The effect of four levels of palm kernel meal in broiler diets [1]

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Abstract. Palm kernel meal (PKM) is a by-product obtained from palm oil extraction of the seed of the African Palm (*Elaeis guinensis*). Honduras is one of the largest producers and exporters of palm oil in Central America. Due to its availability, PKM could be used as a potential feed ingredient in poultry diets. This experiment was conducted to evaluate the effect of using four levels of PKM in broiler diets. Four levels of PKM were used in a corn-soybean based diet and fed to chicks from 0 to 42 days of age. The levels were 0, 10, 20, and 30%. Body weights and feed conversion were not significantly different between control and 10% PKM, but were decreased by the higher levels of PKM. Carcass weight was reduced by all levels of PKM but only by 6% when 10% PKM was used. Feed consumption and carcass yield lowered as levels of PKM increased. Percent mortality significantly elevated when 20 and 30% PKM was used in the diet. This suggests that no more than 10% of this particular PKM can be used without having major effect on broiler performance or carcass yield.

Key words: African palm, palm kernel meal, feedstuff.

Resumen. La harina de coquito es un sub-producto de la extracción del aceite de la semilla de la palma africana (*Elaeis guinensis*). Honduras es una de los más grandes productores y exportadores de aceite de palma en Centro América. Debido a su disponibilidad, la harina de coquito tiene el potencial de ser usada como un ingrediente en las dietas de las aves. Este experimento fue realizado para evaluar el efecto del uso de harina de coquito en dietas de pollos de engorde. Cuatro niveles de harina de coquito fueron usados en dietas basadas en maíz y harina de soya y alimentados a los pollos de engorde desde 0 a 42 días de edad. Los niveles fueron 0, 10, 20 y 30%. Los pesos corporales y las conversiones alimenticas no fueron significativamente diferentes entre el control y 10% de harina de coquito, los pesos disminuyeron con los niveles más altos de harina de coquito. El peso en canal se redujo con todo los niveles usados, pero sólo 6% cuando se usó 10% de harina de coquito. El consumo de alimento y rendimiento en canal disminuyeron al incrementar los niveles de harina de coquito. El porcentaje de mortalidad significativamente se elevó cuando se usó 20 y 30% de harina de coquito. Esto nos surgiere que no más del 10% de harina de coquito puede ser usado, sin tener mayor efecto sobre la productividad y rendimiento en canal de los pollos de engorde.

Palabras claves: Harina de coquito, ingrediente, palma africana.

INTRODUCTION

The poultry industry in Latin America has frequently encountered problems in obtaining feed ingredients that are available, economical, and of adequate nutritional quality to support growth. Attempts to cut costs have revolved around finding cheap and available substitutes, generally of agro-industrial origin. For this reason, there is a need to evaluate other products or by-products native to the region that can substitute for conventional feedstuffs such as corn, soybean meal, meat meal, which in most cases are imported or are in limited supply.

The African palm oil industry is a major supplier of vegetable oil on the world market, supplying approximately 16% of all oils produced. Palm kernel meal (PKM) is the residue discarded from the extraction of oil from the African palm (*Elaeis guinensis*) fruit. About 20% of oil is extracted from the fruit either by solvent or mechanical extraction, the residue left is basically composed of fiber and kernel which is the seed found in the core of the fruit, effluents, and water. The kernel is put through a process of oil extraction and the oil is used in the production of cosmetics, soaps and food industry and the remaining residue is considered to be PKM which can be used as animal feed, (Zumbado,1990). Little attention has been given to this by-product as a feed ingredient for poultry. Armas and Chicco (1977) fed groups of 5-d-old broilers diets that were isocaloric and iso-nitrogenous containing various levels of PKM with or without supplemental lysine and methionine and compared it to a control ration with-

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out PKM. They found that the average weight of birds from 4 to 6 wk of age was lower with 45% PKM in the diets compared to 15 or 30% PKM. Supplementation with lysine and methionine improved the growth of broilers fed with 45% PKM. It was also observed that feed efficiency decreased with increasing PKM in the diet. Nwokolo *et al.* (1976) studied the availability of amino acids in PKM, soybean meal, cottonseed meal and rapeseed meal for growing chicks. They found that the amino acid availability of PKM ranged from glycine 63.3% to arginine 93.2% with an average of 84.5%, compared to 97.3% in soybean meal, 92.5% in cottonseed meal and 91.9% in rapeseed meal. It was suggested that PKM could be a reasonable source of protein for poultry. Yeong (1983) also tested amino acid availability in PKM and found values lower (64.4%) than those reported by Nwokolo *et al.* (1976). McDonald *et al.* (1982) suggested that PKM in diets of poultry should be limited to 20%. Osei and Amo (1987) fed broilers different levels of PKM up to 15% in isonitrogenous diets. They found no significant difference for body weight and feed consumption up to 8 wk of age. Feed conversion in contrast, significantly declined as PKM levels reached 12.5% of the diet or higher. Yeong *et al.* (1981) fed various levels of PKM up to 30% to broilers in isocaloric and isonitrogenous diets. They found no significant differences in daily feed intake and daily weight gain among treatments. However, a significantly better feed conversion ratio was observed for treatments fed the control diet and diets containing lower levels of PKM. The inclusion of PKM did not affect the overall performance of birds at 10 wk of age. The objective of this study was to evaluate the optimum level of locally produced PKM that can be used in broiler diets.

Table 1. Analysis of palm kernel meal with oil mechanically extracted (as fed basis)

Components	Palm kernel meal (%)
Dry matter[1]	91.40
Crude protein[1]	9.70
Ether extract[1]	12.10
Ash[1]	2.90
Crude fiber[1]	24.90
TME_n, kcal/kg[2]	2,254
Amino acid, %[3]	
Methionine	0.20
Lysine	0.36
Arginine	1.18
Tryptophan	0.07
Threonine	0.31
Aspartic acid	0.76
Serine	0.34
Glutamic acid	1.53
Proline	0.33
Glycine	0.43
Alanine	0.41
Cysteine	0.14
Valine	0.49
Isoleucine	0.34
Leucine	0.62
Tyrosine	0.21
Phenylalanine	0.39
Histidine	0.18

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MATERIAL AND METHODS

Prior to formulation a proximate analysis and other analyses (Table 1) were performed on samples of PKM in accordance with the AOAC (1990). An amino acid profile was also determined. Metabolizable energy values were determined using methodology established by Sibbald (1976).

We received 1600 one-day -old Peterson x Hubbard®[1] male, broiler chicks from a commercial hatchery and placed in an open-sided naturally ventilated broiler house with a photo-regimen of 24 h light. One hundred chicks were weighed individually and randomly assigned in each of 16 pens (3 x 4 m) at a density of 8.33 birds per square meter. Four replicates in blocks containing each of the four treatments were allocated to the 16 pens in a randomized complete block design. Each pen

[1]Peterson Farms, Decatur, AR 72722; Hubbard Farms, Walpole, NH 03608.

was heated by an electric brooder and provided with a bell waterer and tube feeders. Experimental diets (Table 2) and water were provided free choice. The treatments consisted of 0, 10, 20, and 30% of PKM in the diet. Body weight, cumulative feed consumption and feed conversion (feed:gain) were determined for each pen at 7, 14, 21, 28, 35, and 42 d of age. Deaths were recorded daily. Carcass weight and percentage yield without giblets (WOG) were determined prechilled on 50% of bird population.

The yield WOG was calculated by dividing carcass weight (without the liver, heart, gizzard and neck) by live weight. A second trial was conducted using the same treatment and procedures.

Data from each trial were evaluated by ANOVA using General Linear Models (GLM) procedures (SAS Institute, 1991). Preliminary ANOVA indicated a non-significant trial effect; therefore, the data from the two trials from each experiment were pooled. Percentage data were subjected to arc sine square root of the percentage transformation and treatment means separated by the test of least significant difference. A probability of ($P < 0.05$) was required for significance.

RESULTS AND DISCUSSION

Broiler´s weekly body weights decreased significantly ($P < 0.05$) with 30% PKM, frequently did so with 20% PKM especially at the older ages, but were not significantly different with 10% PKM except during the first

Table 2. Composition of experimental diets.

Ingredients and analysis	Starter[1]				Grower[1]				Finisher[1]			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
	(%)				(%)				(%)			
Ground corn	52.72	40.26	27.81	15.36	60.02	47.57	35.11	22.66	64.68	52.23	39.77	27.32
Soybean meal (46% CP)	39.13	39.18	39.13	39.28	31.66	31.71	31.77	31.82	27.76	27.81	27.86	27.91
Palm kernel meal	0.00	10.00	20.00	30.00	0.00	10.00	20.00	30.00	0.00	10.00	20.00	30.00
Dicalcium phosphate	1.24	1.25	1.26	1.27	1.11	1.12	1.13	1.14	1.12	1.13	1.14	1.15
Ground limestone	1.76	1.70	1.65	1.59	1.58	1.53	1.48	1.42	1.52	1.47	1.41	1.36
Salt (NaCl)	0.30	1.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin + mineral premix[2]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Coban 60®[3]	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Surmax®[4]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Vegetable oil	4.31	6.75	9.19	11.63	4.77	7.21	9.66	12.10	4.00	6.45	8.89	11.33
DL-methionine	0.13	0.13	0.14	0.14	0.13	0.14	0.14	0.14	0.12	0.13	0.13	0.13
Calculated analyses												
Crude protein	23.00	23.00	23.00	23.00	20.00	20.00	20.00	20.00	18.50	18.50	18.50	18.50
ME, kcal/kg	3100	3100	3100	3100	3200	3200	3200	3200	3200	3200	3200	3200
Calcium	0.95	0.95	0.95	0.95	0.85	0.85	0.85	0.85	0.82	0.82	0.82	0.82
Available phosphonus	0.47	0.47	0.47	0.47	0.42	0.42	0.42	0.42	0.41	0.41	0.41	0.41
Methionine	0.50	0.50	0.50	0.50	0.46	0.46	0.46	0.46	0.43	0.43	0.43	0.43
Lysine	1.36	1.36	1.36	1.36	1.14	1.14	1.14	1.14	1.10	1.10	1.10	1.10

[1] T1 = Control; T2-T4 = 10, 20, 30% palm kernel meal, respectively.

[2] The vitamin and mineral premix provide the following quantities per kilogram of diet: vitamin A, 10,000 IU (all-trans-retinal); cholecalciferol, 2,500 IU; vitamin E, 10 IU (dl- -tocopheryl): vitamin K_3, 2 mg; riboflavin, 5 mg; niacin, 35 mg; D-calcium pantothenic acid, 10 mg; choline chloride, 250 mg; B_{12}; 12 mg, folic acid, 0.75 mg; manganese, 70 mg; zinc, 50 mg; iron, 30 mg; copper, 10 mg; iodine, 1.5 mg; cobalt, 0.15 mg; selenium, 0.10 mg; mold inhibitor, 7 mg; antioxidant, 10 mg.

[3] For prevention of coccidiosis, 0.54 g monensin sodium /kg diet.

[4] Broad spectrom antibiotic, 0.4g avilamycin/kg.

Table 3. The effect of four levels of palm kernel meal in broiler diets on body weight, feed consumption, and feed conversion.

	palm kernel meal				
Parameter	0%	10%	20%	30%	SEM
Body weight, g					
Day 7	140 a	133 b	127b	125 b	3.23
Day 14	326 a	306 a	298a	262 b	13.66
Day 21	679 a	667 a	644a	556 b	25.72
Day 28	1130 a	1077 a	1048 a	923 b	35.52
Day 35	1660 a	1582 ab	1492 b	1378 c	46.81
Day 42	2101 a	2001 ab	1912 ab	1829 c	51.05
Feed consumption, g/bird					
Day 7	128	116	118	121	4.92
Day 14	456	423	413	413	17.91
Day 21	1052	985	1015	976	34.87
Day 28	1932	1787	1870	1826	59.46
Day 35	3049 a	2777 b	2904 ab	2906 ab	92.85
Day 42	3946 a	3604 b	3668 ab	3809 ab	116.52
Feed conversion, g feed: g body weight					
Day 7	0.91	0.86	0.93	0.96	0.038
Day 14	1.39 a	1.34 a	1.42 a	1.61 b	0.061
Day 21	1.55 a	1.47 a	1.57 b	1.76 b	0.050
Day 28	1.71 a	1.65 a	1.78 a	1.98 b	0.069
Day 35	1.84 ab	1.75 b	1.95 a	2.08 c	0.056
Day 42	1.88 ab	1.79 b	1.97 bc	2.11 c	0.065

[abc] Means within rows without common superscript are significantly different ($P < 0.05$).

week (Table 3). No significant differences were found for feed consumption among treatments for days 7, 14, 21, and 28 but at 35 and 42 days feed consumption with 0% PKM was significantly higher than with 10% but not with 20 or 30% PKM. Feed conversion was significantly poorer only for birds consuming diets with 30% PKM when compared to those consuming diets with 0, 10, and 20% PKM during the entire growing period. Our results in general agree with those of Yeong *et al.* (1981) who fed birds PKM from 10 to 30% in the diet. They observed that feed intake was significantly ($P < 0.05$) higher in diets with high PKM levels as compared to the corn-soybean control diet. Body weight and feed conversion ratio were also superior with birds fed the control diet and diets with less amount of PKM. Armas and Chicco (1977) observed similar results using levels of PKM from 15 to 45% in broiler diets. Osei and Amo (1987) found no adverse affects on bird performance when using levels as high as 15% in broiler diets, although a significant decrease in feed efficiency was observed as PKM reached 10% in the diet. Using levels from 0 to 20% of whole palm kernel meal, which is unextracted and thus contains all the oil, Zumbado *et al.* (1992) found that weight gain and feed:gain ratio were significantly improved as levels of whole palm kernel meal increased up to 10%. Higher levels did show a non- significant improvement compared to 10%, but were still significantly better than those of the control group. This increase in bird performance as WPKM increased in the diet was most likely due to the elevated energy content of the diet since they were not isocaloric.

Table 4. The effect of palm kernel meal on mortality, carcass weight, and percentage carcass yield.

Palm kernel meal (%)	Mortality (%)	Carcass weight (g)	Carcass yield (%)
0	2.94 a	1425 a	69.1 a
10	2.68 a	1364 b	68.1 a
20	4. 21 b	1296 b	67. 8 a
30	5. 52 b	1178 c	64.4 b
SEM	0.021	41.47	0.013

[abc] Means within rows without common superscript are significantly different ($P < 0.05$).

Mortality was higher with birds fed 20 and 30% PKM (Table 4). The reasons for this is unknown. Carcass weight decreased as PKM increased in the diet. Carcass yield was significantly ($P < 0.05$) lower only for birds fed 30% PKM. Contrary to these findings Yeong (1983) found no significant differences for carcass characteristics when feeding different levels of PKM to broilers.

The reduction in bird performance as dietary levels of PKM increased may be due to the increasing fiber content of the diets (starter, 2.70, 4.83, 6.96, and 9.09%; grower, 2.09, 4.82, 6.95, and 9.08%; finisher, 2.71, 4.84, 6.97, and 9.10%, respectively). Based on its proximate analysis and energy value (Table 1), PKM is a fibrous and low energy feedstuff. The level of crude protein and amino acids are comparable to most common cereal by-products used in poultry rations. But according to the results of this experiment, 10% would be the maximum PKM that might be used successfully, although lower levels might be more compatible with optimum performance and should be studied.

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