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Feeding Value of Extracted Coconut Meal for White Leghorn Layers*

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Abstract: An experiment was conducted to study the effect of extracted coconut meal (ECM) on egg production performance, egg quality, carcass characteristics and biochemical parameters from 21 to 52 weeks in one hundred and eighty Single Comb White Leghorn (SCWL) layers. These birds were randomly grouped into five treatments with three replicates of twelve birds each. The treatment groups consisted of 0 (T_1), 5 (T_2), 10 (T_3), 15 (T_4) and 20 percent (T_5) coconut meal inclusion in the egg type chicken diet. The results revealed that five percent coconut meal fed group showed significantly ($P<0.01$) higher body weight when compared to other coconut meal fed groups but it was comparable to control at 52 weeks of age. No significant difference was observed in overall mean feed consumption, feed conversion ratio and livability during the experimental period. Both overall hen housed and hen day egg production significantly ($P<0.05$) reduced in T_5 compared to other treatment groups. Based upon this study, it is recommended to include the coconut meal up to 10 percent in egg type ration for better egg production.

Key words: Coconut meal, white leghorn egg production, egg quality

Introduction

The coconut plant is grown in more than 80 countries in the world. Indonesia and Philippines are the first and second largest coconut producing countries in the world. India is the third largest coconut producing country and it is cultivated in an area of about 1.78 million hectares. The world annual coconut production was 53.00 million tonnes which yielded about 1.80 million tonnes of coconut meal. India's coconut meal production was 0.28 million tonnes which was about 15.4 percent of world production (FAO, 2004). In India, Kerala is the largest producer of coconut followed by Tamil Nadu, Karnataka and Andhra Pradesh.

Matured coconut kernel is called copra. The dried kernel is the chief commercial product from coconut, which is mainly used for oil extraction. Copra normally has an oil content varying from 65 to 72 percent. Coconut meal is the residue left after the extraction of oil from the coconut kernel.

In poultry production, the expenditure towards feed is more than 75 percent and it consists of nearly 35 percent oil cakes / meals as a protein source. Inclusion of locally available oil cakes / meals in poultry feed formulation helps in reduction of feed cost.

The fourth and fifth place for India in world, respectively in egg and poultry meat production (Poultry International Executive Guide, 2004; Mandal *et al.,* 2005) was mainly due to immense production from southern states of India viz. Tamil Nadu and Andhra Pradesh.

The price of coconut meal is fixed on the basis of its crude protein content in the world market and it is declining year by year as compared to other oil cakes (All India Poultry Business Directory, 2003-2004). Since, the coconut meal is available locally in the southern poultry belt of India, the present study on feeding value of coconut meal for egg type chicken was carried out for further development of poultry industry.

Materials and Methods

The biological experiment was conducted in Single Comb White Leghorn (SCWL) layers by feeding diet containing different levels of extracted coconut meal (ECM) from 21 to 52 weeks of age to study the growth, egg production performance, egg quality. One hundred and eighty Single Comb White Leghorn pullets at the age of 16 weeks were purchased and reared for adaptation up to 20 weeks of age. The birds were weighed, leg banded and randomly allotted into five treatment groups with three replicates of 12 birds each. Experimental treatments were

T_1 - Control
T_2 - 5 percent extracted coconut meal
T_3 - 10 percent extracted coconut meal
T_4 - 15 percent extracted coconut meal
T_5 - 20 percent extracted coconut meal

The protein concentrate was prepared on isocaloric and isonitrogenous basis to the extracted coconut meal by mixing locally available extracted groundnut meal (21%), extracted sunflower meal (19%) and deoiled rice bran (60%). The experimental diets were prepared as per BIS (1992) by replacing protein concentrate with extracted coconut meal in graded levels of 0, 5, 10, 15 and 20 percent (Table 1)

Production parameters

Body weight: Initial individual body weight of Single

Table 1: Ingredients and nutrient composition (% DM) of experimental diets

Ingredients	T1	T2	T3	T4	T5
Maize	50	50	50	50	50
Protein concentrate	20	15	10	5	0
Extracted coconut meal	0	5	10	15	20
Soybean meal	15	15	15	15	15
Fish meal	5.1	5.1	5.1	5.1	5.1
Calcite	4	4	4	4	4
Shell grit	5	5	5	5	5
Di-calcium Phosphate	0.9	0.9	0.9	0.9	0.9
Total	100	100	100	100	100
Supplements					
Vitamins AB_2D_3K[1]	0.01	0.01	0.01	0.01	0.01
B-Complex[2]	0.02	0.02	0.02	0.02	0.02
Trace minerals[3]	0.1	0.1	0.1	0.1	0.1
Nutrient composition (percent)					
Crude protein	18.14	18.1	18.07	18.06	18.01
Crude fibre	5.06	5.07	5.08	5.14	5.15
Ether extract	2.47	2.48	2.49	2.5	2.53
Nitrogen Free Extract	60.86	61.84	61.88	61.89	62.18
Total ash	13.47	12.51	12.48	12.41	12.13
Acid Insoluble Ash	1.34	1.35	1.34	1.35	1.35
Calcium	3.91	3.91	3.91	3.9	3.89
Total phosphorus	0.82	0.83	0.84	0.84	0.84
Lysine*	0.63	0.64	0.65	0.65	0.66
Methionine*	0.32	0.32	0.32	0.31	0.32
Metabolizable Energy* (kcal/kg)	2605	2603	2600	2597	2592

[1]One gram of vitamin AB_2D_3K supplement contained 82500 IU of vitamin-A, 50 mg of vitamin-B_2, 12000 IU of vitamin-D_3 and 10mg of vitamin-K. [2]One gram of B - complex supplement contained 80mg of vitamin-B_1, 16mg of vitamin-B_6, 80mcg of vitamin-B_{12}, 80mg of vitamin-E, 120mg of niacin, 8mg of folic acid, 80mg of calcium pantothenate and 86mg of calcium. [3]One gram of trace minerals contained 54mg of manganese, 52mg of zinc, 20mg of iron, 2mg of iodine and 1mg of cobalt. *Calculated values

Comb White Leghorn layers in all treatment groups were recorded at the first day of 21st week of age and subsequently once in every 28 days up to 52 weeks of study period.

Feed consumption: Feed consumption of all the treatment groups were recorded for every 28 days period and the mean total feed consumption per bird per day were calculated.

Egg production: During experimental period, the egg production was recorded daily. Based on data, egg production was calculated in terms of hen day (percent) and hen housed (number).

Feed conversion ratio: Feed conversion ratio was calculated and expressed as kg feed consumed to produce one dozen eggs.

Livability: The mortality of birds was recorded on its occurrence during the experimental period and livability percentage was worked out.

Statistical analysis: All the parametric data obtained in this study were subjected to analysis of variance using statistical techniques as per the method of Snedecor and Cochran (1989). Angular transformation was applied to percentages wherever needed before carrying out the statistical analysis.

Results

Body weight: The analyses of data on mean body weight of SCWL layers did not differ significantly between treatment groups at 21, 24 and 28 weeks of age (Table 2). At 32 weeks of age, T_2 significantly ($P<0.05$) gained body weight compared to T_4 and T_5. There was significant ($P<0.01$) gain (1320.17 g) in body weight in T_2 whereas significant reduction (1189.33 g) in body weight was noticed in T_5 at 36 weeks of age.

At 44 weeks of age, there was a significant ($P<0.01$) reduction in body weight (1254.44 g) of T_5 compared to control (1355.89 g). At 48 and 52 weeks of age, the body weight of hens in T_1 and T_2 groups was significantly ($P<0.01$) improved when compared to T_3, T_4 and T_5.

Feed consumption: The overall mean feed consumption (21 to 52 weeks) did not differ significantly between treatment groups (Table 3). But, the overall mean feed consumption was non significantly higher in T_4 (109.74 g) followed by T_2 (108.98), T_5 (108.93), T_3 (108.76) and T_1 (107.32). Throughout the study period (21 to 52 weeks), no significant difference was observed in feed consumption between treatment groups.

Egg production: Hen housed egg production (HHEP)The over all mean hen housed egg production (21 to 52 weeks) was higher in T_2 (207.26) followed by T_3 (205.40), T_1 (204.50), T_4 (203.77) and T_5 (199.14) during the study period (Table 4).

Table 2: Mean (±S.E.) body weight (g) of Single Comb White Leghorn layers fed diet with different levels of extracted coconut meal

Age (weeks)	Inclusion level of extracted coconut meal				
	T1 - 0%	T2 - 5%	T3 - 10%	T4 - 15%	T5 - 20%
21	1173.53±8.79	1178.67±8.19	1173.83±12.03	1171.72±9.54	1175.81±13.13
24	1220.06±15.45	1243.89±13.38	1235.5±13.34	1222.06±12.29	1198.25±14.22
28	1257.72±14.19	1280.5±12.05	1254.17±10.93	1254.78±14.07	1231.92±13.85
32	1255.19^{ab}±13.44	1292.56^{a}±17.20	1261.11^{ab}±17.13	1235.39^{b}±16.51	1214.28^{b}±21.91
36	1256.44^{ABC}±26.31	1320.17^{A}±18.88	1281.47^{AB}±15.92	1222.33^{BC}±17.65	1189.33^{C}±26.57
40	1299.56±19.32	1305.14±11.75	1299.86±11.29	1265.06±11.54	1265.11±14.21
44	1355.89^{A}±10.64	1355.72^{A}±9.16	1309.92^{AB}±9.01	1290.89^{AB}±10.43	1254.44^{B}±37.02
48	1370.06^{A}±6.58	1372.67^{A}±6.41	1341.75^{B}±6.25	1329.46^{B}±6.03	1328.25^{B}±9.05
52	1413.11^{A}±7.66	1405.33^{A}±8.52	1372.00^{B}±6.79	1367.77^{B}±7.04	1367.77^{B}±7.04

Each value is a mean of 36 observations (Except in T4 from 40 weeks, where each value is a mean of 35 observations).
$^{a-b}$Means within a row with no common superscript differ significantly (P<0.05)
$^{A-C}$Means within a row with no common superscript differ significantly (P<0.01)

Table 3: Mean (±S.E.) feed consumption (g/bird/day) of Single Comb White Leghorn layers fed diet with different levels of extracted coconut meal

Age (weeks)	Inclusion level of extracted coconut meal				
	T1 - 0%	T2 - 5%	T3 - 10%	T4 - 15%	T5 - 20%
21-24	98.1±0.96	102.03±1.53	100.8±0.55	103.71±1.48	101.81±1.10
25-28	99.58±1.08	101.6±0.38	101.18±0.03	102.37±1.25	101.92±3.42
29-32	100.08±3.93	102.62±3.87	103.53±3.22	101.76±0.70	101.17±5.22
33-36	106.67±0.89	109.94±3.42	106.57±2.59	108.78±3.01	105.74±6.30
37-40	111.7±1.32	112.9±0.91	116±0.61	115.93±1.91	116.28±0.73
41-44	113.42±0.42	114.03±0.42	113.02±0.47	114.26±1.72	113.76±4.00
45-48	114.25±0.17	114.44±0.52	114±0.18	115.17±1.30	115.18±0.90
49-52	114.78±0.36	114.26±1.33	114.97±0.18	115.93±2.42	115.59±0.51
Overall (21-52)	107.32±4.58	108.98±3.79	108.76±3.96	109.74±3.85	108.93±4.13

Each value is a mean of three observations

No significant difference in hen housed egg production was observed between treatment groups up to 32 weeks of age. Hen housed egg production in T_4 and T_5 was significantly (P<0.05) reduced compared to control during 33 to 40 weeks of age. Significant (P<0.01) increase in HHEP was observed in T_1, T_2 and T_3 compared to other treatment groups from 41 to 48 weeks of age. However, no difference was observed up to 10 percent level of extracted coconut meal in the diet compared to control group.

Hen day egg production (HDEP): The analyses of variance of data on overall mean (21 to 52 weeks) percent HDEP showed significant (P<0.05) difference between treatment groups (Table 5). The HDEP in T_4 and T_5 were significantly lower during the period from 33 to 36 (P<0.05) and from 41 to 52 weeks (P<0.01) of age when compared to control. Comparison of overall mean indicated that T_5 had significantly (P<0.05) lower HDEP than other treatment groups.

Feed conversion ratio (kg/dozen eggs): The analyses of data on overall mean (21 to 52 weeks) feed conversion ratio did not differ significantly between treatment groups (Table 6). From the beginning of the experiment up to 44 weeks of age, no significant difference was observed in the feed conversion ratio. However, feed conversion ratio was significantly (P<0.05) poor in T_5 from 45 to 48 weeks and in T_4 and T_5 from 49 to 52 weeks when compared to other treatment groups.

Livability: Livability was 100 percent in all treatment groups except one bird mortality in T_4 during the period from 37 to 40 weeks of age. Hence, feeding of extracted coconut meal up to 20 percent in the hens diet did not affect livability

Discussion

Production parameters

Body weight: The mean body weight of Single Comb White Leghorn (SCWL) layers at 52 weeks of age was significantly (P<0.01) low in groups fed diet containing 10, 15 and 20 percent coconut meal compared to 0 and 5 percent coconut meal fed groups. No significant difference was observed in body weight during the initial period of egg production (21 to 28 weeks). Similarly, Thomas and Scott (1962) observed no change in body weight of White Leghorn layers in first 3 months of egg production when fed diet containing 30 percent coconut meal supplemented with 7.5 percent fish meal.

During the experimental period, significant difference was observed in body weight during 32, 36, 44 and 48 weeks of age, in which T_4 and T_5 recorded lower body weight compared to other treatment groups. This result

Table 4: Mean (±S.E.) hen housed egg production (eggs/hen) of Single Comb White Leghorn layers fed diet with different levels of extracted coconut meal

Age (weeks)	Inclusion level of extracted coconut meal				
	T1 - 0%	T2 - 5%	T3 - 10%	T4 - 15%	T5 - 20%
21-24	23.42±0.73	25.22±0.37	24.64±0.10	25.25±0.29	24.28±0.62
25-28	25.44±0.32	25.78±0.43	25.89±0.15	26.11±0.19	24.86±0.39
29-32	25.56±0.17	26.31±0.12	26.06±0.26	26.22±0.12	24.61±0.86
33-36	26.36^{a}±0.17	26.11^{ab}±0.18	25.92^{ab}±0.24	25.61^{b}±0.10	25.33^{b}±0.27
37-40	26.11^{a}±0.07	26.08^{ab}±0.05	25.97^{abc}±0.25	25.28^{bc}±0.14	25.25^{c}±0.27
41-44	26.08^{A}±0.05	26.06^{A}±0.07	25.81^{A}±0.16	25.26^{B}±0.10	25.17^{B}±0.05
45-48	25.92^{A}±0.08	26.03^{A}±0.12	25.78^{A}±0.11	25.23^{B}±0.08	25.08^{B}±0.05
49-52	25.61^{A}±0.10	25.67^{A}±0.19	25.33^{AB}±0.08	24.81^{BC}±0.10	24.56^{C}±0.07
Overall (21-52)	204.50^{b}±1.25	207.26^{a}±1.55	205.40^{ab}±2.01	203.77^{b}±1.74	199.14^{c}±2.05

Each value is a mean of three observations. $^{a-c}$Means within a row with no common superscript differ significantly (P<0.05)
$^{A-C}$Means within a row with no common superscript differ significantly (P<0.01)

indicated that incorporation of coconut meal in the layer diet above 10 percent significantly reduced the body weight in layers. But the body weight at 52 weeks of age in groups fed below 10 percent coconut meal was also non significantly lower compared to control. This was contrary to the findings of Padhi *et al.* (2003) who found increased body weight in layers fed diet containing up to 10 percent coconut meal which might be due to the influence of other feed supplements included in the diet during the experiment.

Feed consumption: Incorporation of coconut meal up to 20 percent in the SCWL layer diet did not affect the feed consumption when compared to control which might be due isocaloric and isonitrogenous diets. This finding was in agreement with Sarkar and Banerjee (1987) who observed no significant difference in feed intake by the pure White Leghorn straight run chicks up to 6 weeks of age fed diet containing 0 to 40 percent deoiled coconut meal. Similarly, Panigrahi (1989) reported that addition of coconut meal at the level of 0, 10, 20 and 40 percent in the diet of Shaver Star Cross-288 hens did not affect the feed intake among treatment groups.

This was contrary to the findings of Wignjosoesastro *et al.* (1972) who recorded significantly (P<0.05) higher feed intake (96.3, 96.8, 99.8, 103.2 and 106.6 g/day/bird in diet containing 0, 10, 20, 30 and 40 percent coconut meal, respectively) in White Leghorn pullets from 24 to 48 weeks of age, which increased linearly as the level of coconut meal was increased from 10 to 40 percent in the diet. This was attributed to poor utilization of coconut meal at higher levels in the diet. Similarly, Padhi *et al.* (2003) found that Nicobari hens fed diet containing 5 percent coconut meal consumed significantly (P<0.05) higher amount of feed (110.70 g/day/bird) compared to 10 (88.00), 15 (88.07) and 0 (80.36 g) percent coconut meal diet.

Egg production

Hen housed egg production: The overall hen housed egg production of 20 percent coconut meal fed group was significantly low (199.14) compared to other treatment groups during the period from 21 to 52 weeks of age. The observation of this study differed from the earlier report of Wignjosoesastro *et al.* (1972) and Kawsar *et al.* (2001). The reduction in hen housed egg production might be due to decreased digestibility of coconut meal as observed in the ileal digestibility trial (Table 5).

The SCWL layers fed diet containing 15 and 20 percent extracted coconut meal showed significant (P<0.05) reduction in hen housed egg production from 33 to 40 weeks and from 41 to 52 weeks (P<0.01) of age compared to control during the study period from 21 to 52 weeks.

Hen day egg production: When coconut meal was fed to SCWL layers from 21 to 52 weeks of age, the statistical analysis showed significant decline in hen day egg production starting from 33 to 36 weeks of age. T_3, T_4 and T_5 had significantly lesser hen day egg production when compared to control during 33 to 36 weeks of age. The same trend was continued in T_4 and T_5 groups from 41 to 52 weeks of age. However, overall mean showed significant (P<0.05) reduction in hen day egg production in T_5 compared to other groups.

This was contrary to the findings of Kawsar *et al.* (2001) who reported that percent hen day production was higher (80.1) in Star Cross Brown-579 commercial layers fed diet containing 20 percent coconut meal and 12 percent soybean meal when compared to 20 percent coconut meal and 10 percent fish meal diet (77.8 percent). Similarly, Thomas and Scott (1962) reported better egg production in White Leghorn layers fed diet containing 30 percent coconut meal supplemented with 7.5 percent fish meal.

Padhi *et al.* (2003) recorded significantly (P<0.05) higher number of eggs (54.0) in Nicobari hens fed diet containing 5 percent coconut meal during the 100 days of experimental period from 30 weeks of age. However, the number of eggs laid by hens fed diet containing 0 (37.0), 10 (40.0) and 15 (40.0) percent coconut meal did

Table 5: Mean (±S.E.) percent hen day egg production of Single Comb White Leghorn layers fed diet with different levels of extracted coconut meal

Age (weeks)	Inclusion level of extracted coconut meal				
	T1 - 0%	T2 - 5%	T3 - 10%	T4 - 15%	T5 - 20%
21-24	83.64±2.59	90.07±1.31	88±0.36	90.18±1.05	86.71±2.21
25-28	90.86±1.14	92.07±1.54	92.46±0.52	93.25±0.69	88.79±1.40
29-32	91.29±0.60	93.96±0.43	93.07±0.95	93.64±0.43	87.9±3.08
33-36	94.14^{a}±0.60	93.25^{ab}±0.65	92.57^{bc}±0.86	91.46^{bc}±0.36	90.46^{c}±0.96
37-40	93.25±0.26	93.14±0.17	92.75±0.88	90.28±1.25	90.18±0.96
41-44	93.14^{A}±0.17	93.07^{A}±0.26	92.18^{A}±0.55	90.21^{B}±0.34	89.89^{B}±0.17
45-48	92.57^{A}±0.30	92.96^{A}±0.43	92.07^{A}±0.40	90.11^{B}±0.27	89.57^{B}±0.17
49-52	91.46^{A}±0.36	91.67^{A}±0.69	90.46^{AB}±0.30	88.61^{B}±0.36	87.71^{B}±0.26
Overall (21-52)	91.29^{a}±1.46	92.52^{a}±0.34	91.70^{a}±0.42	90.97^{a}±0.87	88.90^{b}±0.70

Each value is a mean of three observations. $^{a-c}$Means within a row with no common superscript differ significantly (P<0.05)
$^{A-B}$Means within a row with no common superscript differ significantly (P<0.01)

Table 6: Mean (±S.E.) feed conversion ratio (kg/dozen eggs) of Single Comb White Leghorn layers fed diet with different levels of extracted coconut meal

Age (weeks)	Inclusion level of extracted coconut meal				
	T1 - 0%	T2 - 5%	T3 - 10%	T4 - 15%	T5 - 20%
21-24	1.41±0.03	1.36±0.03	1.37±0.01	1.38±0.00	1.41±0.03
25-28	1.32±0.02	1.33±0.02	1.31±0.01	1.32±0.01	1.38±0.02
29-32	1.32±0.05	1.31±0.05	1.34±0.04	1.3±0.00	1.38±0.02
33-36	1.36±0.01	1.42±0.04	1.38±0.03	1.43±0.03	1.4±0.07
37-40	1.44±0.02	1.45±0.01	1.5±0.01	1.53±0.02	1.55±0.02
41-44	1.46±0.05	1.47±0.01	1.47±0.01	1.52±0.03	1.52±0.05
45-48	1.48^{a}±0.01	1.48^{a}±0.01	1.49^{ab}±0.00	1.53^{ab}±0.03	1.54^{b}±0.01
49-52	1.51^{a}±0.00	1.50^{a}±0.03	1.52^{ab}±0.01	1.57^{b}±0.02	1.58^{b}±0.01
Overall (21-52)	1.41±0.04	1.42±0.05	1.42±0.05	1.44±0.05	1.47±0.05

Each value is a mean of three observations. $^{a-b}$Means within a row with no common superscript differ significantly (P<0.05)

not differ significantly during the study period.

Panigrahi (1989) observed no significant difference in hen day egg production of Shaver Star Cross-288 hens fed diet containing 40 percent coconut meal with high fat content (22.9 percent). This was contrary to the findings of this study, where significant (P<0.05) difference observed in hen day egg production of SCWL layers fed diet containing up to 20 percent extracted coconut meal with low fat content (2.89 percent), which was very low when compared to the coconut meal used by Panigrahi (1989).

Feed conversion ratio (kg/dozen eggs): Feeding of coconut meal up to 20 percent level to SCWL layers did not show any significant effect in overall feed conversion ratio compared to control during the study period from 21 to 52 weeks of age. Whereas, the feed conversion ratio of T_5 was comparable to other treatment groups up to 44 weeks and it was significantly (P<0.05) poor from 45 to 52 weeks of age compared to control.

This was contradictory to the findings of Wignjosoesastro *et al.* (1972) who observed better feed conversion ratio (kg/dozen eggs) in White Leghorn pullets fed diet containing 20 (1.62) percent coconut meal when compared to 10 (1.71), 30 (1.84), 40 (1.97) and 0 (1.97) percent coconut meal fed groups.

The finding of this study was also inconsistent with Padhi *et al.* (2003) who found a poor feed conversion ratio from 2.43 to 2.68 when the level of coconut meal was increased in the layer diet from 5 to 10 percent. But, Thomas and Scott (1962) reported better feed conversion ratios (2.20 in experiment I and 1.82 in experiment II) in White Leghorn layers fed diet containing 30 percent coconut meal and 7.5 percent fish meal. However, the overall feed conversion ratio of T_5 was less which might be due to lower digestibility of coconut meal when incorporated at 20 percent level in the SCWL layers diet.

Livability: Eventhough there was a significant (P<0.01) reduction in body weight at the end of the study period in T_3, T_4 and T_5 compared to control, no significant difference was observed in overall mean livability. Dhara *et al.* (1994); Bera and Mandal (1995) and Kawsar *et al.* (2001) were also reported that livability was not affected by feeding coconut meal to Japanese quail, broilers and commercial layers, respectively.

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