MARDI Res. Bull., (1982) 10, 3: (393–398)

THE NUTRITIVE VALUE OF PALM OIL SLUDGE IN LAYER DIETS

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Keywords: Nutritive value, palm oil sludge, layer diets, optimum levels

RINGKASAN

Dua percubaan ayam penelur telah dijalankan untuk menguji kemungkinan penggunaan hampas kelapa sawit (Palm oil sludge) atau aliran pepejal kilang kelapa sawit (Palm oil mill effluent solid) di dalam makanan ayam penelur. Kepekatan yang dimasukkan adalah 0, 5, 10, 15, 20 dan 25% di dalam percubaan yang pertama. Tiap-tiap makanan mengandungi 18% protein kasar dan 11.3 hingga 11.5 MJ/kg (2,700 hingga 2,750 kcal/kg) tenaga ungkaibena. Dalam percubaan kedua, 6 makanan mengandungi 10 atau 20% hampas kelapa sawit dengan kandungan tenaga rendah (10.9 mj/kg atau 2,600 kcal/kg) atau dengan tambahan lysine dan/atau methionine. Ayam penelur Hisex Brown berumur dua puluh sembilan minggu telah digunakan dalam kedua-dua percubaan ini untuk jangkamasa 52 minggu. Keputusan menunjukkan bahawa kepekatan optima memasukkan hampas kelapa sawit adalah 10% dengan tambahan *DL*-methionine atau *DL*-methionine + lysine di dalam makanan ayam penelur. Formula ini memperlihatkan keputusan yang baik bagi pengambilan makanan, pengeluaran telur, kecekapan makanan dan kualiti telur yang mana adalah setaraf dengan makanan kawalan yang menggunakan jagung-kacang soya. Kesan buruk dari makanan mengandungi lebih daripada 10% hampas kelapa sawit tidak dapat dipulihkan dengan penambahan lysine dan methionine.

INTRODUCTION

Palm oil sludge (POS) or palm oil mill effluent solid (POME Solid) is the solid waste discharged from the effluent of palm oil processing. In its dry form, it contains about 12 to 14% crude protein, 15% crude fibre with its ether extract level fluctuating between 11.8 to 26% (*Table 1*) depending on the procedure of processing of the oil mills. Some attempts on its utilization as animal feed were reported by several research workers (DEVENDRA and MUTHURAJAH, 1976; DALZELL, 1977 and WEBB *et. al.*, 1976). YEONG (1980) found that 15% POS could be incorporated into broiler diets to partly replaced soybean meal and corn and obtain favourable performance which was comparable to corn-soy control diets.

In view of its economic implication to the palm oil industry and the possible benefit to egg farmers in this country, an attempt was made to exploit the possibility of using POS as a feed ingredient in layer diet.

MATERIALS AND METHODS

Two layer trials were carried out successively to test the nutritive value of POS in layer diets. In the first trial, POS in graded levels from 0, 5, 10, 15, 20 to 25% were included in the diets. The crude protein levels of all the diets were maintained at 18% and metabolizable energy (ME) levels at 11.3–11.5 MJ.kg (2,700–2,750 kcal/kg). In the second trial, there were 6 diets containing 10 or 20% POS with additional lysine and/or methionine. The purpose of this particular trial was to study the availability of these amino acids in POS-based diets. Likewise study was also extended to the effect of POS in low energy diets. The rations of Trial I and Trial II were shown in *Tables 2* and *3*.

A total of 864 29-week old layers (Hisex Brown) were used in these two trials of which

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TABLE 1. CHEMICAL COMPOSITION OF POS (Dry matter basis)

Constituents	Composition
Dry matter, %	93.1
Crude protein (N × 6.25), %	13.3
Ether extract, %	11.8—25.9
Crude fibre, %	16.3
Ash, %	12.0
N-free extract	32.4
Calcium, %	0.3
Phosphorus, %	0.19
Gross energy, Kcal/kg	4,638
Metabolizable energy, kcal/kg	1,840
Lysine	0.38
Methionine	0.19
Cystine	0.13

each trial was having equal bird number. The birds were initially given a 20% protein starter diet from day-old to 8 weeks of age and were followed up with a 16% protein grower diet from 9 to 20 weeks. The birds were subsequently fed a layer diet containing 18% crude protein and 2,750 kcal/kg ME. During starting and growing periods, the chickens were brooded and raised on litter floor until 18 weeks of age. After that they were transferred randomly to 2-tier individual battery cages. When the chickens were at 29th week, they were split into randomised blocks. Every 4 blocks of lower and upper cages each containing 9 birds were randomly assigned to an experimental ration. The number of chickens in each ration was 72 and totally 6 rations were used for each of these two trials. The trials started from 29th week for a period of 52 weeks. Feed and water were provided to all the birds in both trials.

Initial and final body weights of each chicken were recorded. Individual egg production and average egg weight of 9 birds were recorded daily. Egg quality tests including albumen quality and yolk colour measurements were conducted at monthly intervals. Data of 52 weeks were compiled and tested for analysis of variance (STEEL and TORRIE, 1960). The significant means were compared by the procedures of Duncan's Multiple Range test (DUNCAN, 1955).

RESULTS

Laying performance

The laying performance of birds from 29 weeks of age for 52 weeks were shown in *Table 4*. In this trial, the average daily feed intake ranged from 108.7 to 110.6 g. The variation did not follow the mode of treatments. The percent hen-day egg production and egg number were superior in birds fed control, 5 and 10% POS-based diets irrespective of the dietary energy level and the level of amino acid supplementation. Lower egg production were observed in birds fed diets with higher POS level. The total egg mass produced followed the same trend of egg production. However, the feed efficiency (feed intake/egg mass) was superior in control and 5% POS-based diets and diets containing 10% POS with amino acids supplementation. As far as egg quality was concerned the Haugh units of egg white were superior in control and all the POS-based diets. Amino acids supplementation did not help in improving the egg quality.

TABLE 2. COMPOSITION OF LAYER DIETS WITH GRADED LEVEL POS IN TRIAL I

Ingredient	POS level (%)					
	0	5	10	15	20	25
Corn	59.80	53.50	47.00	41.35	35.85	29.90
POS	—	5.00	10.00	15.00	20.00	25.00
Soybean meal	26.60	26.40	26.40	26.00	26.00	26.00
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Lucerne leaf meal	2.00	2.00	2.00	2.00	1.00	0.45
Palm oil	0.50	2.00	3.50	5.00	6.50	8.00
Trical. phosphate	2.00	2.00	2.00	2.00	2.00	2.00
Limestone powder	4.50	4.50	4.50	4.00	4.00	4.00
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00
Vit-min. premix[1]	0.30	0.30	0.30	0.30	0.30	0.30
DL-methionine	0.05	0.05	0.05	0.10	0.10	0.10
Total	100	100	100	100	100	100
Calculated constituents:						
Crude protein, %	18.1	18.2	18.2	18.3	18.2	18.2
Crude fibre, %	3.4	4.0	4.6	4.5	5.6	6.1
Ether extract, %	3.3	5.8	8.2	10.7	13.1	15.6
Calcium, %	3.34	3.38	3.42	3.30	3.33	3.35
Phosphorus	0.80	0.79	0.78	0.77	0.76	0.75
ME, kcal/kg	2,752	2,746	2,736	2,748	2,742	2,752
Lysine, %	0.96	0.95	0.95	0.94	0.93	0.92
Methionine, %	0.35	0.34	0.34	0.39	0.38	0.38
Meth. + Cyst., %	0.65	0.63	0.63	0.67	0.65	0.64

+ Vit-min. premix per kg diet contained vit. A 10,000 IU, D_3 2,000 IU, E15 IU, K_3 1.5 mg, B_1 1.5 mg, B_2 5 mg, B_6 2 mg, B_{12} 10 ug, pantothenic acid 12 mg, biotin 10 ug, niacin 25 mg, choline chloride 900 mg, folic acid 0.5 mg, Cu 10 mg, Mn 52.5 mg, Zn 60 mg, Fe 100 mg, I 1.5 mg, Co 0.25 mg.

Body weight gain and mortality

The average body weight gain of birds for the laying period ranged from 256 g in 20% POS-based diet to 459 g in 20% POS-based diet supplemented with lysine and methionine. In general, the POS inclusion did not affect the body weight gain. However, the two diets containing 10 and 20% POS with lower dietary energy levels and the lowest body weight gain, i.e. 314 g and 256 g respectively. No significant difference in mortality of birds among the treatments was observed. The mortality rate fluctuated from 0 in the 10% low energy diet to 12.5% in the 20% POS diet with *DL*-methionine supplementation (*Table 4*). In view of the irregularity of the mortalty rate among the treatments, the POS level might not be the factor affecting it.

TABLE 3. COMPOSITION OF LAYER DIETS WITH GRADED LEVEL POS IN TRIAL II

	Variables					
POS level (%)	10	20	10	10	20	20
Amino acid/energy	Low ME	Low ME	Meth	Ly+Meth	Meth	Ly+Meth
Corn	49.90	38.35	47.00	47.00	35.65	35.80
POS	10.00	20.00	10.00	10.00	20.00	20.00
Soybean meal	26.00	25.00	26.20	26.00	26.00	25.65
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Lucerne leaf meal	2.00	2.00	2.00	2.00	1.00	1.00
Palm oil	1.00	4.00	3.50	3.50	6.50	6.50
Tricalcium phosphate	2.00	2.00	2.00	2.00	2.00	2.00
Limestone powder	4.50	4.00	4.50	4.50	4.00	4.00
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit-min. premix[1]	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine	—	—	—	0.20	—	0.20
DL-methionine	0.05	0.10	0.25	0.25	0.30	0.30
Total	100	100	100	100	100	100
Calculated constituents:						
Crude protein, %	18.3	18.1	18.4	18.5	18.4	18.4
Crude fibre, %	4.7	5.9	4.6	4.6	5.6	5.6
Ether extract, %	5.8	10.8	8.2	8.2	13.1	13.1
Calcium, %	3.42	3.33	3.42	3.42	3.32	3.32
Phosphorus	0.79	0.76	0.76	0.78	0.76	0.76
ME, kcal/kg	2,617	2,608	2,734	2,728	2,737	2,729
Lysine, %	0.94	0.91	0.94	1.14	0.93	1.12
Methionine, %	0.34	0.38	0.53	0.54	0.58	0.58
Meth. + Cyst., %	0.63	0.65	0.81	0.82	0.85	0.85

+ Vit-min. premix per kg diet contained vit. A 10,000 IU, D_3 2,000 IU, E15 IU, K_3 1.5 mg, B_1 1.5 mg, B_2 5 mg, B_6 2 mg, B_{12} 10 ug, pantothenic acid 12 mg, biotin 10 ug, niacin 25 mg, choline chloride 900 mg, folic acid 0.5 mg, Cu 10 mg, Mn 52.5 mg, Zn 60 mg, Fe 100 mg, I 1.5 mg, Co 0.25 mg.

TABLE 4. EFFECT OF POS IN LAYING PERFORMANCE AND EGG QUALITY IN LAYER (52 weeks)

Treatment (% POS level)	Egg No.	% Egg Production (Hen-day)	Avg. daily Feed intake (g)	Total Egg Mass (kg)	Feed Egg Mass	Haugh unit	% Mortality
0	259.7[a]	70.2[a]	104.2[cd]	15.5[a]	2.44[a]	56.1[ab]	4.2
5	256.1[a]	69.6[a]	106.0[bc]	15.4[ab]	2.51[abc]	56.8[ab]	4.2
10	257.3[a]	69.9[a]	110.6[a]	15.3[ab]	2.64[cd]	56.7[ab]	4.2
15	242.7[b]	66.0[b]	104.3[bcd]	14.5[bcd]	2.61[bcd]	55.1[abc]	8.3
20	239.7[c]	65.1[c]	108.5[ab]	14.3[cd]	2.76[e]	57.0[a]	6.9
25	243.3[b]	66.1[b]	107.4[ab]	14.8[bcd]	2.65[de]	55.4[abc]	6.9
10% Low E[1]	252.3[ab]	68.6[ab]	105.9[bc]	15.0[abc]	2.57[bdc]	54.9[bc]	0
10% *DL*-m	253.1[ab]	68.5[ab]	105.4[bcd]	15.6[a]	2.46[ab]	53.8[c]	2.8
10% *DL*-m+Ly[2]	249.0[ab]	67.6[ab]	106.7[bc]	15.3[ab]	2.55[abcd]	51.0[d]	5.6
20% Low E	238.2[c]	64.7[c]	100.7[d]	14.1[d]	2.60[bcd]	49.7[d]	8.3
20%+*DL*-m	240.7[c]	65.2[c]	103.3[cd]	14.4[cd]	2.62[cd]	53.8[c]	12.5
20%+*DL*-m+Ly	243.6[b]	66.2[b]	104.9[bcd]	14.3[cd]	2.68[de]	54.0[c]	11.1

[1]E — energy

[2]*DL*-M — *DL*-methionine

Ly — lysine

[a,b,c,d.] Superscripts showed significant difference at 5% level.

DISCUSSION

From the results of egg number, egg laying rate and amount of egg mass produced, the optimum level of POS inclusion was 10%. Judging from the figures of feed intake, the inclusion of POS in diets did not appear to cause higher consumption even though they were higher in fibre compared to the low POS diets. This could be due to the effect of palm oil supplement which improved the energy availability of the feed (CAREW and HILL, 1964; CAREW *et. al.*, 1964).

The lower level of hen-day egg production in high POS-based diets could be affected by the low POS amino acid availability which has an average value of 24.8% (YEONG, 1981). This effect could also explain the lower feed efficiency in those groups of birds. This showed that lysine and methionine were not involved with the adverse effect of these diets since the supplementation of these two amino acids in 20% POS-based diets did not reverse the adverse situation.

ACKNOWLEDGEMENT

The authors wish to express their appreciation to Encik Zainuddin b. Yusof and other supporting staff in Poultry Branch for their assistance in conducting the trial, Animal Nutrition laboratory for analysing the feed and Encik Ahmad Shokri b. Hj. Othman in analysing the data. The cooperation of Antara Palm Oil Pollution Control Pte. Ltd. Ipoh in supplying dry palm oil sludge for the test is gratefully acknowledged.

SUMMARY

Two layer trials were conducted to examine the possibility of using palm oil sludge (POS) or palm oil mill effluent solid (POME Solid) in layer diets. The inclusion levels were 0, 5, 10, 15, 20 and 25% in the first trial. Each diet contained 18% crude protein and 11.3 to 11.5 MJ/kg (2,700 to 2,750 kcal/kg) metabolizable energy. In the second trial, 6 diets containing 10 or 20% POS with either lower energy 10.9 MJ/kg (2,600 kcal/kg) or with additional lysine and/or methionine were formulated. Twenty-nine weeks old Hisex Brown layer were used in these two trials for a period of 52 weeks. Results indicated that the optimum inclusion level of POS was 10% with addition of *DL*-methionine or *DL*-methionine + lysine which resulted in favourable feed intake, egg production, feed efficiency and egg quality which were comparable to those of corn-soybean control diet. The adverse effect from diets containing more than 10% POS could not be remedied by supplementary lysine and methionine.

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