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UTILIZATION OF POTATO PEELS MEAL IN LAYING HENS DIETS

Mona M. Hassan

Animal and Poultry Nutrition Dept., Desert Research Centre, Mataria, Cairo, Egypt.

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SUMMARY

The present work was carried out at south Sinai Experimental Research Station (Ras Suder city) which belongs to the Desert Research Center. An experiment was carried out to determine optimal dietary level of inclusion of sun dried potato peels meal as a substitute for maize in laying hens diet. A total number of 75 white Leghorn laying hens of 40 weeks of age were randomly divided into five experimental groups, 15 hens each. Each group was sub-divided into three replicates, (five hens each). A simple one-way classification experimental design with five levels of potato peels meal (PPM) (0, 15, 20, 25 and 30 %DM basis) was tested for 12 weeks. Hens fed a diet contained 25% PPM recorded the highest significant ($P<0.05$) values of Egg weight (g), shell weight % and albumin weight % being 48.40g ,4.53% and 57.07% ; respectively. The highest significant ($P<0.05$) values of Albumen height (mm) and Haugh units (5.23 and 74.34) were recorded by hens fed diet contained 20% PPM; while, the highest significant ($P<0.05$) values of Shape index and Albumen index% (75.56 and 54.07) were recorded when hens fed diet contained 25% PPM. Hens in control group consumed highest significant ($P<0.05$) quantity of feeds (67.78 g/hen/day) as compared with other experimental groups that had a significant decrease in there feed intake with increasing PPM content from 20% up to 30%. The best significant ($P<0.05$) values of feed conversion ratio recorded for hens fed 20% PPM (2.14) and those fed a diet contained 25% PPM (2.20). There were a significant ($P<0.05$) gradual decrease in digestion coefficients of DM, OM, CP and CF with increasing PPM levels in hens diets. Water intake ranged from 190.67 to 245.00 (ml/ bird/day) with a signifiant increase with increasing PPM levels. There were no significant differences among treatments in all blood serum criteria; except hens fed 30% PPM recorded the highest significant ($P<0.05$) value of Globulin.(g/dl)as compared with other treatment groups. Economical efficiency and relative economical efficiency were ranged between 1.10-2.08 and 100-189 % for the control and experimental treatments .The best value for (E.E) and (R.E.E) had been recorded by hens fed diet contained 25% PPM as compared with the control. From the nutritional and economical efficiency stand points of view, formulating diets contained 25% sun dried Potato Peels Meal (DM basis) as a substitute for maize could be recommended to be used successfully and safely in formulating diets for laying hens raising under new reclaiming region without adversely affecting their laying performance or egg quality .

Keyword: *potato peels meal; egg production; egg quality; economical efficiency; blood parameters; White Leghorn laying hens.*

INTRODUCTION

Feed is one of the major problems of intensive poultry production in Egypt due to the competition between man, animal and industries for conventional feed materials. This has led to the escalating cost of conventional feed ingredients and has made feed cost to account for about 70% of total cost of production (Akinmutimi, 2004). This problem has been the prime stimulants for the continuous search for alternative feedstuffs that can meet the nutritional requirements of poultry, reduce the cost of feed and animal production ; such a feedstuff should be one that has very low human food preference and of low industrial usage (Olorede *et al.*, 2002). Replacing cereals and expensive and less available agro-industrial by-products with agricultural by-products, which are less exploited by man is one of the solutions to increase the supply of animal protein. The use of agricultural by-products in poultry nutrition represents valuable means of the indirect production of food from waste (El Boushy and Van Derpoel 1994).

Maize is the main cereal involved in animal nutrition as the main energy source and constitutes 60 to 70% of monogastrics' diets, especially poultry. However, owing to its nutritional value, there has always been keen competition between human and animals for maize. This pressure on maize has resulted in its skyrocketing price with consequential increased cost of livestock production, which has further exacerbated animal protein consumption problem. This scenario has therefore led to an increasing interest in search for alternative non conventional agricultural products that can substitute for maize in poultry feed. Potato waste is one of these by products, that remaining after potatoes have been processed to produce frozen potato products for human consumption. Potato products approximately 35% of the total processed potato crop is discarded as a waste during processing. This waste ferments rapidly and adds to the pollution problem if not properly utilized. The total world potato waste is estimated to 12 million ton per year (El-Boushy and Van derpoel,1994). Smith and Huxsoll (1987) estimated the peeling losses of the potato chips industry which used abrasion peeling extensively to be 10%. Stanhope *et al.* (1980) reported that potato processing residue can replace barley as an energy source for finishing beef cattle. Studies by Heinemann and Dyer(1972) on steers indicated that potato processing slurry had a dry matter digestibility of 73.5% when fed at 19.2 to 37.5% of the diet dry matter. At these two levels, potato slurry had digestible energy values of 3.5 and 3.1 M cal / Kg, respectively. Also Gado *et al.* (1998) reported that replacement of concentrate feed mixture by potato waste at level 25% of DM significantly increased digestibility of DM and nitrogen balance. The peels are good sources of quality plant carbohydrate. It contains about 6.3% crude protein and metabolizable energy of about 3411kcal/kg (Jansen, 1989).

The main objective of the present work was to determine optimal dietary level of inclusion of potato peels meal as a substitute for maize in laying hens diets.

MATERIALS AND METHODS

The present work was carried out at south Sinai Experimental Research Station (Ras Suder city) which belongs to the Desert Research Center. An experiment was carried out to determine optimal dietary level of inclusion of potatoes peel meal as a substitute for maize in laying hens diet. A total number of 75 white leghorn laying hens of 36weeks of age were randomly taken and distributed in five experimental groups. Each group contained 15 birds. Birds in all treatments were reared under similar hygienic and managerial conditions and divided randomly into three equal replicates (5 hens each). Wet potato peel waste (PPW) was obtained from Chipsy for food industries CO. S.A.E., 6th October city. The waste was spread in thin layers on trays and left for sun drying and fine grinded for the experimental purpose. Experimental diets (Table1) were formulated to be iso-caloric (2900 kcal ME /kg) and isonitrogenous (16% crude protein) which are corn-soy bean based with five levels of Potato peels meal 0,15,20,25 and 30% (dry matter basis) were formulated to meet N.R.C. (1994) recommendations. Feed and water were offered *ad- libitum*. All hens were kept under the same managerial and environmental conditions and artificial lighting (16 hours of light per day) through the experimental periods. Body weights were recorded at the beginning and at the end of the experiment (40 and 52 weeks of age, respectively). Egg weight and egg number were recorded daily to calculate the egg production percentage and egg mass (g/hen/day). Feed consumption (g/hen/day) and feed conversion values (g feed /g eggs) were recorded biweekly.

At the end of the experiment, egg quality parameters were measured using 100 eggs (20 eggs / each treatment group). These measurements involved yolk, albumen and shell weight percentage. Egg shell thickness was measured in μm using a micrometer and specific gravity according to Harms *et al.* (1990). Egg shape index was computed as the ratio of egg width to the length (Awosanya et al., 1998). Yolk index was calculated according to Funk et al., (1958), as yolk height divided by yolk diameter. Haugh unit was calculated according to Eisen *et al.* (1962) using the calculation chart for rapid conversion of egg weight and albumen height.

At the end of the experimental feeding period, digestion trial was conducted using 15 females (three from each treatment) to determine the digestion coefficients of the experimental diets. Hens were individually housed in metabolic cages. The digestibility trials extended for 9 days; 5 days as a preliminary period followed by 4 days as collection period. During the main period, excreta were collected daily and weighed, dried at 60 C^{o}, bulked, finally ground and stored for chemical analysis. The faecal nitrogen was determined according to Jakobsen *et al.*(1960). Urinary organic matter was calculated according to Abou-Raya and Galal (1971). Metabolizable energy was calculated according to the equation of Tiuts and Fritz (1971).

The digestion coefficients % of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and nitrogen free extract (NFE) of the experimental diets were estimated Chemical analysis of the experimental diets and faeces were assayed using methods of the Association Official Analytical Chemists (A.O.A.C,1990).Proximate analysis (%) of PPM was listed in Table (2).

The economic efficiency of the experimental diet was calculated based upon the differences in both selling revenue and feeding cost, which was calculated according to the price of the experimental diets and egg production during the year of 2010. Data obtained were statistically analyzed using the General Linear Model Procedure (SAS, 1996), all the characteristics were performed in conformity by one way analysis model. Duncan's multiple range test was used to test the significance of mean differences (Duncan, 1955).

Table (1): Composition and calculated analysis of the experimental diets

Ingredients %	Experimental diets				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Yellow corn	66.10	47.00	43.70	39.50	34.80
Soybean meal(44%CP)	21.40	16.90	14.20	13.00	12.20
Corn gluten meal (60%)	2.00	4.00	5.00	5.20	5.20
Vegetable oil	3.50	5.00	5.00	5.20	5.70
Potato peels meal	0.00	15.00	20.00	25.00	30.00
Limestone	9.10	9.00	9.00	9.00	9.00
Dicalcium phosphate	2.00	2.00	2.00	2.00	2.00
Vit& Min premix*	0.30	0.30	0.30	0.30	0.30
NaCl	0.30	0.30	0.30	0.30	0.30
DL- Methionine	0.10	0.10	0.10	0.10	0.10
L-Lysine-HCl	0.00	0.20	0.20	0.20	0.20
Choline chloride	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated analysis:**					
ME, K cal/kg	2892.62	2893.70	2883.00	2862.50	2852.90
Crude protein %	15.98	16.06	15.87	15.80	15.72
C/P ratio	181	181	181	181	181
Calcium %	3.97	3.92	3.91	3.90	3.90
Av. Phosphorus %	0.41	0.44	0.45	0.45	0.44
Methionine + cystine%	0.66	0.61	0.59	0.57	0.55
Lysine%	0.79	0.74	0.77	0.73	0.70

* *Each 3 Kg of Vit and Min. premix contains: 10000000 IU Vit. A; 2000000 IU. vitD3; 10000mg Vit.E; 1000mg Vit.K3; 1000mg Vit. B1;5000mg Vit. B2; 10 mg Vit. B12; 1500mg Vit . B6;30000mg Niacin; 10000mg Pantothenic acid; 1000mg Folic acid ;50mg Biotin; 300000 mg Choline; 4000 mg Copper; 300mg Iodine; 30000 mg Iron; 50000 mg Zinc; 60000 mg Manganese; 100mg Selenium; 100mg Cobalt and CaCO3 as carrier to 3000g*

** *According to NRC (1994)*

RESULTS AND DISCUSSION

Composition, Chemical Analysis and Cell Wall Constituents:

Chemical analysis and cell wall constituents of feed ingredients are shown in Table 2. Potato peels Meal (PPM) contained 13.89% CP, 11.83% CF, 1.21% EE, 62.00 NFE, 11.07% ash, 54.71% NDF, 20.37% ADF, 34.34% hemi-cellulose and 2456.73 ME (kcal/kg). In a study of Tawila, *et al* (2008), they found that potato peels waste contained about 90.11% DM, 88.50%OM, 14%CP, 6.55% CF, 1.38% EE, 66.57% NFE and 11.50% ash. However, Akinumutimi and Anakebe (2008) found that sweet potato peel meal contained about 89.74% DM, 6.34%CP, 0.36% CF, 1.30% EE, and 77.16% NFE, 4.58% ash and 2800 kcal/kg ME.

Egg components:

Egg components content fluctuates according to variety and can be affected only to a limited extent by feed. A chicken egg has an average weight of about 60 g ,the largest proportion (58%) consists of egg white, the yolk amounting to approx. 32 % and the shell stability approx. 10 % (Kirchgessner, 1997). In our study; hens fed a diet contained 25% PPM recorded the highest significant ($P<0.05$) values of Egg weight (g), shell weight % and albumin weight % being 48.40g ,4.53% and 57.07% ; respectively. Table (3).

Table (2): Chemical composition % of potato peels and experimental diets.

Item	Potato peels	Experimental diets				
		Control	15% PPM	20% PPM	25% PPM	30% PPM
DM	91.60	93.83	93.65	92.27	92.83	94.37
OM	88.93	74.52	72.64	85.53	84.28	62.81
Ash	11.07	25.48	27.36	14.47	15.72	37.19
CP	13.89	16.10	15.87	15.82	15.85	15.80
CF	11.83	3.23	4.25	4.84	4.59	7.17
EE	1.21	2.24	1.89	1.38	1.58	1.83
NFE	62.00	52.95	50.63	63.49	62.26	38.01
NDF	54.71	20.98	23.96	29.00	29.28	34.63
ADF	20.37	6.40	5.23	9.99	6.69	9.70
Hemi-cellulose	34.34	14.58	18.73	19.01	22.59	24.93
Carbohydrates	63.21	55.19	52.52	64.87	63.84	39.84
Converted carbohydrates	45.29	79.02	76.04	71.00	70.72	65.37
ME (Kcal/kg)	2456.73	2849.34	2857.21	2847.01	2840.26	2841.44

Hemi-cellulose = (NDF- ADF. Carbohydrates = OM- (CP+ CF). converted carbohydrates = (100- NDF).

Table (3): Egg components and egg quality parameters (Means ±SE) of White leghorn hens as affected by potato peels meal level.

Criteria	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Egg components:					
Egg weight (g)	45.89 ± 0.81 ^{BC}	45.54 ± 1.10 ^{C}	48.34 ± 0.94 ^{A}	48.40 ± 0.75 ^{A}	43.30 ± 1.50 ^{C}
Shell weight,%	3.94± 0.12 ^{C}	4.13± 0.10 ^{BC}	4.42± 0.01 ^{AB}	4.53± 0.21 ^{A}	4.05± 0.11 ^{C}
Yolk weight. %	35.928 ± 0.61 ^{A}	34.97 ± 0.81 ^{AB}	33.35 ± 0.81 ^{B}	35.51 ± 0.81 ^{A}	36.12 ± 0.81 ^{A}
Albumen weight. %	55.46 ± 0.67 ^{B}	55.95 ± 0.51 ^{B}	57.05 ± 0.70 ^{A}	57.07 ± 0.88 ^{A}	54.47 ± 1.01 ^{B}
Exterior quality:					
Egg specific gravity	1.0098 ±0.001 ^{AB}	1.0094 ± 0.001 ^{B}	1.0096± 0.001 ^{B}	1.0094±0.001 ^{B}	1.0099±0.001 ^{A}
Shell thickness, mm	0.334 ± 0.01 ^{B}	0.349 ± 0.03 ^{B}	0.358 ± 0.04 ^{B}	0.399 ± 0.02 ^{A}	0.358 ± 0.01 ^{B}
Interior quality:					
Albumen height, mm	4.78 ± 0.23 ^{AB}	4.30± 0.74 ^{B}	5.23± 0.74 ^{A}	4.90 ± 0.74 ^{AB}	4.68 ± 0.74 ^{AB}
Haugh units	72.15± 1.93 ^{AB}	68.15± 1.01 ^{B}	74.34 ± 1.99 ^{A}	71.36± 1.92 ^{AB}	72.75± 1.82 ^{AB}
Albumen index, %	50.99 ± 3.55	54.52 ± 3.17	50.06 ± 3.05	54.07 ± 2.99	51.12± 2.70
Shape index	72.28 ± 0.74 ^{B}	73.65 ± 0.91 ^{AB}	74.40 ± 0.85 ^{AB}	75.56 ± 0.60 ^{A}	73.48 ± 0.51 ^{AB}
Yolk index, %	41.98 ± 1.17	41.16 ± 1.74	41.68 ± 1.00	42.02 ± 1.01	44.16 ± 1.19

a.b: Means in the same row in each classification bearing different letters differ significantly ($P\leq 0.05$)

Egg quality measurements:

Data of egg quality measurements for 52-weeks old Leghorn laying hens fed diets containing different PPM levels are presented in Table (3).

Exterior quality:

Hens fed diet contained 25% PPM recorded the highest significant ($P<0.05$) values of Shell thickness (0.399mm) while, highest Egg specific gravity value was recorded by hens fed 30% PPM. Results of a study on laying birds fed some agro-industrial by products revealed no significant effect of dietary treatments on egg shell thickness which were all well above the value (0.3 mm) reported to be optimum for thickness of chicken egg shells which will not adversely result in breakages (Donkoh l and Zanu, 2010).

Interior quality

The highest significant (P<0.05) values of Albumen height (mm) and Haugh units (5.23 and 74.34) were recorded by hens fed diet contained 20% PPM: while, the highest significant (P<0.05) values of Shape index and Albumen index% (75.56 and 54.07) was recorded when hens fed diet contained 25% PPM. On the other hand, experimental diets had no significant effect on Yolk index %. Oladunjoye, et al. (2010) found that feeding laying hens on sun dried cassava peel meal had a significant (P < 0.05) effect on yolk color score, Haugh unit and yolk cholesterol. However, Donkoh l and Zanu(2010) . did not show any adverse effects on the Haugh unit values of eggs for the various agro-industrial by products. On the other hand, El-Deek, et al (2009) fed laying hens different levels of Sun dried guava by-product meal and found no significant effect on yolk index and significantly higher shell thickness than those fed the control diet. In general, the increased laying performance is not a sign of egg quality reduction but negative correlations between laying performance and the strength and stability of the shells have been found (Pingel and Jeröch, 1995).

Productive performance:

The productive performance of hens fed different levels of PPM are shown in Table (4). At the end of the experiment (at 52 weeks of age), there were no significant differences among dietary treatments in final live body weight of birds. This result is in line with the findings obtained by Donkoh et al. (2004) body weight gain of laying chickens was not significantly (P<0.05) affected by feeding diets with agro-industrial by-products. However, the slightly depressed weight gain for birds could be attributed to the high levels of fiber in the diet.

Table (4): Body weight and feed utilization (Means ±SE) of White leghorn hens as affected by potatoes peel meal level.

Criteria	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Initial body weight g	1354.60±43.18	1221.70±39.10	1335.80±28.21	1259.00±50.41	1333.40±36.55
Final body weight, g	1459.60±20.96	1331.70±62.12	1433.80±50.15	1355.00±36.60	1428.40±42.13
Feed consumption (g/day)					
40-44	70.67 ± 0.59 ^{A}	66.13 ± 0.50 ^{B}	59.27 ± 0.45 ^{C}	57.00 ± 0.49 ^{D}	53.70 ± 0.51 ^{E}
44-48	71.67 ± 0.54 ^{A}	70.33 ± 0.46 ^{A}	61.67 ± 0.41 ^{B}	61.00 ± 0.35 ^{B}	61.33 ± 0.51 ^{B}
48-52	61.00 ± 0.71 ^{A}	61.00 ± 0.70 ^{A}	58.67 ± 0.55 ^{AB}	57.67 ± 0.60 ^{B}	60.00 ± 0.62 ^{A}
Overall mean	67.78 ± 3.02 ^{A}	65.82 ± 2.04 ^{A}	59.87 ± 1.54 ^{B}	58.56 ± 2.64 ^{B}	58.34 ± 2.55 ^{B}
Feed conversion(g/feed/g egg)					
40-44	2.46 ± 0.02 ^{A}	2.43 ± 0.03 ^{A}	2.11 ± 0.01 ^{B}	2.15 ± 0.05 ^{B}	1.87 ± 0.01 ^{C}
44-48	2.27 ± 0.03 ^{C}	2.42 ± 0.02 ^{B}	2.21 ± 0.01 ^{C}	2.29 ± 0.01 ^{C}	2.63 ± 0.01 ^{A}
48-52	2.05 ± 0.02 ^{D}	2.25 ± 0.03 ^{B}	2.10 ± 0.01 ^{C}	2.15 ± 0.01 ^{C}	2.83 ± 0.05 ^{A}
Overall mean	2.25 ± 0.19 ^{B}	2.37 ± 0.02 ^{A}	2.14 ± 0.12 ^{C}	2.20 ± 0.50 ^{C}	2.40 ± 0.16 ^{A}

a.b: Means in the same row in each classification bearing different letters differ significantly (P≤ 0.05).

Feed consumption and feed conversion ratio:

Hens in control group consumed highest significant (P<0.05) quantity of feeds (67.78 g/hen/day) as compared with other experimental groups that had a significant decrease in there feed intake with increasing PPM content from 20% up to 30% (Table 4); this might be explain that PPM has some of ant nutritional factors that adversely affect digestibility coefficients of nutrients and utilization as well, the results of digestion trail (Table 7) could interprets this opinion. . There were many opinions discuss the reasons which affect feed intake as follows; Banjoko *et al.*(2008), indicated that feed consumption increased correspondingly with incremental levels of the agro-industrial by-products and the difference in feed intake between dietary control diet and the other dietary treatments might be due to the high fiber contents of the agro-industrial by-product-based diets. Others refer to anti- nutritional factors like solanine that affect feed intake of laying hens fed potato protein as a substitute of soybean meal (Strobel, *et al*.,2002) . In brief , Increasing feed intake may explain the increase in laying rate and egg mass of hens (El-Deek, *et al*. ,2009). The best significant (P<0.05) values of feed conversion ratio recorded for hens fed 20% PPM (2.14) and those fed a diet contained 25% PPM (2.20), Table 4. It is worth noticing that increasing some by product meal level improved feed utilization of laying hens . In this regard, El-Deek *et al*. 2009, reported that laying hens are better able to overcome the anti-nutritional factors and/or poor digestibility by products compared to broilers .

Egg production and egg number

Results in Tables (5 and 6) showed that the highest (P<0.05) overall mean values of egg production, egg number and egg mass were recorded for hens fed the control diet followed by groups fed diets

Table (5): Egg production and number (Means ±SE) of White leghorn hens as affected by potatoes peel meal level.

Criteria	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Egg production (%)					
40-44	61.43 ± 0.41^{A}	58.11 ± 0.40^{C}	57.86 ± 0.35^{C}	60.46 ± 0.32^{A}	57.39 ± 0.23^{C}
44-48	65.95 ± 0.37^{A}	62.39 ± 0.30^{B}	58.32 ± 0.10^{C}	58.57 ± 0.25^{C}	50.71 ± 0.30^{D}
48-52	59.75 ± 0.35^{A}	57.39 ± 0.29^{B}	56.89 ± 0.30^{B}	57.39 ± 0.27^{B}	46.68 ± 0.19^{C}
Overall mean	62.39 ± 2.34^{A}	59.29 ± 1.14^{AB}	57.68 ± 2.04^{AB}	58.82 ± 1.11^{AB}	51.61 ± 2.00^{B}
Egg number					
40-44	17.20 ± 0.11^{A}	16.27 ± 0.17^{C}	16.20 ± 0.12^{C}	16.93 ± 0.14^{B}	16.07 ± 0.13^{D}
44-48	18.47 ± 0.10^{A}	17.47 ± 0.10^{B}	16.33 ± 0.10^{C}	16.40 ± 0.20^{C}	14.20 ± 0.21^{D}
48-52	16.73 ± 0.10^{A}	16.07 ± 0.09^{B}	15.93 ± 0.08^{B}	16.07 ± 0.10^{B}	13.07 ± 0.06^{C}
Overall mean	17.47 ± 0.66^{A}	16.60 ± 0.16^{B}	16.15 ± 0.51^{B}	16.47 ± 0.62^{B}	14.45 ± 0.52^{C}

a,b: Means in the same row in each classification bearing different letters differ significantly (P≤ 0.05).

Table (6): Egg weight and egg mass (Means ±SE) of White leghorn hens as affected by potatoes peel meal level.

Criteria	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Egg weight (g)					
40-44	46.83 ± 0.29^{C}	46.88 ± 0.27^{C}	48.58 ± 0.25^{B}	43.76 ± 0.21^{D}	50.08 ± 0.19^{A}
44-48	47.95 ± 0.36^{A}	46.49 ± 0.30^{B}	47.85 ± 0.29^{A}	45.43 ± 0.37^{B}	45.97 ± 0.31^{B}
48-52	49.84 ± 0.32^{A}	47.37 ± 0.21^{B}	49.05 ± 0.30^{A}	46.66 ± 0.29^{B}	45.41 ± 0.31^{C}
Overall mean	48.21 ± 1.29	46.91 ± 0.99	48.49 ± 0.80	45.28 ± 1.02	47.15 ± 1.12
Egg Mass (g/hen/day)					
40-44	28.76 ± 0.30^{A}	27.24 ± 0.39^{B}	28.11 ± 0.15^{A}	26.46 ± 0.23^{C}	28.74 ± 0.41^{A}
44-48	31.63 ± 0.14^{A}	29.00 ± 0.10^{B}	27.91 ± 0.10^{C}	26.61 ± 0.05^{D}	23.31 ± 0.20^{E}
48-52	29.78 ± 0.12^{A}	27.18 ± 0.10^{B}	27.91 ± 0.10^{B}	26.78 ± 0.09^{B}	21.20 ± 0.11^{C}
Overall mean	30.08 ± 1.46^{A}	27.81 ± 1.74^{B}	27.97 ± 1.00^{B}	26.63 ± 1.40^{B}	24.33 ± 0.99^{C}

a,b: Means in the same row in each classification bearing different letters differ significantly (P≤ 0.05).

including PPM level up to 25% , however; lowest (P<0.05) values were recorded by hens fed a diet contained 30% PPM. On the other hand, there were no significant differences of experimental groups on overall means of egg weight. The hypothesis of Jacob, *et al*.(2011) may be discuss our obtained results, they hypothesized that laying cycle of a chicken flock that usually covers a span of about 12 months and Egg production begins when the birds reach about 18-22 weeks of age, depending on the breed and season. Flock production rises sharply and reaches a peak of about 90%, 6-8 weeks later, then production gradually declines to about 65% after 12 months of lay and added that typical production curve for a laying flock, showing changes in the level of egg production and egg production can be affected by such factors as feed consumption (quality and quantity),water intake, intensity and duration of light received, parasite infestation, disease, and numerous management and environmental factors. Literatures in many ways had demonstrated these factors such feed intake; according to Polin and Wolford (1972), there is a correlation between feed intake and the rate of egg production, and that as feed consumption increased egg production also increased significantly. Others refer to diet type; El-Deek, *et al* (2009) fed laying hens different levels of Sun dried Guava By-Product(GBP) Meal and found no significant differences were observed between the control group and those fed 10 and 15%GBP levels in terms of egg number and egg mass. Donkohl and Zanu (2010)reported that birds fed diets containing agro-industrial by-products had highest number of eggs, even though the differences were not significant. Generally; Elswinger, (2005) found that pure leghorns produce 220 to 240 eggs per year while the leghorn crosses produce about 300 eggs per year.

Digestion coefficients (%)

Data presented in Table (7) indicated that there were a gradual ($P<0.05$) decrease in digestion coefficients of DM, OM, CP and CF with increasing PPM levels in hens diets. Water intake ranged from 190.67 to 245.00 (mL/ bird/day) with a signifiant increase with increasing PPM levels . On the other hand, the lowest significantly ($P<0.05$) value of water/feed intake DM was recorded by hens fed control diet as compared with other treatment groups. Results of Tawila , *et al*(2008) showed that replacing 50% of potato peel waste (PPW) did not change feed intake of sheep significantly, which may due to the high palatability of PPW ; meantime feeding sheep 50% PPW decreased the water intake, the differences between the groups were not significant. Increasing level of PPW in the diet gradually insignificantly decreased ($P>0.05$) water intake. Contrarily, Nelson *et al.* (2007) reported a reduction in body weight for birds fed on agro-industrial by-products based diet which may due to addition of fiber to the diet can lead to a lower apparent digestibility of starch and minerals and thereby depress weight gain .

Blood serum parameters:

Serum parameters of Leghorn laying hens, measured in the study were estimated to show the metabolic and health status of hens as affected by feeding different levels of PPM (Table 8).

There were no significant differences among treatments in all blood serum criteria. Hens fed 30% PPM recorded the highest significant ($P<0.05$) value of Globulin,(g/dl)as compared with other treatment groups. The serum lack of pronounced variations in the concentration of blood parameters are in harmony with those obtained by Raya *et al.* (1990) who reported that several factors, such as nutrition, season, age and physiological status of the various blood constituents. Literatures in many ways had demonstrated the effects of these factors on bird as followed; Oladunjoye, et al.(2010) refers to lower egg yolk cholesterol values observed in birds at 70 and 80% inclusion level can be attributed to higher fiber content of the diets. This supports the hypothesis that increased dietary fiber often result in reduction in availability of cholesterol for incorporation into lipoproteins (Story et al., 1990). The presence of hydrocyanic acid in cassava peel can also exert hypo-chlesteronic influence as glycosides have ability to interfere with the intestinal absorption of the dietary cholesterol and lipid (Brown et al., 1999).

Table (7): Digestion coefficients (%) and water intake of nutrients as affected by potato peels meal level.

Item	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
DM	82.52 ±3.06 ^{A}	81.46 ± 2.42 ^{A}	78.80 ± 2.42 ^{AB}	69.69 ± 3.02 ^{B}	54.767 ± 2.14 ^{C}
OM	84.99 ± 2.01 ^{A}	82.74 ± 2.02 ^{A}	80.51 ± 2.42 ^{AB}	74.39± 2.42 ^{B}	63.10 ± 2.42 ^{C}
CP	79.85 ± 5.23 ^{A}	70.11 ± 4.77 ^{A}	67.31 ± 6.07 ^{AB}	65.66 ± 5.17 ^{B}	60.55 ± 4.01 ^{B}
CF	19.02 ± 5.13 ^{A}	18.64 ± 5.00 ^{A}	16.64 ± 5.12 ^{B}	14.30 ± 5.03 ^{C}	13.10 ± 5.02 ^{C}
EE	90.79 ± 8.77 ^{A}	90.14±8.01 ^{A}	74.70± 7.01 ^{AB}	71.87± 6.91 ^{B}	69.20± 7.21 ^{B}
Water intake (mL/ bird/day)	190.67 ± 24.24 ^{C}	203.20±20.01 ^{C}	222.00 ± 21.03 ^{B}	236.00 ± 19.80 ^{A}	245.00 ± 18.50 ^{A}
Water/feed intake. (Ml/g)	2.73 ± 0.89 ^{C}	2.96 ± 0.10 ^{C}	3.61 ± 0.40 ^{AB}	3.77 ± 0.90 ^{AB}	4.14 ± 0.95 ^{A}

a.b :Means in the same row in each classification bearing different letters differ significantly ($P\leq 0.05$).

Table (8): Some serum constituents (Means ±SE) of White leghorn hens as affected by potato peels meal level.

Item	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Total protein (g/dl)	9.21 ±1.29	8.13±1.20	10.18 ±1.01	10.53 ±1.30	11.17±1.00
Albumin (g/dl)	4.55 ±0.67	4.75 ±0.50	5.11 ±0.61	3.62 ±0.36	3.16 ±0.65
Globulin (g/dl)	4.66 ±1.28 ^{AB}	3.38 ±1.09 ^{B}	5.07 ±1.20 ^{AB}	6.92 ±1.30 ^{AB}	8.01 ±1.23 ^{A}
A/G (ratio)	0.98 ±1.00	1.41±1.00	1.01 ±0.90	0.52 ±1.01	0.39 ±1.02
Glucose (mg/dl)	224.18±22.07	186.54±21.09	184.27 ±21.0	195.09 ±22.13	194.52±22.00
Cholesterols (mg/dl)	160.80±14.66	131.48±13.91	157.10 ±14.0	155.25 ±14.50	135.80±14.35

a.b : Means in the same row in each classification bearing different letters differ significantly (P≤ 0.05).

Economical efficiency:

Results of economical efficiency (E.E) and relative economical efficiency (R.E.E) estimated for different treatments during experiment are shown in Table (9). According to the input-output, economical efficiency and relative economical efficiency were ranged between 1.10-2.08 and 100-189 % for the control and experimental treatments .The best value for (E.E) and (R.E.E) had been recorded by hens fed diet contained 25% PPM as compared with the control Akinmutimi (2004) demonstrated that economics of rabbits diets with 40% inclusion of sweet potato peels had significant (P<0.05) differences for cost /kg. This may be due to the prices of the test ingredients and also had good weight gain and good revenue. On the other hand, Donkoh land Zanu,(2010) The results of the cost-benefit analysis derived from feeding various dietary agro-industrial by-products indicated that the inclusion of rice bran, maize bran, brewers' spent grains and cocoa pod husk in laying hen diets resulted in economic gains.

Table (9): Input and output analysis and economical efficiency of different treatments during the experimental period.

Item	Experimental treatments				
	Control	15% PPM	20% PPM	25% PPM	30% PPM
Price/kg feed (L.E.) [1]	2.196	1.872	1.743	1.633	1.549
Total feed intake /hen (kg)	5.693	5.528	5.029	4.919	4.901
Total feed coast / hen (L.E.)	12.50	10.35	8.77	8.03	7.59
Total number of egg/hen	52.40	49.81	48.46	49.40	43.34
Total price of eggs/hen (L.E.) [2]	26.20	24.91	24.23	24.70	21.67
Net revenue/hen(L.E.)	13.70	14.56	15.46	16.67	14.08
Economical efficiency (E.E.) [3]	1.10	1.41	1.76	2.08	1.86
Relative EE(%) [4]	100	128	160	189	169

1-Price of potato peels meal (air dried)=105 L.E./ton

2-Price of an egg at the time of experimental period = 0.50 L.E.

3-Net revenue per unit of total feed coast.

4- Relative economical efficiency % of the control. assuming that relative EE of the control =100.

CONCLUSION

From the nutritional and economical efficiency of stand points of view, formulating diets contained 25% Sun dried Potato Peels Meal (DM basis) as a substitute for maize could be recommended to be used successfully and safely in formulating diets for laying hens raising under new reclaiming region without adversely affecting their laying performance or egg quality .

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الاستفادة من مسحوق قشور البطاطس فى علائق الدجاج البياض

منى محمد علي حسن

قسم تغذية الحيوان والدواجن -مركز بحوث الصحراء -المطرية- القاهرة

تم تنفيذ الدراسة الحالية بمحطة بحوث جنوب سيناء(مدينة رأس سدر) التابعة لمركز بحوث الصحراء . أجريت هذه الدراسة لتحديد المستوى الأمثل لإضافة مسحوق قشور البطاطس الجافة كبديل للذرة في علائق الدجاج البياض - استخدم عدد 75 دجاجة بياضه من دجاج اللجهورن الأبيض عمر 40أسبوع وزعت على خمس مجموعات تجريبية بمعدل15 دجاجة لكل مجموعة مقسمة على ثلاث مكررات بكل مكررة خمس دجاجات. أجريت التجربة في تصميم إحصائي أحادي الاتجاه باستخدام خمس مستويات إضافة لمسحوق قشور البطاطس الجافة (صفر , 15, 20, 25, 30 % من مكونات العليقة على أساس المادة الجافة) واستمر البحث لمدة 12 أسبوع وأوضحت النتائج ما يلي :

سجل الدجاج المغذى على العليقة المحتوية على مستوى 25% من مسحوق قشور البطاطس الجافة أعلى قيم معنوية لوزن البيض (48.40 جم), وزن قشرة البيض (4.53%) و وزن لالبيومين البيض (57.07%).

سجل الدجاج المغذى على العليقة المحتوية على مستوى 20% من مسحوق قشور البطاطس الجافة أعلى قيم معنوية لارتفاع البيومين البيض (5.23 مم), وحدات هاو(74.34)

سجل الدجاج المغذى على العليقة الكنترول أعلى قيم معنوية لاستهلاك العلف (69.78 جم/دجاجة/اليوم) مقارنة بباقي المعاملات التجريبية التي أظهرت انخفاضا معنويا في قيم استهلاك الغذاء بزيادة نسبة إضافة مسحوق قشور البطاطس الجافة.

سجل الدجاج انخفاض معنوي متدرج في معاملات الهضم بزيادة مستوى إضافة مسحوق قشور البطاطس الجافة للعليقة, تراوحت قيم المستهلك من ماء الشرب ما بين 190.67 إلى 245 ملل/للطائر/اليوم مع وجود زيادة معنوية بتلك القيم بزيادة نسبة إضافة مسحوق قشور البطاطس الجافة.

لم تلاحظ أي اختلافات معنوية بين المعاملات التجريبية لقيم بعض مكونات سيرم الدم فيما عدا الجلوبيولين حيث سجل الدجاج المغذى على العليقة المحتوية على 30% مسحوق قشور البطاطس الجافة أعلى قيمة معنوية للجلوبيولين مقارنة بباقي المجاميع التجريبية.

تراوحت قيم الكفاءة الاقتصادية ما بين1.10 إلى 2.08 أما الكفاءة الاقتصادية النسبية تراوحت ما بين 100الى 189% للمجموعة الكنترول وباقي المجاميع التجريبية. اظهر الدجاج المغذى على العليقة المحتوية على 25 % مسحوق قشور البطاطس الجافة أفضل قيم للكفاءة الاقتصادية والكفاءة الاقتصادية النسبية مقارنة بباقي المجاميع التجريبية.

يمكن التوصية من الوجهة الغذائية والاقتصادية بإمكانية استخدام مسحوق قشور البطاطس الجافة بنسبة تصل إلى 25% (على أساس المادة الجافة) كبديل للذرة في تكوين علائق الدجاج البياض عند التربية تحت ظروف المناطق الصحراوية دون أدنى تأثير على إنتاجية وجودة البيض .