

RESPONSE OF LAYING HENS TO DIFFERENT INCLUSION LEVELS OF PALM KERNEL MEAL AND VEGETABLE OIL

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ABSTRACT

Palm kernel meal (PKM) was isonitrogenously substituted at 15.9 and 31.8% into a maize-groundnut meal based diet and balanced for dietary energy by adding 2.5 or 5.0% vegetable oil as palm oil (PO) or palm kernel oil (PKO). The five diets including the basal diet were fed to 26 week old Ross brown pullets for 12 weeks. The utilization of major nutrients and production performance were unaffected by the inclusion of 15.9% PKM with either of the two oils. Increased egg output for birds fed this level offset the noted increase in feed intake. Depressed dry matter, energy and crude fibre retention, were associated with 31.8% PKM in the diet but hen day egg production, egg weight and efficiency of feed conversion were not adversely affected. The contribution of oils to efficient utilization of a diet containing a fibre source as palm kernel meal, apart from boosting up dietary energy, is discussed along with the advantage that may accrue with the feeding of either palm oil or palm kernel oil.

Key Words: Laying hens; palm kernel meal; vegetable oil; performance; nutrient utilization.

INTRODUCTION

Palm kernel meal (PKM) is a by-product of the mechanical extraction of oil from the endosperm of the oil palm fruit *Elais guineensis*. The possible use of this meal as a source of protein and energy in livestock rations, has been tested for poultry (Armas and Chicco, 1977), pigs (Babatunde *et al*, 1975), cattle (Witt, 1952), sheep and goats (Davendra, 1978). Limited levels were recommended for pigs and poultry by Nwokolo *et al*, (1976) and Fetuga *et al*, (1977), based on its high fibre content and poor availability of energy, protein and minerals. Studies (Onwudike 1986a,b,c) have shown that, contrary to earlier views, PKM would replace up to 60% of the protein in groundnut meal in the diet

of broilers, pullet starters and growers, thereby permitting incorporation of 28-38% of PKM. Yeong (1980) observed that diets containing graded levels of PKM, up to 40%, when fed to broilers, depressed body weight gain and feed efficiency at levels beyond 20%. Yeong *et al* (1981) noted however, that palm oil supplementation at higher PKM dietary levels improved texture of diet and also birds' performance. This suggests that lowering of dietary energy, which accompany PKM inclusion into poultry diets, may be a major problem in the feeding of this by-product apart from poor palatability and lowered acceptability, attributable to the gritiness of such diets with consequent reduction in feed intake.

This paper reports the effects of substitut-

ing two levels of palm kernel meal supplemented with two different vegetable oils, palm oil (PO) and palm kernel oil (PKO) into a maize-groundnut meal-based diet on nutrient utilization for egg production, during the early part of the laying year.

MATERIALS AND METHODS

Diets

Four diets were formulated by replacing 25% and 50% of the protein supplied by groundnut cake in a maize-groundnut cake based diet (basal diet) with PKM, and supplementing the diets with vegetable oil, so as not to alter significantly, the calculated calorie: protein ratio of 1.56. The vegetable oils used were palm oil (PO) and palm kernel oil (PKO). This method of substitution into the basal diet permitted the inclusion of 15.9% and 31.8% PKM (Table 1). All diets were balanced with respect to methionine and lysine.

Animals

Sixty 26 week old Ross Brown pullets were randomly assigned to the five dietary treatments at the rate of 12 birds, housed two per cage. Diets and water were offered *ad libitum*. Food intake was measured daily and body weight weekly. During the last week of the twelve week experimental period, six birds per treatment were transferred to metabolism cages and individually housed for balance studies. Droppings for each bird were collected over a 5 day period and dried at 60°C.

Egg production

Records of egg production per cage was kept daily throughout the experimental period. All eggs laid on 3 consecutive days, each week, were weighed individually and measured for shell thickness using a micrometer screw gauge and albumen

height, using a spherometer to enable calculation of the Haugh unit.

Analytical methods

The proximate analyses of diets and droppings, were carried out (A.O.A.C., 1975). Their gross energy values were determined in a ballistic bomb calorimeter (Gallenkamp). Egg yolks were analysed in duplicate for cholesterol by the procedure of Folch *et al*, (1956) as modified (Washburn and Nix, 1974).

All data were subjected to analysis of variance with assessment of differences by the Multiple Range Test (Steel and Torrie, 1960).

RESULTS

No mortality was recorded throughout the 12 week period. The mean feed intake, hen-day egg production and efficiency of feed conversion for the layers, are presented in Table 2. With the exception of the diet containing 31.8% + 5% PKO, feed consumption increased significantly ($P < 0.05$) as a result of PKM inclusion in the basal diet. This rise in feed intake was reflected in the overall rate of egg production for the 15.9% PKM diet supplemented with 2.5% of either of the vegetable oils. Birds on these diets produced a greater number of eggs, although effect was not statistically significant, just as for food conversion efficiency. These aspects of performance also seemed to have evened out thereby resulting in comparable egg weights among all diets, except for the high PKM diet with palm kernel oil.

Metabolizable energy of diets and retention of nutrients with the exception of ether extract and crude protein were significantly better ($P < 0.05$) at the lower levels of dietary palm kernel meal and vegetable oil (Table 3). The internal quality of egg measured did not reveal any detrimental effect of added oil over the basal (Table 4) diet

Table 1
Composition of experimental diets (%)

Treatment No.	D I E T S				
	1	2	3	4	5
<i>Ingredients</i>					
Maize	62.5	47.2	47.2	34.3	34.3
Groundnut meal	25.4	19.2	19.2	12.7	12.7
Blood meal	2.0	3.0	3.0	4.0	4.0
Palm kernel meal	—	15.9	15.9	31.8	31.8
Oyster shell	7.0	7.0	7.0	7.0	7.0
Bone meal	4.0	4.0	4.0	4.0	4.0
Vitamin-mineral premix ¹	0.5	0.5	0.5	0.5	—
Palm oil	10	2.5	—	5.0	—
Palm kernel oil	—	—	2.5	—	5.0
Salt	0.3	0.3	0.3	0.3	0.3
Methionine	0.3	0.3	0.3	0.3	0.3
Lysine	0.1	0.1	0.1	0.1	0.1
<i>Determined Chemical Composition</i>					
Dry matter (%)	93.2	93.1	91.2	93.7	93.2
Crude protein: N x 6.25 (%)	19.9	20.0	20.1	18.8	18.7
Crude fibre (%)	2.7	3.5	3.4	3.9	3.8
Ether Extract (%)	5.0	6.9	6.8	7.1	7.1
Ash (%)	4.9	5.0	5.1	5.0	5.0
Nitrogen free extract	67.5	65.6	64.6	65.2	65.4
Gross energy (MJ/kg)	17.2	17.5	17.4	16.9	17.1

¹ Longe (1984).

Table 2
Effect of level of dietary palm kernel meal and vegetable oil on the performance of laying hens

Parameters	D I E T S				
	1	2	3	4	5
Average feed intake/bird/day (g)	86.3 ^a ±2.8	101.1 ^b ±1.2	105.1 ^c ±1.0	97.4 ^d ±2.8	87.0 ^a ±3.6
Hen-day production (%)	60.6 ^a ±11.9	69.9 ^a ±18.8	67.4 ^a ±9.0	59.8 ^a ±5.6	56.9 ^a ±18.5
Food conversion efficiency (kg) feed consumed/kg egg produced	2.66 ^a ±0.52	2.57 ^a ±0.29	2.76 ^a ±0.45	2.88 ^a ±0.28	3.06 ^a ±0.83

± SD Means with different superscripts within a parameter differ significantly (P < 0.05).

Table 3
Effect of level of dietary palm kernel meal and vegetable oil on metabolizable energy and nutrient retention

Parameters	<i>D I E T S</i>				
	1	2	3	4	5
Dry matter (%)	78.9 ^a ±2.0	75.5 ^a ±1.4	79.9 ^a ±1.5	68.1 ^b ±5.0	69.0 ^b ±5.0
Crude protein (%)	80.1 ^a ±1.9	75.8 ^b ±1.5	80.4 ^a ±1.3	73.2 ^b ±4.1	74.5 ^b ±3.9
Ether Extract (%)	89.5 ^a ±0.9	91.5 ^a ±0.5	90.9 ^a ±4.3	86.6 ^a ±4.7	79.2 ^a ±3.3
Crude fibre (%)	29.0 ^a ±9.2	30.5 ^a ±7.8	34.2 ^a ±5.9	17.9 ^b ±13.1	17.3 ^b ±6.3
Metabolizable energy	13.1 ^a ±0.24	12.9 ^a ±0.33	13.1 ^a ±0.27	11.2 ^b ±0.92	11.4 ^b ±0.71

±SD Means with different superscripts within a parameter differ significantly ($P < 0.05$).

Table 4
Effect of level of dietary palm kernel meal and vegetable oil on egg quality characteristics

Parameters	<i>D I E T S</i>				
	1	2	3	4	5
Average egg weight (g)	55.4 ^{ab} ±2.4	57.0 ^a ±1.9	57.6 ^a ±1.9	56.9 ^a ±1.7	53.9 ^b ±0.8
Average Haugh Unit	82.1.1 ^a ±3.5	83.4 ^a ±4.4	84.0 ^a ±5.0	82.4 ^a ±4.0	82.6 ^a ±4.2
Average egg shell thickness (mm)	0.35 ^a ±0.015	0.35 ^a ±0.014	0.34 ^a ±0.03	0.33 ^a ±0.016	0.33 ^a ±0.01
Average egg yolk cholesterol (mg/g)	14.3 ^a ±3.4	12.6 ^a ±3.6	11.4 ^a ±2.4	14.9 ^a ±2.3	11.9 ^a ±3.1

±SD Means with different superscripts within a parameter differ significantly ($P < 0.05$).

DISCUSSION

Incorporation of feedingstuffs, high in fibre, has been proved to affect physical texture of diet and increase feed intake of birds, in an attempt to satisfy energy needs. Such increases are sometimes not apparent under high ambient temperature as in the tropics, where energy dilution of high calorific diets may even be desirable (Longe, 1984). Addition of oil, on the other hand, to a diet that is otherwise adequate in energy, lowers feed intake. The rise in feed intake with the PKM diets, could not have been due to differences in metabolizable energy contents, at least for the low PKM diets, as evidenced by the energy values of the diets. Even though all diets were designed to be isocaloric, there were real differences in the utilisation of dry matter as confirmed by the energy values for the five diets. The trends of results for percentage retention of other nutrients, suggest that crude fibre played a role in the extent of utilisation of dry matter as apparent retention of ether extract *per se*, was not significantly different but for 5% PKO ($P > 0.05$). The metabolizable energy of the basal and low PKM diets were higher than expected and those of the high PKM diets, even though are lower, seem adequate judged by hen day egg production, feed conversion efficiency and even egg weights.

Fats are known to improve utilization of dietary nutrients (Maiorino *et al*, 1986). Experiments conducted with laying hens in which diets were supplemented with animal tallow to levels of 6% (Sell, 1977) or 3% of maize oil or olive oil (Whitehead, 1981), showed marked improvement in hen day egg production. Egg weight was also increased, when maize oil or olive oil, was included in the layer's diet. These oils are respectively rich in linoleic acid and oleic acid, both of which are unsaturated fatty acids. Response of egg weight will depend, therefore, on type of oil used. Palm oil used in the present

study, is rich in saturated fatty acids (Ogunmodede and Ogunlela, 1971) and palm kernel oil may not be rich either in the unsaturated. This might be the reason for the insignificant differences noted in egg weights for all the supplemented diets and the basal diet with no additional oil.

The mechanism by which fat is able to exert an extra metabolic effect on energy utilization, was explained by Mateos and Sell (1981), as a slowing down of the rate of passage of diet through the digestive tract. A situation as this should allow longer contact with the digestive enzymes and possibly microorganisms necessary for fermentation of indigestible fraction of a feed like the fibre. Thus Yeong (1980) noted improvement in birds' performance, when palm oil was added to diets containing high levels of PKM. In an opposite manner, dietary fibre is reported to result in more rapid transit times of diet through the gastro intestinal tract (Gear *et al*, 1981), a condition which is true for most species of animals. Prolongation of transit time by added oil, for diets containing fibre will therefore be quite beneficial, allowing for more effective utilization of dietary nutrients.

Some dietary fats impair calcium absorption and so affect shell thickness (Ogunmodede and Ogunlela, 1971). The oils used in this study did not result in significant reduction in shell thickness at the levels of inclusion tested. Dietary oils also affect egg yolk cholesterol, level often increases as degree of unsaturation of oil increases (Ogunmodede and Ogunlela, 1971). The results presently obtained seem to suggest that yolk cholesterol level have some correlation with the rate of egg production. The diets containing the low PKM level resulted in lower cholesterol level and higher hen day production than the basal. Such a relationship could not be established (Longe, 1984) when various fibre sources were fed to layers, although without supplemental dietary fats or

oils. It was also observed (Longe, 1984) that fibre in itself is able to decrease yolk cholesterol but varies in its ability to do this, depending, probably, on its composition and to what extent it can bind bile salts. Palm kernel meal was, however, found not to be effective in lowering egg yolk cholesterol (Longe, 1984). It can be concluded then, that neither the oils nor the palm kernel meal in these diets, influence egg yolk cholesterol.

From the present experiment, evidence is provided that it is possible to supply up to 5% of the dietary protein of a layer diet from PKM supplemented with palm oil or palm kernel oil, and still maintain reasonable productive performance, comparable to that of a conventional diet, such as obtained in the basal of this study. Onwudike (1986b) observed that 34% palm kernel meal in diets of starter pullets and 38% in the grower diet, representing a 60% replacement of the protein contributed by groundnut cake in both diets did not result in any deleterious effects on performance or subsequent egg production. Either levels of the PKM tested in this study resulted in lowered levels of maize and groundnut cake, which are more expensive ingredients. The addition of oil, which offsets the energy imbalance, should still permit savings on feed cost more so with cheaper palm kernel oil, even though palm oil obviously would be the oil of preference. Palm kernel oil as used in this investigation, is not directly used as cooking oil and therefore does not find its way into human diets as prominently as does palm oil. It appears however that inclusion of palm kernel oil in the diet at levels lower than 5%, when palm kernel meal is present in the diet, would be better utilized. Information (Longe and Tona, 1988) portrays palm kernel oil as inferior to palm oil in absorbability and energy value.

No attempt has been made to appraise the economics of production, but the good

performance of birds fed even the low level (15.9%) of palm kernel meal and the palm kernel oil, is encouraging. It should be noted that the experiment lasted only three months. The effects of the diets after prolonged feeding on egg production and even body composition particularly of fat, cannot be predicted from results presently obtained.

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