

Feeding Value of Palm Kernel Meal in Layer Diet

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ABSTRACT: A total of forty eight 22-week old Single Comb White Leghorn (SCWL) were used to evaluate the feeding value of palm kernel meal (PKM) in layer diet. The pullets were randomly assigned to four groups of treatment in Completely Randomized Designed (CRD) and fed their respective diets containing 0%, 5%, 10% and 15% PKM. Weekly feed consumption, feed efficiency, egg production and egg weight were monitored for 12 weeks. During the period yolk color and shell thickness were also measured biweekly. Nutrient digestibility of four treatments ration were examined as a supporting data. All data were analyzed using split plot in time in CRD. Trend comparison was used to determine the linear, quadratic and cubic effect of the inclusion levels of PKM (Gomez and Gomez, 1984). A significant interaction between levels of PKM in the diet and weeks of feeding was

observed on all parameters measured ($P < 0.01$) except on feed efficiency. After four weeks applying the treatment, the chicken fed diets with 15% PKM can adjust its condition to produce normal weight of eggs with more intense yellow color of the yolk. However on the sixth week of feeding the egg production decreased while the egg shell thickness became thinner. This result was also supported by the nutrient digestibility. Although differences were not statistically significant as far as the nutrient digestibility study of the ration with increasing level of PKM were concerned, the digestibility of the nutrients tended to decrease with 15% PKM. Within the limits under which this study was conducted it could be concluded that PKM could only be used in layer diet up to 10% without adversely affecting the layer production.

Key Words: Feeding Value, Palm Kernel Meal, Layer Diet

Introduction

Palm kernel meal is abundant in many areas of tropical countries. In Asia and the Pacific, Malaysia ranks first in the production and utilization of oil palm residues followed by Indonesia and Papua New Guinea (FAO, 1988 cited by Tinimit, 1989). Knowing its composition, which is very similar to rice bran (Tinimit, 1989), it is a good source for dietary energy. However based on the protein content which usually range between 15% - 19% (Ortega, 1989 and Onwudike, 1986a), it is also a good source for dietary protein. Incorporating PKM in animal ration should be done in combination with other seed meals, to compensate for the nutritional deficiencies like amino acid deficiency and high fiber content. These limitations could influence the performance of layer fed with PKM, therefore this study aims to evaluate the feeding value of PKM in layer diet.

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Experimental Procedures

Four different diets were used as treatment diets. The PKM was not incorporated in control diet. Three diets were formulated with 5%, 10%, and 15% of PKM. All treatment diets were made more or less isonitrogenous (16.50% crude protein) and isocaloric (2650 kcal ME/kg). The composition and analysis of the diets are presented in Table 1.

The pullets were placed in adjacent layer cages with 2 birds per cage. After an adjustment period of 7 days, the different dietary treatments were randomly distributed to the pullets following a CRD with 6 replications per treatment. The pullets were fed their respective diet *ad libitum*. Clean drinking water was provided at all times. The feeding period lasted for 12 weeks.

Weekly feed consumption, egg production and feed efficiency were monitored. All eggs produced were weighed daily. Egg quality was observed biweekly by measuring the shell thickness using a micro caliper and evaluating the yolk color using a

Table 1. Composition and analysis of the experimental diets with increasing levels of palm kernel meal (PKM)

Ingredient	Percent Inclusion of PKM			
	0	5	10	15
	----- % -----			
Corn	48.000	48.000	48.000	48.000
Soybean meal	21.110	20.770	20.420	20.080
Fish meal	3.000	3.000	3.000	3.000
Rice bran	17.630	12.160	6.680	1.210
PKM	-	5.000	10.000	15.000
Crude coco oil	0.130	0.990	1.870	2.740
Biofos	0.590	0.640	0.680	0.730
limestone	5.880	5.780	5.690	5.590
Oyster shell	3.000	3.000	3.000	3.000
Methionine	0.060	0.060	0.050	0.050
Vit-Min Premix	0.225	0.225	0.225	0.225
Salt	0.300	0.300	0.300	0.300
Anti-oxidant	0.025	0.025	0.030	0.030
Anti-mold	0.050	0.050	0.050	0.050
Total	100.000	100.000	100.000	100.000
Analysis :				
ME, kcal/kg	2685.00	2708.00	2704.00	2714.00
CP, %	16.51	16.65	16.77	16.71
CF, %	3.74	4.34	4.59	4.73
EE, %	4.65	5.21	5.66	6.17
Ca, %	3.01	4.09	3.59	3.23
P, %	0.99	0.87	0.85	0.79

Roche yolk color fan. Nutrient digestibility of the experimental diets were determined by total collection method.

All data gathered were analyzed using split plot in time in CRD. Trend Comparison were used to determine the linear, quadratic, and cubic effect of the inclusion level of PKM (Gomez and Gomez, 1984).

Result and Discussion

Feed consumption

The average daily feed consumption of the birds fed diets with increasing levels of PKM showed more or less the same pattern throughout the feeding period (Table 2). The pullets in all treatments showed increase in feed consumption up to the third week and leveled off on the fourth week. Thereafter to the ninth week, the pullets showed consistent decline in feed consumption. During tenth and eleventh week the feed consumption of the pullets slightly increased and finally decreased on the twelfth week.

Analysis of variance of the data revealed significant interaction between levels of PKM and weeks of feeding on feed consumption ($P < 0.01$). Trend comparison of the weekly data showed that except on the fourth to the eighth, and on the twelfth week, the feed consumption of the pullets showed no significant trend with increased level of PKM in the diet. Although no specific trend was observed in some weeks, the pullets especially those fed diets with 10% and 15% PKM tend to consume slightly lesser amount of feed with increasing PKM in the diets starting on the fifth week (Figure 1). Since the diets used in this study had more or less similar energy content (Table 1), the chicken were expected to have similar feed consumption. Patrick and Schaible (1980) stated that high fiber in the ration affects feed consumption. However the fiber content of the experimental diets remained at tolerable level (Table 1) as it is mentioned by Titus and Fritz (1971). Therefore, the most probable reason for the decrease in feed consumption of the pullets is the grittiness and unpalatable nature of PKM (Onwudike, 1986b). Feed material with such quality,

like wheat bran straws are unpalatable and difficult to eat (Hegde, et al, 1978).

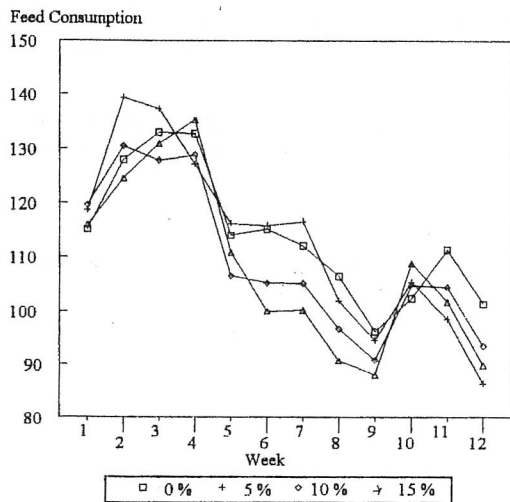


Figure 1. Average daily feed consumption of pullets fed diets with increasing levels of palm kernel meal for 12 weeks, grams per head day.

Egg production

The average percentage egg production of pullets fed diets with increasing levels of PKM for 12 weeks are presented in Table 2. The pullets fed diets with 0%, 5%, 10% and 15% PKM reached their peak of production on the fifth, seventh, sixth and fifth week of feeding period, respectively. Increasing levels of PKM in the diets induced the pullets to reach their peak earlier but at a much lower level of egg production.

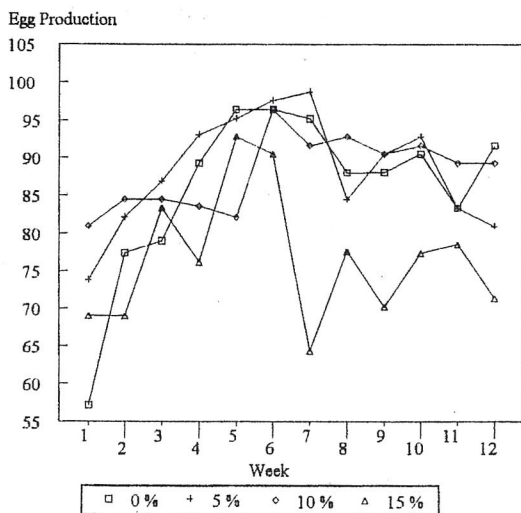


Figure 2. Average weekly egg production of pullets fed diets with increasing levels of palm kernel meal for 12 weeks, percent.

Statistical analysis of the data revealed significant interaction between levels of PKM and weeks of feeding ($P < 0.05$). Comparison of the effects of treatments showed significant trends in some weeks. The result indicate that egg production of pullets throughout the feeding period was not consistently influenced by the inclusion of 5% to 15% PKM. However, inclusion of 15% PKM in the diet more or less consistently depressed egg production of the pullets after six week of feeding (Figure 2). This depression could be attributed to the decrease in feed consumption and decreased nutrient digestibility of diets with 15% PKM. Eventhough no differences were noted, the digestibility of the nutrients tended to decrease with 15% PKM (Table 8).

Feed efficiency

The average feed efficiency of birds fed diets with increasing levels of PKM for 12 weeks are shown in Table 4. On the average, the feed efficiency of the pullets were generally poor and tended to improve from the first to the fourth week. From fifth to twelfth week the feed efficiency of the pullets were generally better but fluctuated inconsistently with increasing level of PKM in the diets (Figure 3).

The feed efficiency of the pullets showed no interaction between levels of PKM in the diet and weeks of feeding, suggesting that inclusion of PKM in the diet up to 15% did not influence the feed efficiency of the pullets throughout the feeding period.

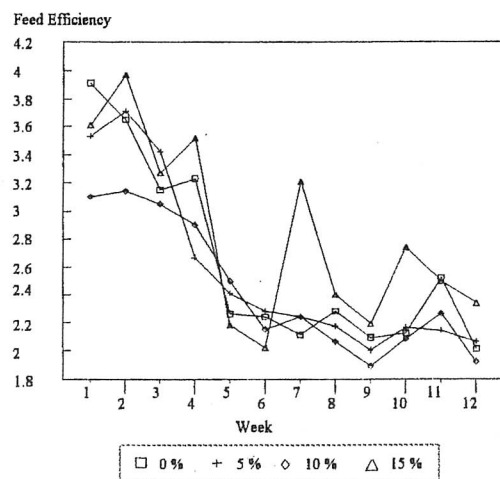


Figure 3. Average weekly feed efficiency of pullets fed diets with increasing levels of palm kernel meal for 12 weeks.

Egg weight

Table 5 showed an average weekly weight of the eggs laid by pullets from the different treatments throughout the 12-week period. Analysis of variance of the data revealed significant interaction ($P < 0.01$) between levels of PKM and weeks of feeding on egg size. Trend comparison of the weekly data showed significant linear decrease in egg weight with increased PKM in the diet during the second ($P < 0.05$), third ($P < 0.01$), sixth and eighth ($P < 0.01$) weeks of the feeding period.

The results suggest that the inclusion of PKM in the diets up to 10% slightly depressed the increased in egg size throughout the feeding period. The inclusion of 15% PKM in diet drastically depressed the egg weight during the first 4 weeks (Figure 4). However, as the feeding period progressed, they gradually recovered to their normal egg weight. Egg weight depression during the early part of the feeding period could be due to the sudden shift from the standard layer ration to the experimental layer diet which included PKM. This sudden switch without prior conditioning could have disturbed the hen's digestive system. However the birds were apparently capable of anatomical and physiological adaptation to the new ration (Kondra et al., 1974) as evidenced by their ability to produce eggs with lesser weight difference from the control group after eight weeks.

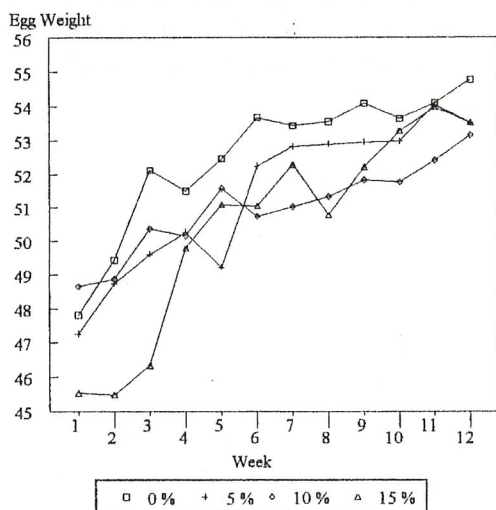


Figure 4. Average egg weight laid by pullets fed diets with increasing levels of palm kernel meal for 12 weeks, grams per head per day.

Shell thickness

The shell thickness of eggs laid by pullets fed diets with increasing level of PKM are presented at

Table 6. Statistical analysis showed significant interaction between levels of PKM and weeks of feeding on shell thickness of egg produced by the pullets. Trend comparison of the data revealed that except on the second and fourth week, significant trends were noted.

During the first four weeks, eggs laid by pullets fed diets with 0%, 5%, 10%, and 15% PKM had more or less similar shell thickness. Pullets fed diets with 0%, 5%, and 10% PKM maintained similar egg shell thickness until the end of feeding trial. However, starting on the sixth week up to the end of the feeding, the pullets fed diet with 15% PKM had significantly thinner egg shell as compare to the egg of the other treatments (Figure 5).

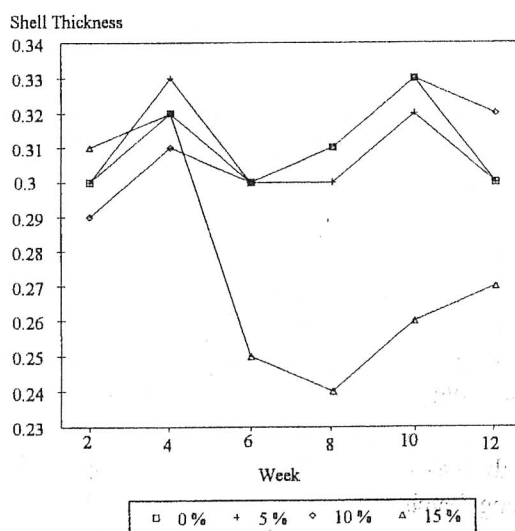


Figure 5. Average biweekly shell thickness of eggs laid by pullets fed diets with increasing levels of palm kernel meal for 12 weeks, mm.

Yolk color

Generally, the yolk color score of eggs laid by the pullets showed inconsistent trend throughout the feeding period with increasing level of PKM (Table 7). Statistical analysis of the data revealed significant interaction between the levels of PKM and weeks of feeding on yolk color score ($P < 0.05$). Trend comparison of the biweekly data showed significant trends in yolk color score with increased PKM in the diets.

Inclusion of PKM in the diets tended to increase yolk color score of eggs laid by the pullets. Pullets fed diet with 15% PKM had the highest yolk color score (Figure 6). The increased in yolk color score of eggs produced by pullets fed diets with increased levels of PKM could be attributed to the increased

levels of fat in the ration (Table 1). The fat of the ration had high digestibility. Although statistically was not significant, the fat digestibility increased as the level of PKM increased (Table 8). The fat content of the diet with 15% PKM improved the absorption of xanthophyll (Patrick and Scaible, 1980), which resulted in a more intense yellow color of the yolk of eggs produced.

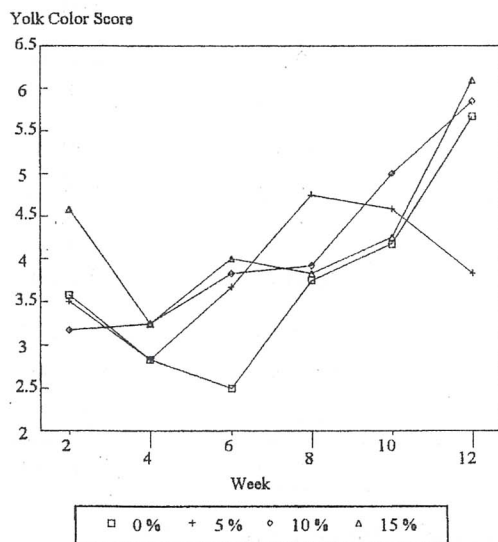


Figure 6. Average biweekly yolk color score laid by pullets fed diets with increasing levels of palm kernel meal for 12 weeks.

Conclusion

The pullets fed diets with 15% PKM can adjust its condition after four week applying the treatment to produce normal weight of eggs with more intense yellow color of the yolk. On the other hand the egg shell became thinner as compare with those fed diets with 0%, 5%, and 10% PKM.

While the feed consumption and egg production of the pullets decreased when the ration was added with 15% PKM. Therefore it could be used in layer diets up to 10% without affecting the performance of the pullets.

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Table 2. Average daily feed consumption of pullets fed diets with increasing levels of palm kernel meal (PKM) for 12 weeks, grams per pullet per day¹.

Week	% Inclusion of PKM			
	0	5	10	15
1 ^a	115.15	118.66	119.59	115.96
2 ^a	127.91	139.35	130.46	124.54
3 ^a	133.00	137.25	127.81	130.91
4 ^b	132.74	127.09	128.75	135.18
5 ^c	114.05	116.20	106.50	110.88
6 ^d	115.18	115.84	105.17	100.00
7 ^e	112.08	116.60	105.12	100.24
8 ^d	106.45	101.93	96.76	90.78
9 ^a	96.23	94.55	90.90	88.09
10 ^a	102.32	105.42	104.80	108.80
11 ^a	111.38	98.55	104.40	101.80
12 ^c	101.35	86.41	93.50	89.90
Average	113.99	113.15	109.48	108.09

1. Each entry is the average of six replicates with 2 pullets per replicate.

a. No significant trend, b. Quadratic (P<0.05), c. Cubic (P<0.05), d. Linear (P<0.01), e. Linear (P<0,05)

Table 3. Average percentage egg production of pullets fed diets with increasing levels of palm kernel meal (PKM) for 12 weeks¹.

Week	% Inclusion of PKM			
	0	5	10	15
1 ^b	57.14	73.81	80.95	69.05
2 ^b	77.38	82.14	84.52	69.05
3 ^a	79.05	86.91	84.52	83.33
4 ^a	89.29	93.10	83.57	76.19
5 ^a	96.43	95.24	82.14	92.86
6 ^a	96.43	97.62	96.43	90.48
7 ^b	95.24	98.81	91.67	64.28
8 ^a	88.10	84.52	92.86	77.62
9 ^b	88.11	90.48	90.48	70.24
10 ^a	90.48	92.86	91.67	77.38
11 ^a	83.33	83.33	89.29	78.57
12 ^c	91.67	80.95	89.29	71.43
Average	86.05	88.31	88.12	76.71

1. Each entry is the average of six replicates with 2 pullets per replicate a. No significant trend

b. Quadratic (P<0.05), c. Cubic (P<0.05)

Table 4. Average weekly feed efficiency of pullets fed diets with increasing levels of palm kernel meal (PKM) for 12 weeks¹.

Week	% Inclusion of PKM			
	0	5	10	15
1 ^a	3.91	3.53	3.10	3.61
2 ^a	3.65	3.71	3.14	3.97
3 ^a	3.15	3.42	3.05	3.27
4 ^a	3.23	2.67	2.90	3.52
5 ^a	2.26	2.41	2.50	2.18
6 ^a	2.24	2.28	2.15	2.02
7 ^a	2.11	2.24	2.24	3.21
8 ^a	2.28	2.17	2.06	2.40
9 ^a	2.09	2.00	1.89	2.19
10 ^b	2.12	2.16	2.08	2.74
11 ^a	2.52	2.14	2.26	2.50
12 ^a	2.01	2.06	1.92	2.34
Average	2.63	2.57	2.44	2.83

1. Each entry is the average of six replicates with 2 pullets per replicate
a. No significant trend, b. Cubic ($P < 0.05$)

Table 5. Average weight of egg laid by pullets fed diets with increasing levels of palm kernel meal (PKM) for 12 weeks, g per pullet per day¹.

Week	% Inclusion of PKM			
	0	5	10	15
1 ^a	47.81	47.26	48.65	45.55
2 ^b	49.43	48.74	48.87	45.50
3 ^c	52.12	49.59	50.36	46.34
4 ^a	51.50	50.25	50.15	49.79
5 ^a	52.46	49.21	51.58	51.09
6 ^b	53.67	52.24	50.73	51.05
7 ^a	53.43	52.82	51.03	52.29
8 ^b	53.54	52.89	51.33	50.77
9 ^a	54.09	52.94	51.82	52.22
10 ^a	53.63	52.97	51.76	53.27
11 ^a	54.10	54.04	52.41	53.97
12 ^a	54.77	53.52	53.14	53.52
Average	52.55	51.37	50.99	50.45

1. Each entry is the average of six replicates with 2 pullets per replicate.
a. No significant trend, b. Linear ($P < 0.05$), c. Linear ($P < 0.01$)

Table 6. Average biweekly shell thickness of egg laid by pullets fed diets with increasing levels of palm kernel meal (PKM) for 12 weeks, mm¹.

Week	% Inclusion of PKM			
	0	5	10	15
2 ^a	0.30	0.30	0.29	0.31
4 ^a	0.32	0.33	0.31	0.32
6 ^c	0.30	0.30	0.30	0.25
8 ^b	0.31	0.30	0.31	0.24
10 ^d	0.33	0.32	0.33	0.26
12 ^c	0.30	0.30	0.32	0.27
Average	0.31	0.31	0.31	0.28

1. Each entry is the average of six replicates with 2 pullets per replicate.

a. No significant trend

b. Linear (P<0.01)

c. Quadratic (P<0.01)

d. Cubic (P<0.05)

Table 7. Average biweekly yolk color of egg laid by pullets fed diets with increasing levels of palm kernel meal (PKM) for 12 weeks^{1,2}.

Weeks	% Inclusion of PKM			
	0	5	10	15
2 ^a	3.58	3.50	3.17	4.58
4 ^c	2.83	2.83	3.25	3.25
6 ^a	2.50	3.67	3.83	4.00
8 ^d	3.75	4.75	3.92	3.83
10 ^b	4.17	4.58	5.00	4.25
12 ^d	5.67	3.83	5.85	6.10
Average	3.75	3.86	4.17	4.34

1. Each entry is the average of six replicates with 2 pullets per replicate.

2. The scoring number of egg yolk color ranged from whole number of 1 to 16 with 1 having the most pale and 16 the most intense yellow color of the egg yolk.

a. No significant

b. Linear (P<0.05)

c. Linear (P<0.01)

d. Cubic (P<0.05)

Table 8. Coefficient of digestion of nutrient in layer diets with different levels of palm kernel meal (PKM)¹.

Inclusion of PKM	Coefficient of Digestion				
	DM (a)	CP (a)	CF (a)	EE (a)	NFE (b)
			----- % -----		
0%	70.89	40.16	31.98	90.25	86.72
5%	72.55	44.78	35.85	91.06	86.86
10%	77.24	56.79	44.03	91.37	89.10
15%	71.97	41.07	32.09	92.32	85.13
C.V. %	6.07	27.66	22.01	2.64	2.77

1. Each entry is the average of six replicates.

(a) No significant trend

(b) Quadratic (P<0.05)

DM = Dry matter; CP = Crude protein;

CF = Crude fiber; EE = Ether extract;

NFE = Nitrogen free extract

C.V = Coefficient of variation