted using HPLC system for amino acid Analysis Model 1993 from Shimadzu, Japan.

The data, obtained from the analysis of Samh was compared with that of the literature and with corn and Soybean meal as reported in NRC, 1994 to validate the results of this experiment. These results are shown in Table 2.

True Metabolizable Energy (TME) determination: TME of the seeds was estimated according to the method developed by Sibbald (1976).

Four White Leghorn Cockerels were housed individually in cages and starved for 24 hours before being forcibly fed 30 gm of Samh seeds. Two cocks were left un-fed to be considered as control.

Forced feeding was accomplished using a stainless-steel funnel with a 35-cm long stem and 1.3 cm outer diameter and plunger fitted in 0.9-cm outer diameter.

The funnel containing Samh seeds was pushed down the esophagus of the cock till the end of the crop was reached. The plunger then pushed the feed in question down the crop of each roaster. Sibbald (1980) suggested that in adult White Leghorn cockerels, the optimum input of test material as pellet was 30-40 or 25-30 gm as feed. The birds fed Samh and that kept unfed (control) were placed in the cages and excreta voided were collected quantitatively after 48 hours (Schang and Hamilton, 1982). The collected feces was then dried at 54°C for 24 hrs in an oven, weighed and left outside the oven to equilibrate with atmospheric moisture.

Ground samples and excreta collected were assayed for gross energy by using a diabetic oxygen bomb calorimeter (AOAC, 1995).

True Metabolizable energy of Samh seeds was estimated using the following equation as described in "Sibbald, 1976":

TME (Kcal/g air dry) = $(GE_f * X) – (Y_{ef} - Y_{ec})/X$

Where:

GE_f the gross energy of the feeding stuff (Kcal/g),

Y_{ef} the energy voided as excreta by the fed bird,

Y_{ec} the energy voided as excreta by the unfed bird and X is the weight of feedingstuff fed.

Statistical Analysis: Summarized data for all response variables were subjected to combined analysis in Completely Randomized Design where Level of Samh (TRT) was considered the main effect on traits while period of the year (P) was the secondary effect. Replication within period P(R) was the first error term carrying 8 degrees of freedom (Steel and Toori, 1980). The mathematical model of this arrangement is presented in the next paragraph. General Linear Models procedure in the PC-SAS® (SAS Institute, 1988) was used to estimate the variations among the means. Variable means showing significant differences in the analysis of variance table were compared using the Duncan Multiple Range Test (Steel and Toori, 1980).

The mathematical model used to estimate the effect of treatment levels and period on traits was as follows:

$Y_{ijk} = \mu + T_i + P_j + P(R)_{jk} + T_i{*}P_j + e_{ijk}$

Where:

Y_{ijk} the effect of $_i$th treatment and $_j$th period on K_{th} pen

μ the overall mean

T_i the effect of treatment, i = 1......5

P_j the effect of period, j = 1 2

$P(R)_{jk}$ the random effect of period within replication, considered to be error I

$T_i{*}P_j$ the effect of interaction between treatments and periods

e_{ijk} the error II.

Procedure during the starting and growing period: During the starting-growing period, the chicken house (windows on sides) was prepared by placing circular metal guard (50 cm height) around hanged gas type hoover about one meter from it's age to prevent floor draft and to keep chicks from staying too far from the source of heat. Wood shavings were used as a litter inside the guard and inside growing pens as well. Temperature was maintained according to the chick's need at that time of the year.

In the laying house, the cages were prepared to contain the pullets. Waterers were checked and the pads and fans were cleaned and tested so was the lighting timer.

Two hundred fifty day-old White Leghorn Hisex chicks were brought from a local hatchery. Upon arrival, they were weighed by groups and fed commercial starter diets, containing 21% crude protein and 2800 Kcal/Kg metabolizable energy (ME). The chicks were kept on the starter diet till reached the breeder's target weight at week 10 when they were switched to the commercial grower diets, containing 16% protein and 2780 Kcal/kg ME. Leeson and Summers (2001) recommended that pullets should not be moved to grower diets till reached breeder target weight. During the first ten weeks, the chicks were vaccinated and debeaked.

Chicks were exposed to continuous lighting during the first week of their life then decreased by one hour weekly till reached 9 hours, at which time it was held constant.

Procedure during the laying period: One hundred ready-to-lay pullets were moved to layer cages on

Table 1: The nutritional composition of the dietary treatments (0, 5, 10, 20 and 30% Samh seeds)

Ingredients	%, Samh seeds				
	0	5	10	20	30
Yellow corn	60.00	53.00	50.00	45.00	40.00
SBM, 44%	24.0	22.0	20.0	15.0	10.0
Wheat Bran	0.00	4.57	4.59	4.02	3.83
Fish Meal, 72%	3.00	2.50	2.50	3.15	3.70
Limestone	8.28	7.70	7.70	7.70	7.70
MV Mix[1]	0.20	0.20	0.20	0.20	0.20
DL Methionine	0.40	0.32	0.32	0.32	0.35
Dical Phosphate	0.95	0.78	0.76	0.78	0.78
L-Lysine	0.10	0.00	0.00	0.00	0.00
Choline Cl	0.10	0.00	0.00	0.14	0.04
Salt	0.40	0.40	0.40	0.40	0.40
Corn Oil	1.49	2.43	2.43	2.19	1.92
Anti Oxidant	0.08	0.10	0.10	0.10	0.08
Samh seeds	0.00	5.00	10.00	20.00	30.00
Deh. Alfalfa	1.00	1.00	1.00	1.00	1.00
Total	100	100	100	100	100
Calculated Composition					
Crude protein, %	18.00	18.00	18.00	18.00	18.00
ME, kcal/kg[2]	2800	2800	2800	2800	2800
Calcium, %	3.53	3.26	3.25	3.25	3.25
Av. Phosphorus,%	0.34	0.30	0.28	0.28	0.27
Riboflavin, mg/kg	1.71	1.75	1.66	1.50	1.35
Niacin, mg/kg	24.59	30.37	29.10	26.00	23.50
Pantothenic Acid, mg/kg	7.04	7.77	7.34	6.27	5.31
Choline, mg/Kg	1306	1176	1102	1043	839
Methionine, %	0.68	0.60	0.60	0.61	0.64
Cystine, %	0.29	0.28	0.26	0.22	0.18
Meth + Cyst, %	0.97	0.88	0.86	0.88	0.82
Lysine, %	1.14	0.99	0.94	0.85	0.76
Tryptophan, %	0.24	0.23	0.22	0.18	0.14
Linoleic Acid, %	1.42	2.55	2.48	2.22	1.95

[1]Vitamin and Minerals mix provided the following per Kilogram of the diet: Vit. A, 6,670,000; Vit. D_3, 1,340,000; Vit. E, 5000 mg; Vit. K_3, 2,680 mg; Vit. B_2, 3000 mg; Vit. B_6, 2000 mg; Vit. B_{12}, 10000 mcg; Nicotinamide, 16,670 mg; Ca d-Pantothenate, 5,340 mg; Folic Acid, 334 mg; Choline Chloride 200,000 mg; Manganese, 66,700 mg; Zinc, 26700 mg; Iron, 33,400 mg; Copper, 1600 mg; Cobalt, 134 mg; Iodine, 234 mg; Selenium, 54 mg; Antioxidant 2000 mg. [2]Samh ME was calculated based on the determined TME.

week 19 and fed 5 experimental diets containing; 0 (control), 5, 10, 20 and 30% samh seeds. The diets (treatments) were distributed randomly among cages (reps) in such away that each cage contained 4 birds. These diets are shown in Table 1.

The cages are located in a closed house where comfortable temperature was maintained during the laying period. However, during the summer months average temperature of the house, measured 3 times a day, 6 AM, 2 PM and 9 PM, were 30°C in July, 29.5°C in August and 27°C in September. While average temperature of the house during the fall months; October, November and December were 25°C, 23°C and 20°C, respectively. Therefore, temperature of the house was considered as a factor may be affecting the traits under the study.

Birds were weighed individually at the beginning of the experiment and then periodically on a bi-weekly basis. Each two weeks were considered a period. Eggs were collected daily however, calculation of hen-day production was based on two weeks collection of the eggs. Egg weight, albumen height and specific gravity of the eggs were performed on three days collection at the end of each period (2 weeks).

At the end of each 28-day period, three days of egg collection was used for quality determination, Yolk index and Haugh unit (albumin height). Specific gravity method was used to measure the shell quality of the eggs. This method was described in (North, 1984). Feed was

Table 2: The Chemical and Amino Acids analysis of Samh seeds

Nutrients	Results of this study	CORN in NRC[1]	SBM in NRC[1]	Results of other studies	Reference
Moisture, %	6.93	11.0	11.0	5.70	Mustafa *et al.*, 1995
Crude Protein, %	22.16	8.5	44.0	22.25	Mustafa *et al.*, 1995
Ether Extract, %	3.09	3.8	0.80	5.60	Mustafa *et al.*, 1995
Crude Fiber, %	10.62	2.2	7.0	9.70	Mustafa *et al.*, 1995
Ca, %	0.05	0.02	0.29	1.33 mg/100gm	Al-Jassir *et al.*, 1995
T P, %	0.17	0.28	0.22	NA	
Ash, %	2.49	NA	NA	4.00	Mustafa,1995
ME, kcal/kg	2976	3350	2230	3480	Bhattacharya, 1988
Aspartic Acid, %[3]	1.93	NA	NA	9.43* (2.10%)	Al-Jassir *et al.*, 1995
Serine, %[3]	0.88	0.37	2.29	3.74* (0.83%)	Al-Jassir *et al.*, 1995
Glutamic Acid, %[3]	4.56	NA	NA	24.10* (5.36%)	Al-Jassir *et al.*, 1995
Glycine, %[3]	2.96	0.33	1.90	15.70* (3.49%)	Al-Jassir *et al.*, 1995
Alanine, %[3]	0.55	NA	NA	2.79* (0.62%)	Al-Jassir *et al.*, 1995
Valine, %[3]	0.74	0.40	2.07	1.95* (0.43%)	Al-Jassir *et al.*, 1995
Methionine, %[4]	0.37	0.18	0.62	1.68* (0.37%)	Al-Jassir *et al.*, 1995
Isoleucine,%[4]	0.69	0.29	1.96	2.58* (0.57%)	Al-Jassir *et al.*, 1995
Leucine, %[4]	0.90	1.00	3.39	NA	Al-Jassir *et al.*, 1995
Tyrosine, %[4]	0.85	0.30	1.91	3.10* (0.69%)	Al-Jassir *et al.*, 1995
Phenylalanine, %[4]	0.79	0.38	2.16	3.56* (0.79%)	Al-Jassir *et al.*, 1995
Histidine, %[4]	1.16	0.23	1.17	4.20* (0.93%)	Al-Jassir *et al.*, 1995
Lysine, %[4]	0.38	0.26	2.69	2.60* (0.58%)	Al-Jassir *et al.*, 1995
Arginine, %[4]	2.64	0.38	3.14	NA	
Therionine, %[4]	0.64	0.29	1.72	2.98* (0.66%)	Al-Jassir *et al.*, 1995

[1]NRC (1994). [2]ME was calculated from the determined TME using the correction factor (1.097) as reported by. Sibbald in "Scott *et al.*, 1982". [3]Non-essential amino acids. [4]Essential amino acids. *, % of Protein; ( ), % of diet; NA, Not Available

added to cages as necessary. Feed left was measured periodically to determine feed intake.

Results and Discussion

Chemical Analysis: The chemical analysis of the seeds used in this study was in close proximity to those reported by others, with few exceptions (Table 2). Higher moisture, higher fiber, lower fat and lower ash were found in the Samh seeds of this study. Dumping the seeds with coat in water and removing the seeds after disintegration from the coat was the method used to remove the seeds. Amount of water and time of soaking could be a reason for the extra moisture held by the seeds. Percent wise, higher fiber and higher water could be attributed to the lower fat and consequently lower energy in Samh comparing to the one reported by Bhattacharya (1988).

Level of the non-essential amino acids for poultry was little higher than the essential ones. This was supported by the work of Mustafa *et al.* (1995). However, arginine, an essential amino acid was higher in Samh than that of the corn and was comparable to that of the soybean. The first and second limiting amino acids, methionine and lysine in the corn are limited in the Samh too.

Layer experiment: With the exception of feed intake, effect of interaction between level of Samh and period of year had no significant effect on the traits measured (Table 3). Feed intake was higher in the fall season when 10 and 20% Samh seeds were incorporated in the layer diet ($P<0.01$). This was not surprising since it is known that birds eat to satisfy their hunger for energy (Scott *et al.*, 1982). Average temperature inside the house reached 30°C in the day during the summer season. Therefore, birds ate less during the summer season. This was clearly demonstrated when feed intake was compared between the two seasons (108.3 g/b/d in summer vs 116.7 g/b/d) during the fall season. Lowest feed conversion was found in birds fed 0% Samh seeds. This feed conversion, however, did not significantly differ from those fed 10% or 20% Samh seeds. The worst feed conversion was found in birds fed 30% Samh seeds, which could be due to the lowest production and egg weight of those birds.

Response of egg weight to the treatment levels was significant ($P <0.05$) (Table 3). However, the only notable differences were between 20 and 30% Samh seed, fed birds while differences among other treatments may not seem of any magnitude. Response of egg weight to the seasonal variation was highly significant ($P<0.001$). Birds in the fall season (October, November, December months) produced larger eggs with better feed

Table 3: Effect of incorporating Samh seeds on some traits of layers fed different levels of Samh seeds during two seasons of the year[1]

Source of variation	GBD, g	FC, Kg/kg	EW, g	HD, %	LIV, %	EM, g/HD
P X TRT	**	NS	NS	NS	NS	NS
Sum 0	105.9± 7.6	2.207±0.4	56.27±4.3	87.36±10.7	99.63±2.3	49.42±8.4
Sum 5	05.6± 6.8	2.313±0.7	55.69±4.2	85.60±13.2	100.00±0.0	47.88±8.9
Sum 10	107.6± 8.9	2.257±0.6	56.34±6.8	87.67±11.4	99.77±1.8	49.56±8.9
Sum 20	111.3± 5.9	2.320±0.6	56.20±4.6	88.58±12.0	100.00±0.0	50.01±8.8
Sum 30	111.4± 6.8	2.449±0.5	55.54±4.4	84.58±13.1	100.00±0.0	47.15±8.9
Fall 03	110.2±10.5	2.037±0.3	63.0±4.0	87.16±10.5	99.58±3.2	54.87±7.0
Fall 5	112.9± 9.6	2.220±0.4	63.0±2.2	83.10±14.0	99.58±2.5	52.37±8.9
Fall 10	120.5±12.3	2.056±0.2	64.1±3.2	92.28± 9.2	99.68±1.9	59.10±6.4
Fall 20	120.2± 7.8	2.120±0.3	65.3±7.7	88.64± 9.5	99.88±0.9	56.16±10.3
Fall 30	119.8± 6.2	2.376±0.3	62.9±6.5	82.35±13.9	99.65±2.7	51.47±8.0
P =	0.0009	0.8928	0.2703	0.1282	0.9315	0.0685
Among TRT	**	**	*	**	NS	**
0	108.1[a]	2.122[c]	59.66[ab]	87.26[a]	99.61[a]	52.15[ab]
5	109.2[a]	2.266[b]	59.37[b]	84.35[b]	99.79[a]	50.13[bc]
10	114.0[b]	2.156[bc]	60.21[ab]	89.97[a]	99.72[a]	54.33[a]
20	115.8[b]	2.220[bc]	60.74[a]	88.61[a]	99.94[a]	53.92[a]
30	115.6[b]	2.412[a]	59.21[b]	83.47[b]	99.82[a]	49.31[c]
P =	0.0001	0.0001	0.0139	0.0001	0.7436	0.0001
Among Perios	**	**	**	NS	NS	**
Summer	108.3[b]	2.309[b]	56.01[b]	86.76[a]	99.88[a]	48.80[b]
Fall	116.7[a]	2.162[a]	63.67[a]	86.71[a]	99.68[a]	55.13[a]
P =	0.0001	0.0001	0.0001	0.9564	0.1981	0.0001

[1]Means Within columns carrying different superscripts are significantly different, P<0.01, P<0.05. NS = Not significant, P>0.05. [2]GBD, gram per bird per day, daily feed intake; FC, Kg feed per Kg eggs, feed conversion; EW, gram egg weight; HD, percent hen-day production; LIV, percent livability; EM, gram per hen-day egg mass (% HD * EW) TRT = 0, 5, 10, 20 and 30% of Samh seeds

conversion which could be due to the higher intake. Okumura *et al.* (1988) reported that egg weight was significantly lower in June hatched layers (Nov., Dec., Jan. and Feb. in production) which contradicted the results of this experiment. However, Tanor *et al.* (1984) found that feed consumption, egg production, egg weight and egg shell thickness decreased with heat stress. Furthermore, high environmental temperature or cyclic temperature has been reported to lower egg production and decrease egg weight and egg shell thickness (de Andrade *et al.*, 1976, 1977; Cowan and Michie, 1980; Miller and Sunde, 1975; Jones *et al.*, 1976).

Data presented in Table 3 showed a significant (P<0.001) response of hen-day production to the treatment levels. The highest production (90%) was obtained when 10% Samh seeds were incorporated in the ration.

Although this value may not have differed significantly from the control but still the numerical increase was about 3%.

The highest rate of Samh inclusion (30%) has significantly (P<0.001) depressed egg production and egg weight. This depression was not due to lower feed intake since consumption of the birds was in close proximity to other Samh treatments. Therefore, it is assumed that digestibility of the Samh was impaired as level of Samh increased. Intestinal viscosity, due to feeding some grain intact, was blamed for the reduction in rate of digestion and ultimately reduces performance (White *et al.*, 1983; Antoniou and Marquardt, 1982). This area needs further investigation since Samh seeds were fed intact and to my knowledge Samh digestibility has never been investigated. It is not clear why birds fed 5% Samh seeds had lower production rate compared to birds on other treatments. This depression was consistent in all cages of the birds fed 5% Samh seeds. No significant differences (P>0.05) were observed between the two seasons related to egg production. This result is surprising since feed intake, egg weight, feed conversion and egg mass were highly affected by season of the year.

Livability trait was not significantly (P>0.05) affected by the interaction between treatments and season of the year; neither was a significant difference among treatments nor between periods of the year (P>0.05) (Table 3).

Egg mass was highly affected by level of Samh and

Table 4: Effect of interaction between level of Samh and season of the year on some traits of layers fed different levels of Samh seeds[1]

Source Of variation	SPG	HU	YC	YI
Period X TRT	NS	NS	NS	NS
Summer 0	1.092±0.004	102.67±2.507	3.078±0.812	1.076±0.392
Summer 5	1.091±0.005	102.49±2.680	2.873±0.815	1.118±0.584
Summer 10	1.091±0.004	102.45±2.617	2.600±0.823	0.990±0.218
Summer 20	1.091±0.004	102.43±2.616	2.856±0.871	1.048±0.248
Summer 30	1.092±0.004	102.44±2.218	2.900±0.690	1.017±0.243
Fall 0	1.090±0.002	103.20±2.414	3.023±1.048	1.340±0.343
Fall 5	1.089±0.004	102.42±2.404	2.767±1.076	1.292±0.162
Fall 10	1.089±0.004	102.95±2.080	2.466±1.016	1.226±0.130
Fall 20	1.089±0.003	101.97±4.786	2.316±0.940	1.265±0.124
Fall 30	1.090±0.002	102.43±3.091	2.389±0.798	1.275±0.139
P =	0.9765	0.6301	0.0826	0.7686
Among TRT	NS	NS	**	*
0	1.091[a]	102.94[a]	3.051[a]	1.210[a]
5	1.090[a]	102.46[a]	2.820[b]	1.208[a]
10	1.090[a]	102.70[a]	2.533[c]	1.108[b]
20	1.090[a]	102.20[a]	2.586[bc]	1.158[ab]
30	1.091[a]	102.44[a]	2.644[bc]	1.148[ab]
P =	0.1137	0.3200	0.0001	0.0426
Among Perids	**	NS	**	**
Summer	1.092[a]	102.50[a]	2.861[a]	1.049[a]
Fall	1.089[b]	102.60[a]	2.592[b]	1.280[b]
P =	0.0001	0.6734	0.0003	0.0001

[1] Means Within columns carrying different superscripts are significantly different, P<0.01, P<0.05. NS = Not significant, P>0.05. SPG, specific gravity of the egg; HU, haugh unit; YC, Yolk color (graded from 1 to 5 where 5 is the darkest); YI, yolk index (yolk height ÷ yolk diameter) TRT = 0, 5, 10, 20 and 30% of Samh seeds

period of the year. Again, best egg mass was achieved when 10% Samh was incorporated in the layer ration (Table 3). Best production and excellent egg weight were the reason for best egg mass. These two traits are the function of egg mass. Furthermore, better egg mass was found in the fall period comparing to the summer. Birds in this season produced larger eggs also.

Specific gravity of the egg was not significantly affected by either the interaction between period of the year and level of Samh or treatment levels (P>0.05) (Table 4). However, significant (P<0.001) period effect was found. Summer eggs, to the contrary, had better shell quality than fall eggs. This could be due to the fact that temperature of the house was not high enough to cause panting and/or eggs were much smaller in the summer comparing to the fall. Roland (1979) found that as egg gets progressively bigger, less shell materials are deposited in the shell since amount of calcium available for the shell remains constant during the laying year.

Haugh unit on the other hand was not significantly (P>0.05) affected by either treatments nor by period of the year (Table 4).

Samh effect on egg color was evident in Table 4. Darkest color was found in eggs of birds fed 0% Samh (P<0.001). This was not surprising since part of the corn, the main coloring agent in the ration, was replaced with Samh seeds in the other treatments. One kilogram of corn contains 20-25 mg Xanthophylls (Leeson and Summers, 2001). Regardless of treatments birds in summer produced egg with darker yolk. This is against the odd and could be due to the smaller eggs produced in this period.

Yolk index followed similar trend. Better (P<0.05) index was found in egg of birds fed no or low level of Samh seeds (Table 4). Therefore, it is postulated that larger egg laid by birds fed 10-20% Samh seeds could be due to the larger amount of albumen and not to the yolk weight. Albumen weight was not determined in this study.

In general, better performance was seen when 10% Samh was incorporated in the diet. This would lead to conclude that Samh seeds may be used safely with layers, provided that more studies are needed to determine the carbohydrate type present in the endosperm cell wall of the Samh seeds or whether grinding the Samh seeds can overcome the problem of indigestibility at high levels.

Conclusion: It was evident from the result of this preliminary study that Samh seeds are good source of protein (22%), however, it's deficiency in some of the essential amino acids limits it's use as a sole protein source. Nevertheless, with either adding different source of protein or fortifying the ration with the deficient Amino Acids may end up with an excellent source of energy and protein if the biological trial would approve that too.

Samh seeds plantation is still experimental (personal communication) and therefore, economic evaluation of using Samh seeds in poultry may not be done till plantation become commercialized. Results of this project and those done with human revealed the fact that Samh seeds are valuable protein source and/or energy for human and poultry, therefore, further research should be done on the cell constituents of the seeds and the availability of energy and protein to the birds using treated and untreated Samh seeds. But as of now and till more studies explore more of the unknown of these seeds, no recommendations can be drawn, though, data of this study showed some indications in favor of using the Samh seeds in the layer diet. But in any case the diets should be fortified with coloring agent.

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