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Growth and Anatomical Characteristics of Pullet Chicks Fed Diets Contaminated with Crude Petroleum

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Influence of crude petroleum on marine life has been well studied (George 1961; Blumer et al. 1970; Ottway 1970). Similarly, toxicity of crude petroleum to avian wildlife has been reported (Rattner 1981; Albers and Gay 1982; Eastin and Rattner 1982). Birds being air and land based, come into contact with shoreline oil pollution only during short foraging expeditions along the shoreline, yet these short contacts are enough to kill them. Janis and Morzer-Bruijus (1968) estimated that total annual bird losses due to oil pollution in the North Sea and North Atlantic (excluding specific disasters) amount to between 150,000 - 450,000 birds. Avian species are exposed to crude oil following spillage, through preening of feathers, cleaning of feet, and actual ingestion of contaminated water, plant materials and feed. Hartung and Hunt (1966) reported that a single oral administration of industrial oil (1-2 ml/kg) by intubation to adult ducks, caused adrenalcortical hyperplasia, anaemia, fatty liver, gastrointestinal irritation and lipid pneumonia. Other workers (Holmes et al. 1978; Patton and Dieter 1980) have noted an ability of birds to adapt to continuous ingestion of fairly large levels of crude petroleum without obvious signs of tox- icity. Pollution of farmlands by overland pipelines carrying crude or refined petroleum are capable of exposing domestic livestock and poultry to varying levels of ingested petroleum products. Prolonged ingestion of low levels of oil-polluted plant materials, seeds and water by livestock and poultry may affect tissues and organs and consequently influence growth and performance. The results reported here are from a preliminary study on gross anatomy and performance characteristics of pullet chicks fed diets contaminated with varying levels of crude petroleum.

MATERIALS AND METHODS

Light crude petroleum obtained from Nigerian Agip Oil Company from Ebocha Flow Station, Rivers State, Nigeria was used in the experiment. Crude petroleum was exposed for 24 hours in shallow pans to allow volatile fractions to evaporate, leaving a stable product that simulated naturally occurring conditions following a spillage. One hundred and sixty four-week old pullet chicks (Harco strain) weighing 350 ± 15 g were used in the six-week experiment. Chicks were immunized against common poultry diseases and fed a standard chick starter diet (Table 1) from day-old until onset of the experiment.

To this starter diet was added graded levels of crude petroleum to provide 0%, 2.0%, 3.0% and 6.0% petroleum (w/w) in experimental diets. The experimental arrangement was a completely randomized design with four dietary treatments, two replicates per treatment and twenty chicks per replicate. Test birds were accommodated on deep litter floor with feed and water provided *ad libitum*. Weekly records of feed consumption and body weight were kept for replicate groups. On the 42nd day, following determination of terminal weights, five pullets from each replicate group were sacrificed and their individual liver, pancreas, spleen, heart, gizzard and proventriculus were removed, weighed and preserved in 20% formalin for tissue histology. Statistical analysis was as outlnied by Steel and Torrie (1960) while differences between means were detected at 5% level of significance using a multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

Performance of pullet chicks on various dietary levels of crude petroleum, Table 2, showed significant differences in body weight gain, feed consumption, feed conversion ratio and percentage mortality of experimental chicks.

Ingestion of crude petroleum at 2, 3, and 6% levels depressed final body weight and, consequently, total weight gain and average daily gain. Body weight at the end of the first week was severely depressed, averaging only 4.31 g/bird/day in the 2% crude oil treatment, 4.25 g/bird/day in the 3% crude oil treatment and 2.18 g/bird/day in the 6% crude oil treatment. By the end of the second week, body weight gains had improved in pullets on the 2% crude oil (5.25 g/bird/day) and the 3% crude oil (5.11 g/bird/day) diets, but was still low in chicks on the 6% crude oil diet (2.28 g/bird/day). Average daily gain for the entire experimental period differed significantly among treatments, being significantly higher in chicks on the 2% (6.45 g/bird/day) and

3% (6.75 g/bird/day) crude oil diets than those on the 6% crude oil diet (3.14 g/bird/day). Growth rate of chicks on the control diet (8.31 g/bird/day) was significantly higher than those on the crude oil diets (Table 2).

Feed containing crude oil was initially rejected by test birds, the degree of rejection being related to the level of oil contamination. At the end of the first week, feed consumption was low in chicks on the 2% (22.31 g/bird/day) or 3% (20.61 g/bird/day) crude oil diets. Control chicks ate 32 g/bird/day. At the end of the second week, however, feed consumption had increased to fairly high levels. Average daily feed consumption for the experimental period were 47.86 g, 37.83 g, 38.74 g and 31.55 g for control, 2%, 3%, and 6% crude oil diets, respectively. Feed conversion ratio (kg feed/kg gain) was normal at 0, 2, and 3% dietary crude petroleum but increased to a very high level as the crude oil content increase to 6%, being 174.2% higher than at 3% level. Mortality of test chicks was related to the level of administration of crude petroleum, being low in the 2% or 3% petroleum diet and high on the 6% diet.

Post mortem examination of chicks that died on all experimental diets indicated that one chick on the control diet died of unknown causes. Three chicks on the 2% crude oil diet, two on the 3% crude oil and three on the 6% crude oil diet died of enteritis. One chick on the 2% crude oil diet, three chicks on the 3% crude oil diet and five chicks from the 6% crude oil diet had congestion of the trachea, lungs and pleura; deaths diagnosed as due to pneumonia. Observation of pneumonia among test birds was in line with reports of Hartung and Hunt (1966) who observed lipid pneumonia, intestinal irritation and fatty enlargement and necrosis of liver in ducks fed crude petroleum. Data on anatomical characteristics of test birds expressed per kilogram body weight are presented in Table 3.

Chicks on the control diet had the highest ($P < 0.05$) liver, pancreas, spleen and heart weights compared to those fed diets containing various levels of crude petroleum. There was no significant difference in liver weight or spleen weight in chicks fed crude petroleum at 2 or 3%. There were, however, differences ($P < 0.05$) in pancreas, heart, gizzard and proventriculus weights. Six percent dietary crude petroleum was associated with significant depression in weight of all organs measured. Gross examination of organs of test chicks on the petroleum diets indicated severe degenerative lesions of liver, pancreas and spleen in chicks on the 6% diet. There was noticeable lipid infiltration of hepatic tissues. Lesions were less severe, though present, in the liver and pancreas of chicks on the 2% and 3% crude petroleum diets. There were no distinct lesions in the heart, gizzard and proventriculus of chicks on the 2% and 6% crude petroleum diets.

According to Heywood (1981), of all the characteristics measured during the course of a toxicological study, body weight was the most important because it was an extremely sensitive and objective measure of the health of any group of animals. In rats, as in many animals, suppression of body wieght gain was commonly associated with decreased food intake. Heywood observed that organ weight analysis was of great importance in general toxicity studies. In these experiments (Heywood 1981), organ weights responded to dietary administration of various chemicals in 85% of rodent studies and 65% of dog studies. The liver was affected by 56% of chemicals tested.

Increase or decrease in organ weights is as a response to body overload with high dose levels of test compounds. In some cases, it is an adaptive response, not a pathological manifestation. In others, increase or decrease my be pathologically induced. Detailed tissue enzyme analysis is currently being done to determine the cause of observed decrease in organ weights.

Table 1. Composition of chick starter diets.

Ingredient	Percentage %
Corn	53.0
Soybean meal	15.0
*Chick concentrate (45% protein)	15.0
Wheat bran	15.0
Vitamin/Mineral mix	2.0
Calculated composition:	
C.P. %	20.41
M.E. (Kcal/kg)	27.05
C.F. (%)	4.67

*Chick concentrate is composed as follows: Menhaden fish meal 30%, Soybean meal 58%, L-lysine 1%, DL Methionine 1%, Corn as carrier 10%. Crude protein of concentrate is 45%, M.E. is 2446 Kcal/kg.

Table 2. Performance characteristics of pullet chicks fed crude petroleum for 42 days

Dietary Crude Oil	Initial Body wt (g)	Final Body wt (g)	Total Body wt gain(g)	Av.daily gain (g)	Total Feed Consumption (g)	Daily Feed Consumption (g)	F.R.C.	Mortaity %
0%	338.30^{a}	687.20^{a}	348.90^{a}	8.31^{a}	2010.0^{a}	47.86^{a}	5.76^{b}	2.50^{c}
2%	350.30^{a}	621.09^{b}	270.79^{b}	6.45^{b}	1589.0^{b}	37.83^{b}	5.87^{b}	10.0^{b}
3%	344.20^{a}	627.50^{b}	283.30^{b}	6.75^{b}	1627.0^{b}	38.74^{b}	5.74^{b}	12.50^{b}
6%	352.20^{a}	484.40^{c}	132.20^{c}	3.14^{c}	$1325.^{c}$	31.55^{c}	10.00^{a}	20.00^{a}

a,b,c,d. Means with different superscripts within each column are significantly different ($P<0.05$).

Table 3. Anatomical characteristics (per kg body wt) of pullet chicks fed crude petroleum for 42 days

Dietary Crude Petroleum	Liver wt (g)	Pancreas wt (g)	Spleen wt (g)	Heart wt (g)	Gizzard wt (g)	Proventriculus wt (g)
0%	38.79^{a}	4.82^{a}	1.95^{a}	4.83^{a}	39.09^{b}	6.40^{b}
2%	34.83^{b}	4.12^{b}	1.81^{b}	4.17^{c}	40.96^{a}	7.74^{a}
3%	35.11^{b}	3.81^{c}	1.88^{ab}	4.78^{a}	38.29^{b}	5.69^{c}
6%	34.42^{b}	3.88^{c}	1.42^{c}	4.64^{b}	36.18^{c}	5.04^{c}

a,b,c,d. Means with different superscripts within each column are significantly different ($P<0.05$).

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