EFFECTS OF PALM OIL SUPPLEMENTATION IN BROILER DIETS

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Summary

A study was conducted to determine the effects of varying palm oil levels (0 to 8%) in the diets on the performance of broilers under the warm humid tropical environment. Increasing palm oil levels resulted in corresponding rise in the dietary energy concentrations, and broilers fed on higher energy diets improved feed and energy consumption, daily weight gain and feed conversion ratio. Total carcass fat content was found to increase at higher levels of palm oil inclusions.
(**Key Words** : Palm Oil Supplementation, Broilers, Growth Performance, Carcass Fat)

Introduction

Fat supplementation in diets is recognized as valuable method for meeting the high energy requirement of rapidly growing broiler chicken. Growth and feed efficiency responses of the chicken to dietary fat supplementation are well documented (Waldroup et al., 1976; Coon et al., 1981; and Hurwitz et al., 1983). High energy or nutrient density diets improved growth and feed efficiency. However effects of the dietary fat content are contradictory. Some workers found an increase in carcass fat (Deaton et al., 1981), little or no significant change (Bartov et al., 1974 and Coon et al., 1981), or a decrease in carcass fat (Alao and Balnave, 1984) in response to dietary fat supplementation.

Reports on the use of palm oil compared to animal and vegetable fats in poultry feeds are limited. Very little information is available on the use of palm oil as a source of energy for improving growth performance and carcass composition especially under the warm climate. The objective of this study was to evaluate the effects of palm oil supplementation to provide different energy levels in isonitrogenous diets on growth and carcass composition of broilers.

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Materials and Methods

Sixty male and an equal number of female day-old commercial (Vedette ISA) broiler chicks were fed ad lib commercial diet containing 3,100 ME kcal/kg and 23% crude protein for two weeks. On the third week the chicks were randomly distributed by sex into groups of three birds per replicate into 40 raised wire floor pens with natural ventilation. The chicken were fed on five experimental diets as shown in table 1.

The experiment was designed as 2 × 5 factorial on completely randomised design. Body weight and feed consumption were recorded weekly, on a group basis. At the termination of the experiment (day 49), the final weights of the chickens were determined. For carcass analysis, the chickens were fasted for 48 h in order to reduce the effect of gut content on body weight. From each replicate, two birds of each sex were selected at random and individually weighed. The chickens were sacrificed without blood loss by an overdose intravenous injection of anesthesia (Nembutal). Each carcass was again weighed, placed in individual plastic bags and stored in a freezer for at least 48 hours before analysis.

Carcass analysis

Preparation of dry homogenates from whole and eviscerated chickens were done before analysis using the technique developed by Sibbald and Fortin (1982).

Determination of Metabolisable Energy

The ME was determined on all the diets using the rapid technique developed by Farrell (1978) and Vohra et al. (1981) and the values were calculated using the formula developed by Brue and Latshaw (1985).

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS

	Levels of palm oil (%)				
	0	2	4	6	8
Fish meal	12.00	12.00	12.00	12.00	12.00
Corn meal	70.50	68.50	66.50	64.00	61.50
Soybean meal	15.00	15.40	15.80	16.30	16.80
Palm oil	–	2.00	4.00	6.00	8.00
Dicalcium phosphate	0.05	0.03	0.03	0.021	0.016
Lime stone	0.25	0.26	0.27	0.282	0.30
Choline chloride	0.35	0.35	0.35	0.35	0.35
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25	0.25
Coccidiostat	0.10	0.10	0.10	0.10	0.10
Kaolin clay	1.00	0.61	0.20	0.197	0.184
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Protein (%)	20.004	20.004	20.004	20.004	20.004
ME (kcal/kg)	3,035	3,143	3,250	3,344	3,437
Ether extract (%)	3.93	5.85	7.78	9.77	11.60
Calcium (%)	0.90	0.90	0.90	0.90	0.90
Available phosphorus (%)	0.40	0.40	0.40	0.40	0.40
Lysine (%)	1.18	1.19	1.20	1.21	1.22
Methionine + Cystine (%)	0.73	0.73	0.73	0.72	0.72
Methionine (%)	0.45	0.45	0.45	0.45	0.45
Determined analysis					
Protein (%)	19.73	20.58	20.50	20.13	19.86
ME (kcal/kg)	3,106	3,265	3,434	3,564	3,675
Ether extract (%)	3.85	5.68	7.62	9.54	11.32
Calorie : Protein ratio (C:P ratio)	157	159	168	177	185

(Ethoxyquin was added at 125 mg/kg feed as antioxidant and antifungus).

Proximate analysis

Dry homogenates were allowed to equilibrate with atmospheric moisture prior to analysis and air-dry weights were measured. Because the analysis were spread over time, it was necessary to correct the moisture gain in accordance with the AOAC (1980) method.

Statistical analysis

The data were statistically analysed by both regression analysis and analysis of variance using the Statistical Analysis System (SAS), (1982). The differences between treatments were determined using the protected Least Significant Difference (LSD) method (Steel and Torrie, 1980). Simple correlations were determined for all possible pairs of variables.

Results and Discussion

The effects of varying ME and palm oil level in isonitrogenous diets on the broiler performance is given in table 2. Feed intake appeared to be constant regardless of treatments (93.93 to 97.86 g/d) However, birds fed 2, 4 and 8% palm oil diets consumed more feed than the control with the exception of chicks on 6% palm oil. These observed differences were not significant. On the other hand, ME consumption was significantly higher in the treated groups compared to the control. The relationship between ME intake and dietary energy level appeared to be linearly related ($r = 0.98$). The results clearly indicate the benefit of high energy diets since they can increase the level of ME consumption. It is possible that the heat increment has been corespondingly reduced with increasing level of palm oil in the diets, thus enabling the chicks to increase voluntary intake. Similar effects were also observed by Fuller and Mora (1973) and Lipstein and Bornstein (1975).

TABLE 2. EFFECTS OF PALM OIL LEVELS IN THE DIETS ON THE PERFORMANCE OF BROILERS[1]

	Levels of palm oil (%)				
	0	2	4	6	8
Feed intake (g/bird · day)	95.00[a] ±2.94	95.71[a] ±3.53	96.79[a] ±4.20	93.93[a] ±3.52	97.86[a] ±3.23
Weight gain (g/bird · day)	43.93[a] ±1.53	41.57[a] ±1.79	46.07[ab] ±2.62	46.07[ab] ±2.15	48.21[b] ±1.74
Feed/gain	2.16[ab] ±0.03	2.21[b] ±0.07	2.10[ab] ±0.04	2.05[a] ±0.04	2.04[a] ±0.02
Nitrogen intake (g/bird · day)	2.68[a] ±0.08	2.86[a] ±0.11	2.85[a] ±0.13	2.71[a] ±0.10	2.75[a] ±0.09
Energy intake (kcal/bird · day)	263.87[a] ±8.16	279.42[b] ±10.28	298.48[bc] ±12.98	300.24[c] ±11.21	320.91[d] ±10.68

[1]Mean of four replicate determinations on 3 chicks ± standard error of mean.

Different superscripts in the same row show significant differences at the 5% level.

There was a tendency for body weight of the chicks to increase with increasing palm oil content in the diets (table 2). Statistical analysis, however, failed to show significant differences between the control, 2, 4 and 6% or between 6 and 8% palm oil diets. Only chicks fed 8% palm oil gained significantly more than the control. However, the relationship appeared to be linear except chicks on 4 and 6% palm oil diets had similar growth rate at 46.07 g/d. The increase in body weight was mostly due to higher ME consumption in the palm oil supplemented groups. It seemed possible to improve growth rate of chicks reared under tropical conditions with fluctuating (23-36℃) ambient temperature by incorporating palm oil in the diets to increase the ME density and lowering of heat increment as demonstrated by Dale and Fuller (1979, 1980) and Bartov et al. (1974).

The effect of sex on body weight is more pronounced. Growth rate of male chicks (50.14 g/d) were significantly more than the females (41.00 g/d) (table 3). This is probably due to the male consuming more feed than the female resulting in concomitant increase in ME consumption. Conversely, the males had less carcass fat than the females (table 5). These differences in the results demonstrated the physiological and genetical variability between sexes. The male is known to grow faster than the female and at the same time had higher metabolic rate (Robbin, 1981). Besides, the circulating level of growth hormone which is possitively connected with growth rate is higher in the male chicks (Harvey et al., 1979).

TABLE 3. PERFORMANCE OF MALE AND FEMALE BROILERS[1]

	Male	Female
Feed intake (g/bird · day)	104.00±1.23[a]	87.71±0.89[b]
Weigh gain (g/bird · day)	50.14±0.83[a]	41.00±0.57[b]
Feed/gain	2.07±0.03[a]	2.14±0.03[a]
Nitrogen intake (g/bird · day)	3.01±0.04[a]	2.53±0.03[b]
Energy intake (kcal/bird · day)	317.52±6.25[a]	267.65±4.57[b]

[1]See table 2.

Different superscripts in the same row show significant difference at the 1% level.

Feed conversion appeared to improve with increasing ME intake. The lowest feed conversion value of 2.04 was obtained from 8% palm oil, but it was not significantly higher compared to the group on 6%. The differences obtained between the control, 2, and 4% groups were also not significant (table 2). As indicated earlier, the observed differences in feed intake was not significant in spite of varying ME content. On the other hand, increasing ME density resulted in higher ME consumption leading to an improvement in both average daily gain and feed coversion ratio (table 2). Broilers that consumed more nutrients per day required less days to reach a given weight which explained for the differences in the result between the control and the treated groups, indicating the advantage of high energy diet in feeding broilers under tropical conditions.

The effects of adding palm oil and consequently increasing ME density in the diets resulted in a change in body composition (table 4). The percentage of carcass ash was reduced when palm oil level exceeded 4%. At higher levels (6 and 8%) of palm oil inclusion, ash content was further reduced. These results are in agreement with those of Pepper et al. (1955), Griffith et al. (1961), Waibel and Mraz (1964) and Whitehead et al. (1971), where addition of oil or fat in the feed might interfere with mineral metabolism, thus causing a lowering in the body ash content as similarly shown by Hakansson (1975).

TABLE 4. EFFECTS OF PALM OIL LEVELS ON THE BODY COMPOSITION OF BROILERS[1]

	Levels of palm oil (%)				
	0	2	4	6	8
Dry matter (%)	97.80 ±0.39[a]	97.41 ±0.29[a]	97.85 ±0.24[a]	97.18 ±0.57[a]	97.39 ±0.38[a]
Ash (%)	8.16 ±0.23[a]	8.06 ±0.25[a]	7.43 ±0.16[b]	7.25 ±0.20[b]	7.46 ±0.10[b]
Protein (%)	52.62 ±1.04[a]	49.21 ±1.11[b]	46.46 ±0.64[bd]	45.61 ±0.62[cd]	45.23 ±0.57[cd]
Fat (%)	32.03 ±1.13[a]	35.43 ±1.16[b]	38.04 ±0.79[bc]	38.28 ±1.26[c]	37.69 ±1.00[bc]

[1]Mean of four replicate determinations on 2 chicks ± standard error of mean.

Figures with different superscripts in the same row differ significantly at the 5% level.

Crude fat in the carcass dry matter was found to increase with increasing palm oil content of the diets (table 4) and the relationship appeared to be linear (r = 0.89). The chicks fed 2, 4, 6 and 8% diets had significantly higher carcass fat content than the control diet. The increase in fat content indicated that the amount of energy consumed by the chicks was excessive. It was also possible that the reasons for the high fat content in the treated groups could be due to the widening of calorie: protein ratio as calorie : protein ratio has been shown by Yamashita et al. (1975) and Shen et al. (1985) to affect body composition, particularly the fat content. They showed that carcass fat was reduced either by decreasing dietary energy levels while maintaining the protein content or by maintaining the energy level but increasing the protein content.

On the other hand, supplementing palm oil in the diets produced significant changes in carcass crude protein content (table 4). All the chicks fed 2, 4, 6 and 8% palm oil had significantly lower carcass protein content than the control, the lowest being chicks given 8% palm oil diet. The decline in crude protein and ash is likely due to the substantially higher rate of fat gain during this period. Fat, protein and ash are the basic body constituents making up most of the carcass dry matter content. A change in any component could affect the composition of the others.

The rate of fat accumulation was also different between sexes (table 5). Male chicks had significantly lower carcass fat than the females in spite of the fact that the males consumed more energy than females. This is probably due to the higher metabolic rate in the males. These results are similar to those of Edwards and Denman (1975), Dale and Fuller (1980) and Mabray and Waldroup (1981). Another factor is probably due to higher estrogen hormone in female, hence it increased the amount of fat deposition in the tissue (Sturkie, 1965). However, in term of carcass protein, the difference between male and female birds was not significant, although the nitrogen intake of the male was significantly higher than the female birds. The ash content in the male and female birds was not significantly different as similar to the findings of Robbin and Ballew (1984).

TABLE 5. EFFECT OF SEX ON THE BODY COMPOSITION OF BROILERS[1]

	Male	Female
Dry matter (%)	97.23 ± 0.29^a	97.82 ± 0.16^a
Ash (%)	7.84 ± 0.12^a	7.51 ± 0.16^a
Protein (%)	48.38 ± 0.82^a	47.28 ± 0.79^a
Fat (%)	34.84 ± 0.81^a	37.75 ± 0.76^b

[1]See table 4.

Figures with different superscripts in the same row differ significantly at the 1% level.

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