THE EFFECT OF HIGH DIETARY LEVELS OF PALM OIL AND SALT ON THE PERFORMANCE AND MEAT QUALITY OF CHICKENS

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ABSTRACT

Day-old male broiler chicks totalling 480 were randomized in to eight diets with 24% crude protein and either 0.3, 5.0, 10.0, or 15.0% NaCl and 0, 5.0, 10.0 or 15.0% palm oil. The high levels of dietary oil improved the growth rate of the birds with a preferential development of the thigh and breast which probably accounted for an apparent better conformation and finish of the birds. Levels of salt of 5% and above exerted opposite effects to the high dietary fat and appeared toxic. Flavour and the overall acceptability of meat of the chickens benefited from high levels of palm oil but not of salt in the diet. A high water intake induced by high levels of salt was responsible for high moisture content of the litter.

Key Words: Chickens, palm oil, salt, performance, meat quality.

INTRODUCTION

Improved growth rate and efficiency of feed utilization have emerged as the main advantages in experiments designed to show the effects of supplementing chick diets with lipids (Kensett, Ho and Touchburn 1980; Hulan and Proudfoot, 1982). When the dietary oil is at a high level, the composition of the body fat of the chick may reflect that of the diet, probably due to the direct transfer of this fat from the diet rather than its being produced through lipogenesis (Edwards, 1971; Edwards and Hart, 1971). Probably also through this mechanism, fish oil soapstock imparts an undesirable flavour to poultry meat as reported by Lipstein and Bernstein (1973).

According to NRC (1971), the dietary level of sodium required to support the satisfactory growth of chick is 0.15%. A level of 0.25% has been recommended in Nigeria (Olomu, 1979). However, fairly lower and variable levels were indicated by Nott and Combs (1969). Dietary levels of salt (NaCl) that furnish these amounts of sodium are .30 to .38%. According to Ewing (1963), large amounts of salt in the diet depress growth, increase water intake and may be toxic. The toxicity was reported to be 3% by Barlow et al. (1948), whereas Heuser (1952) did not find 4% to be toxic. Dewar, Siller and Whitehead (1974) reported that 3.8% NaCl gave a high incidence of lesions especially testicular cysts. Evidence by Dewar,

Whitehead and Siller (1972) however indicate that the level of toxicity of dietary salt varied with individual birds.

At high dietary salt, chloride was found to accumulate in some tissues, with the exception of skeletal muscles of the chicken (Barlow et al., 1948). High levels of salt in the diet were reported by Siller, Dewar and Whitehead (1972) to cause histological changes in the testis of broiler chicks.

The objective of this study was to determine the effects of high dietary palm oil and salt on meat qualities and performance of chicks.

MATERIALS AND METHODS

A total of 480 day old broiler male chicks was randomly assigned to eight diets formulated as in Table 1. There were two replicates each of 30 chicks assigned to each dietary regimen. Feeding was ad libitum.

Brooding of the chicks was in an open sided deep litter house with an initial brooding temperature of 35°C gradually reduced to environmental temperature. This averaged 33.06°C maximum and 30.0°C minimum while the relative humidity ranged from 40.3% minimum to 72.1% maximum. Floor space (0.93 m²/bird), feeding space (5cm/bird) and drinking cans were sufficient for the experimental period of 8 weeks.

Records consisted of the initial and the final body weights, feed and water intakes and mortality of the birds during the experimental periods. At 2 week intervals, from five randomly selected locations in each pen accommodating each replicate, litter samples were taken to determine the percentage moisture of the litter.

Five 8 week-old chickens were picked at random from each replicate. These were exsanguinated by severing the carotid artery after fixing the birds head downwards in cones.

Table 1
Composition of the Experimental Diets

Variable ¹	Diet							
	1	2	3	4	5	6	7	8
Corn	55.38	49.09	42.30	35.51	48.79	42.00	35.21	18.41
Palm Oil	0	0	0	0	5.0	10.0	15.0	15.0
Groundnut Cake	27.57	29.16	30.95	32.74	29.16	30.95	32.74	34.84
Sodium Chloride	.3	5.0	10.0	15.0	.3	.3	.3	15.0
By Calculation								
ME (Kcal/kg)	2731.9	2769.9	2580.8	2392.5	2758.8	3270.5	3432.2	2903.9
By analysis								
Crude Protein	23.63	24.18	24.02	24.15	23.65	23.20	24.13	24.16
Ether Extract	6.08	6.18	6.42	6.32	11.78	11.78	22.6	22.08
Ash	7.79	13.17	18.11	22.32	9.90	9.16	9.93	17.0

^a

Each diet contained the following (%): fish meal, 8; blood meal; .25, rice bran, 2.0; yeast, 1.0; Oyster shell, 2.5; dicalcium phosphate, 2.5; and feed additives, 5.0. Feed additives estimated to provide the following per kg. Vitamin A, 6000 IU; Vitamin D, 1320 ICU; riboflavin, 4.4mg; Niacin, 22mg; Ca pantothenate, 8.8mg; choline, 440g; Vitamin B12, 5mcg, Fe. 20.2mg, Cu, 8 mg., Zn, 50mg; antioxidant (butylated hydroxytoluene) coccidiostat (amp.rolmix).

The killed birds were hand plucked after scalding them at 60°C. Then they were eviscerated and the weights of their carcasses plus giblets were recorded. A panel of five graded the carcasses subjectively for conformation, fleshing, breast finish and back finish on a 7 point scale with 1 the poorest score.

The thighs and breast of each chicken were deboned separately and the pieces of meat were wrapped in aluminium foil and placed in a pressure cooker. cooking was for 25 min, and the meat samples were allowed to cool for the subsequent 15 min.

The taste panel of five persons were served equally sized pieces (about 1 x 1 x 5cm) of meat from the breast muscle one piece at a time. Each member was secluded so as to make independent judgement. Scoring was carried out for flavour, tenderness, juiciness and overall acceptability based on a 9 point Hedonic scale rating in which 1 was the poorest score.

RESULTS

The inclusion of palm oil in the diet at 5 to 15% without high salt (diets 5, 6 and 7) resulted in significantly ($p < .05$) faster growth of chicks than diets with no oil (Table 2). This is in accord with the bulk of evidence of the beneficial effect on growth obtained by supplementing chick diets with oil (Whitehead, 1981). It will be noted that the chick body weights on diets 5, 6 and 7 were not significantly ($P > .05$) different.

High dietary levels of salt, 5 to 10%, significantly depressed the growth rates of chicks. The higher the dietary salt, the lower the growth rate. This adverse effect was not alleviated by oil supplementation of the diet.

The percentage of carcass weight to live weight of the birds was significantly ($P < .05$) depressed by dietary high levels of salt

whether or not it was accompanied with oil. High levels of salt also tended to detract from the conformation scores of the carcasses. A significant ($P < .05$) depression of carcass conformation was obtained with 15% dietary salt although this adverse effect tended to be alleviated when 15% oil was included in the diet.

The degrees of fleshing of the carcasses and of the finish of both the breast and back largely followed the same trend as that of body conformation of the birds. That is, they were depressed by high levels of salt and seemed to be improved by the presence of palm oil.

The presence of salt at high level of 15% enhanced the weight of the head, neck, back and wing as percentages of whole body weights. By contrast, the inclusion of oil, although not when a high level of salt was included in the diet, significantly ($P < .05$) improved the weights of breast and whole legs as percentages of live weights.

Cooking losses were not significantly ($P > .05$) affected by dietary treatment. Mortality was very high with the chicks on high dietary salt. Although in this study, the highest mortality was associated with 15% dietary salt, some chicks survived even at this level, and 5% salt appeared to be almost as lethal. The mortality percentages with the other diets, with or without oil, were comparatively low.

Table 3 shows that 15% dietary salt when not accompanied with oil resulted in the least amount of feed intake. However, 10% dietary fat also reduced feed intake significantly ($P < .05$). Water intake increased significantly ($P < .05$) with increase in dietary salt but not with increase in dietary oil. However the inclusion of high dietary oil along with the high dietary salt did not reduce the associated high water intake.

Table 2
The eight week body weight, dressing percent, carcass grading values, percentage body parts and cooking losses of some of the parts.

Trait	Dietary Treatment							
	1	2	3	4	5	6	7	8
8 week body weight (g)	1000.3 ^b	855.6 ^c	748.4 ^c	420.3 ^d	1222.2 ^a	1152.8 ^a	1323.1 ^a	863.2 ^c
Dressing (%)	74.3 ^a	67.6 ^a	65.0 ^a	59.5 ^b	74.0 ^a	73.8 ^a	75.4 ^a	66.3 ^b
Carcass grading values ^e								
Conformation	3.94 ^{ab}	3.94 ^{ab}	3.50 ^{ab}	1.00 ^b	4.57 ^a	4.63 ^a	5.71 ^a	2.00 ^b
Fleshing	3.63 ^a	3.00 ^a	2.60 ^{ab}	1.00 ^b	4.43 ^a	4.00 ^a	4.86 ^a	2.50 ^{ab}
Finish (breast)	3.00 ^a	2.50 ^{ab}	2.00 ^b	1.00 ^b	4.00 ^a	3.63 ^a	4.71 ^a	2.00 ^b
Finish (back)	3.13 ^a	2.00 ^b	2.00 ^b	1.00 ^b	4.14 ^a	3.63 ^a	4.43 ^a	2.00 ^b
Cut up parts (%)								
Head	4.22 ^{ab}	4.50 ^{ab}	3.28 ^b	5.90 ^a	4.24 ^{ab}	4.58 ^{ab}	4.37 ^{ab}	4.70 ^{ab}
Neck	5.11 ^{ab}	7.15 ^{ab}	4.40 ^b	7.10 ^a	5.40 ^{ab}	5.79 ^{ab}	5.93 ^{ab}	5.45 ^{ab}
Breast	14.94 ^a	13.60 ^{ab}	11.93 ^b	14.40 ^a	11.57 ^b	14.91 ^a	16.03 ^a	12.75 ^{ab}
Back, lower	8.08 ^a	6.55 ^b	7.12 ^{ab}	7.87 ^{ab}	8.24 ^a	9.19 ^a	7.80 ^{ab}	
Back, front	6.58 ^a	5.20 ^{ab}	4.88 ^b	6.90 ^a	6.71 ^a	6.63 ^a	6.01 ^a	5.85 ^{ab}
Wing	9.16 ^{ab}	8.10 ^b	7.18 ^b	13.80 ^a	9.23 ^{ab}	9.60 ^{ab}	9.40 ^{ab}	10.20 ^a
Whole leg	18.76 ^{ab}	19.95 ^a	14.50 ^b	17.60 ^{ab}	19.33 ^a	20.79 ^a	20.83 ^a	18.00 ^{ab}
Cooking losses (%)								
Breast meat	34.07	37.70	39.42	34.06	35.06	35.86	36.52	35.31
Thigh meat	40.84	44.09	44.82	44.91	41.02	43.82	41.67	43.04
Mortality (%)	5.5	55.5	59.6	66.7	6.1	5.1	6.3	7.0

a b c d In the same horizontal line, figures with different superscripts are significantly different ($P < 0.05$)
e Subjective evaluation based on a 7 point scale and 1 the poorest score.

Table 3
Feed intake, Feed efficiency, water intake and the percentage litter moisture

Trait	Dietary Treatment							
	1	2	3	4	5	6	7	8
Feed intake (g/bird)	3242.3 ^{ab}	3593.5 ^a	3596.5 ^a	2448.8 ^c	3410.9 ^{ab}	3124.2 ^b	3596.7 ^a	3340.4 ^{ab}
Feed efficient (gain/feed)	.30 ^a	.23 ^b	.20 ^b	.16 ^c	.35 ^a	.36 ^a	.36 ^a	.25 ^b
Water intake (ml/bird/week)	689.5 ^d	1516.8 ^c	1943.4 ^b	2826.8 ^a	816.6 ^d	804.9 ^d	918.5 ^d	3041.0 ^a
Litter moisture (%)	15.5 ^c	25.5 ^b	28.9 ^{ab}	34.0 ^a	10.6 ^d	11.7 ^c	17.3	32.0 ^{ab}

a,b,c,d, In the same line figures with different superscripts are significantly different ($P < 0.05$).

Table 4
Taste Panel Evaluation of the Meat of the Birds on the experimental Diets

Characteristics ^a	Dietary Treatment							
	1	2	3	4	5	6	7	8
Flavour	5.57	5.40	5.50	5.40	6.09	6.03	5.69	5.30
Tenderness	6.25	5.70	5.30	5.40	6.34	6.10	5.86	5.40
Juiciness	4.47	4.60	5.00	5.20	4.94	4.88	4.80	5.00
Overall acceptability	5.88	5.20	5.20	5.60	6.37	5.93	6.09	5.30

^a Scored on a 9 point hedonic scale rating in which 1 was the poorest score. No significant differences between treatment groups were found in any of the characteristics listed.

DISCUSSION

The effectiveness of the diets containing palm oil to improve the body weights of the chicks can be attributed to an increase in metabolizable energy due to the palm oil. Contrarily, inadequate dietary energy might contribute to the poorer growth of the chicks fed the high dietary salt level. A high level of salt in the diet was a growth repressive factor by itself, considering that the metabolizable energy of diet 8 (15% oil, 15% salt) was similar to that of diet 1 (basal). Even then, it will be noted that the growth rate of diet 8 was considerably better than on diet 4 with 15% salt but no oil.

It was uncertain whether reduction in feed intake caused by 15% dietary salt was due to the physical nature or the taste of the diet. This high level might exceed the threshold required for taste perception in the fowl whose sense of taste appears poorly developed (Ewing, 1963).

Evidently, starvation was not the cause of mortality in the chicks, but might be aggravated by it in case of the 15% dietary salt. The main cause might be adverse physiological changes which possibly in-

involved a derangement of normal acid-base and mineral and water balance of the body. It may be for this reason that younger poult are more susceptible (Pang Phillips and Campbell, 1979). Water intake was evidently a compensatory response to the effects of salt and this in turn was accountable for the high percentage of litter moisture. Reduced feed efficiency might be caused by the combined effect of excessive water intake and the physiological changes in the body due to excess dietary salt. Probably, part of the water might be discharged with undegraded feed particles thereby reducing the extent of feed digestion and metabolism. According to Parthasarathy (1950) dietary salt level influences nitrogen retention in laying hens.

The cooking loss is minimized by injecting salt solution into the chicken meat prior to cooking (Farr and May, 1970). This property of salt is apparently lost when it is metabolized into Na^+ and Cl^- . The breakdown of the salt could also prevent it from producing its characteristic seasoning effect on meat, as indicated in this study. The improvement in flavours caused by oil, although slight, indicates that palm oil influenced the composition of the meat. This

effect could arise from the amount and the nature of carcass fat.

According to Pang et al., (1979) high dietary salt induced high values for body sodium and water contents while plasma sodium, chloride, osmolarity and lower PCV in the high saline treated poult indicate increased retention of salt and water. Earlier report by Siegel (1961) showed that it caused physiochemical changes in some tissue cells. Evidence in this study (Table 4) that neither the tenderness nor the juiciness of the chicken meat was significantly ($P < .05$) affected by high dietary salt seems inconsistent with these findings.

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