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Full Length Research Paper

Effect of feeding rapeseed meal on the liver weight and hepato-somatic index (HIS) content of liver of Japanese quail

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A detailed study was undertaken in order to determine the safe dose of mustard seed meal in the diet for Japanese quails which can be used at the production level without having deleterious effects on the growth of this bird. For this purpose, some 1500 birds were fed different levels of mustard seed meal in isocaloric and isonitrogenous diets. The results of feeding of these diets for 30 days show that there are no toxic effects on the liver weight and hepato-somatic index (HIS) content of liver of birds. Studies were performed to show that glucosinolates present in the mustard did not have the drastic effects which have been reported in the literature for mammals and other domestic birds. The changes reported herein were seemed to have more of the manifestation of the age rather than the effect of glucosinolates.

Key words: Rapeseed meal, Japanese quail, glucosinolate, growth, nutrition.

INTRODUCTION

Protein is primarily a constituent of active tissues and thus leaves are much richer in this nutrient than are the stems. Fat is also higher in the leaves than in the stems and generally is highest in the seeds. In most seeds of which corn and other cereals are examples, the principal store of energy is in the form of carbohydrates. But oil bearing seeds, such as the soybeans, cottonseed, and flex, contain their reserve primarily as fat, as their name implies. These seeds are used as commercial source of oil, leaving the extracted meals as by-products for animal feeding. Oil bearing seeds are also much higher in proteins than are the cereals seeds.

As far as we know at present, lipids are not specifically required in the diet except as a source of the essential fatty acids and of cholines. Thus, higher the fats content of ration, the greater the energy value per kg.

In the case of chickens March et al. (1975) by studying of tissue energy in birds receiving equal intakes of metabolizable energy, found that corn oil increased the metabolic efficiency of energy utilization. In later studies the authors obtained similar results with soybean oil.

The ability of the liver and the other tissue to store sugar as glycogen is limited, and thus, when the carbohydrates intake regularly exceeds the current need of the body for energy purposes, sugar is transformed into fat. This process takes place on a large scale in the fattening of animals, since their food consists principally of carbohydrates.

Sinigrin, sinalbin, progoltrin, and epiproglotrin are trivial names of some individual glucosinolates. Up till now around 50 glucosinolates have been isolated and identified. For details of the structures of some natural glucosinolates, others have been named by prefixing “gluco” to the botanical name of the plant from which they were first isolated; hence we have the names gluconapin and glucobrassicanapin. A naming system related to chemical structure by which the thioblucosides are all called glucosinolates was proposed by Ettlinger and Dateo (1981). To the glucosinolates is added a prefix that chemically describes the R-group which distinguishes one

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Table 1. Proximate analyses

Protein:	23.92	23.81	24.03	24.34
Metabolizable energy:	3023	3040	2966	3040

glucosinolates from another.

The influence of sinapine at the level found in rapeseed meal on the nutrition of the meal seems to be small. At the higher levels, the palatability of the meal appears to be affected. Sinalbin on the other hand, caused a large decrease in weight gain, feed intake and the PER value to the feeding experiments on mice. These effects are mainly caused by the p-hydroxybenzyl glucosinolate ion. Thus p-hydroxybenzyl glucosinolate has significant detrimental effect on mice even when fed without myrosinase (Josefsson and Uppstorm, 1968).

It has been established by feeding rapeseed oil, high in C-22:1 (erusic acid) concentration, that severe fat accumulation in heart, adrenal and skeletal muscles occur within the first week of feeding. This fatty infiltration gradually disappears after rats are kept for sever al months on these diets (Abdellatif and Vles, 1970). The early cardiac fat accumulation is due mainly to an increase in the concentration of triglycerides and free fatty acids while the phospholipids and cholesterol concentrations remains constant (Kramer, 1973; Bear-Rogers et al., 1971; Bear- Rogers et al., 1972; Hout Smuter et al., 1970).

Hawrysh et al. (1980) found that feeding 20% lower rapeseed meal (a low glucosinolate variety) ration to broiler chicken did not affect the eating quality of the cooked meat. Span variety of rapeseed meal (Leslie et al., 1976) with no amino acid supplementation in a semipurified diet depressed growth in broiler when all the protein was coming from rapeseed meal. The addition of all amino acids known to be limiting (methionine, lysine and arginine) did not completely overcome this growth depression when compared to a soybean meal control diet. When rapeseed meal was included in practical corn soybean type diets, amino acid supplementation has no effect on performance (Summer and Leeson, 1978).

With small initial investment, one can start a quail farm either in specific location or in his house. Dressed quail meat fetches a reasonable market price ranging from Rs.14 to 25 per bird. Steam roasted are precious item of hotels and restaurants, because quail meat has a definite game bird flavour and reputed to be very tasty tender and delicious with high calorific and low cholesterol value (Hameed et al., 2004).

In view of the above, a study was undertaken in order to evaluate the dietary suitability of mustard seed meal achieved after the extraction of oil from the mustard seeds. This meal was incorporated at three dietary levels, that is, 5, 15 and 25% of the diet. The diets prepared were isonitrogenous and isocloric and were fed to the day old chicks for the first month of their life (30 days) and its effect was seen on the growth of liver of Japanese quail.

MATERIALS AND METHODS

Animal husbandry

1450 day-old quail chicks were purchased from a commercial hatchery. These chicks were divided into four experimental groups with three replicates (12 groups in all) each. Every replicate contained 120 birds. Every group was kept in a separate pen. These pens were demarcated by a wire mesh and the floor was covered with deep litre, using 2 inch thick wheat straw. The dimension of these pens was 6×4×4 foot. All these things were disinfected before use.

Brooding temperature of the room containing the pens was maintained at 35℃ in the first week, 32℃ in the se cond, 29℃ in third and the 26℃ in the 4 th week. After this time, the temperature of the room was kept constant at 23℃.

The quail chicks were given rations *ad-libitum*. Four rations were used in all. The composition of the rations, have been given in Table 1. The proximate composition of the mustard seed meal is given in Table 2. The feeders were filled with feed twice a day and fresh water supply was made available to the chicks all the time. O the water was added "VITASOL SUPER", a vitamin premix containing Vitamins A, D, E, B_6, K_3, B_1, B_2, B_{12}, C, folic acid, niacin and calcium pantothenate.

For the duration of the experiment, the photoperiod was kept at 24-h light.

Formulation of feeds

Four rations (Tables 1 and 2) were formulated and designated as A (controls), B (5% mustard seed meal), C (15% mustard seed meal), D (25% mustard seed meal) respectively. All the rations were iso-caloric and isonitrogenous.

Proximate analyses

This is given in table

Weighing

The birds were weighed on the zero day (the day of hatching) and then every day till the end of the experiment to the nearest gram in order to observe the growth pattern. Every group of quails were provided the food *ad-libitum* twice a day and the left over was experiment, all the mortalities and the cause of the death were ascertained by autopsy done on the dead samples.

Sampling

As reported above, the birds were weighed at appropriate time till the age of 30 days. During this time, the samples were taken from each of the four groups from at least 5 male quails for biochemical analyses. In taking the samples care was taken to select those birds which do not deviate from the mean of the sample more than 10% in weight.

At the time of taking samples, the quails were slightly anaesthetized and then slaughtered. After all the blood was drained off, the liver was immediately dissected out, cleaned and blotted with tissue paper and weighed to the nearest milligram and were frozen immediately for analysis.

Table 1. Composition of different rations containing rapeseed meal fed to the Japanese quail *ad-libitum*.

Rations	Percentage rapeseed meal in			
	Control	5	15	25
Maize	15	15	15	15
Wheat	25	22	20	18
Rice	11	11	9	7
Rice Polish	10	10	10	10
Sesame meal	8	8	6	2
Maize gluten	10	8	6	4
Blood meal	4	4	2	2
Fish meal	12	12	12	12
Molasses	3	3	3	3
Bone meal	0.5	0.5	0.5	0.5
Lime stone	1	1	1	1
Pre-mix	0.5	0.5	0.5	0.5
Mustard meal	0	5	15	25
	100	100	100	100

Table 2. Proximate composition of rapeseed meal used in the present investigation. The meal was used after extraction of the oil.

Composition	Percent of the meal
Protein*	40
Fat**	15
Fiber	12
Ash	7.96
Moisture	6.90
Carbohydrates (Nitrogen free Extract).	18.00

*Nitrogen x 6.25, **Soxlet extraction.

Data analyses

Tissue-body index

Tissue-Body Index was calculated using the formula:

$$\text{Tissue-Body Index} = \frac{\text{Weight of organ}}{\text{Weight of animal}} \times 100$$

Statistical procedures

All weights and other values were analysed for statistical difference from respective control values by applying single-factor analysis of variance according to Sokal and Rohlf (1969). The detailed analyses were made according to Campbell (1974).

RESULTS

Liver weight (Tables 3 - 6)

At hatching the liver weight was 0.22±0.01 g (n=10). The weight of liver increased quite linearly up to 14 days and during this time the controls generally had lower values than the experimental. At 14 days the difference between the control and the experimental animals was statistically different (P<0.001). At this time, the controls and the different experimental groups had liver weight as follows; controls (0.85±0.01), 5% (1.46±0.08), 15% (1.29±0.10) and 25% (1.61±0.05). From this it is clear that 25% groups had the heaviest liver at this time. From this time onward till 22 days the liver weights of control increased while all the experimental groups had liver weight more or less constant. At the end of the experiment, the weight increased in all the groups parallely and the difference in weight was not significantly different in any of the group from other (Table 6).

Hepato-somatic index (Tables 7- 9)

The hepato-somatic index (HIS) at zero-day of life

Table 3. Effect of feeding different percentages of Rapeseed meal on the liver weight (g) content of liver of Japanese quail. Values given are Mean±S.E. of 5 animals each.

Age (days)	Percentage rapeseed meal in diet			
	Control	5.0	15.0	25.0
Zero day	0.22±0.01			
6	0.39±0.03	0.55±0.03	0.49±0.03	
8	0. 6±0.08	0.58±0.04	0.71±0.06	0.70±0.05
10	0.77±0.12	0.70±0.05	0.84±0.10	0.78±0.04
14	0.85±0.01	1.46±0.08	1.29±0.10	1.61±0.05
18	1.39±0.15	1.50±0.22	1.34±0.7	1.60±0.06
22	1.48±0.09	1.46±0.18	1.59±0.07	1.57±0.08
30	2.05±0.18	2.28±0.12	2.07±0.07	2.16±0.04

Table 4. Detailed statistical analyses based on the given in Table 3. Statistics according to single factor analysis of variance. Liver weight (14 days) table.

Items	Sum of squares	df (n-1)	Mean squares	F-value
Ratios	1.046231	3	0.3487436	7.3205343 (p<0.001)
Error	0.524031	11	0.0476391	
Total	1.570262	14		

Table 5. Detailed comparisons between rations.

Comparison			F-Value	Significance
Control	Vs	5%	11.611454	P< 0.01
Control	Vs	15%	7.4875995	P<0.05
Control	Vs	25%	20.427674	P<0.001
5%	Vs	15%	1.1522258	N.S.
5%	Vs	25%	0.7688915	N.S.
15%	Vs	25%	0.739995	N.S.

Table 6. Detailed statistical analyses based on the given in Table 3. Statistics according to single factor analysis of variance. Tissue weight (30 days) ANOVA table.

Items	Sum of squares	df (n-1)	Mean squares	F-value
Ratios	0.147805	3	0.0492688	0.7629423 (not significant
Error	0.904075	14	0.0645767	
Total	1.05188	17		

1.98+0.13 g/100 g body weight. From zero-day to 14 days of life, the HIS increased in nearly all the groups, which means that the liver weight was growing faster than the body weight. The peak in somatic index was achieved between 10 to 14 days in all groups. After this peak the HIS started declining gradually till the end of experiment, which is 30 days. At this time 5% group had the highest values for the somatic index followed by controls, 25 and 15%. According to the single factor analysis of variance (ANOVA), the difference between the groups was significant (P<0. 001) (Tables 5 and 10).

DISCUSSION

The present study was undertaken to observe the effects of feeding *Brassica* seed meal on the growth of Japanese quail *Coturnix coturnix j aponica.* As reported earlier

Table 7. Effect of feeding different percentages of rapeseed meal on the Hepato- somatic index (g/100 g) content of liver of Japanese quail. Values given are Mean±S.E. of 5 animals each. For statistical analysis see Tables 8 and 9.

Age (days)	Percentage rapeseed meal in diet			
	Control	5.0	15.0	25.0
Zero day	2.98±0.13			
6	3.58±0.33	3.72±0.28	3.83±0.17	
8	3.96±0.13	4.09±0.28	4.32±0.35	4.22±0.27
10	4.64±0.58	4.39±0.28	4.78±0.24	4.28±0.17
14	4.06±0.02	4.71±0.40	4.40±0.28	4.49±0.11
18	3.82±0.30	3.88±0.36	3.42±0.21	3.80±0.81
22	3.55±0.24	3.53±0.19	3.52±0.11	3.21±0.12
30	2.70±0.15	3.07±0.16	2.14±0.08	2.42±0.07

Table 8. Detailed statistical analyses based on the given in Table 7. Statistics according to single factor analysis of variance. Hepato-Somatic Index (14 Days) ANOVA table.

Items	Sum of squares	df (n-1)	Mean squares	F-value
Rations	0.66079	3	0.2202633	0.3985047 (not significant)
Error	6.07997	11	0.5527245	
Total	6.74076	14		

Table 9. Detailed statistical analyses based on the given in Table 7. Statistics according to single factor analysis of variance. Hepato-somatic index (30 days) ANOVA table.

Items	Sum of squares	df (n-1)	Mean squares	F-value
Rations	2.166665	3	0.7222216	8.61487 (P<0.001)
Error	1.257515	15	0.0838343	
Total	3.42418	18		

Table 10. Detailed comparisons between rations.

Comparison	F-Value	Significance
Control Vs 5%	3.3311809	Not Significant
Control Vs 15%	10.031693	P<0.01
Control Vs 25%	2.6838657	N.S.
5% Vs 15%	1.2385543	N.S.
5% Vs 25%	11.354945	P<0.01
15% Vs 25%	2.339452	N.S.

seeds belonging to the family *Cruciferae* contain certain toxic substances, which upon inclusion in the diet cause growth retardation, thyroid hypertrophy, liver damage and other biochemical and metabolic derailment. The *Brassica* seeds were purchased from the local grain market and were expelled from an oil expeller to extract oil from them. This meal obtained after removing the oil from the seeds was incorporated in isocaloric and isonitrogenous diets at the rate of zero, 5, 10, 15, 20 and 25% of the diet. The diets were prepared from the local ingredients and were designed to be low cost diets. The feeding of these diets was started from the day of hatching and continued up to 4-weeks of age.

Liver is an important vital organ in the body of any vertebrate organism. It not only performs a lot of functions in the normal physiology of the animals, it also synthesizes enzymes used in the inactivation of the toxic xenobiotics. In view of this a study was undertaken to observe the effect of feeding mustard seed meal in the biochemistry and physiology of liver of Japanese quails.

The weight of liver increased linearly but slowly up to the 14 days of life in controls. From 14 to 30 days the liver increase in weight was quite rapid and therefore, its growth can said to be bimodal during the tenure of the experiment in the control groups. The experimental groups had slightly different growth pattern for this organ. The growth of liver was faster ($P<0.001$) in all the experimental groups during the 14 days of life. After this time, the liver weight remain more or less constant till 22 days of life and at the end of the experiment, the organ weights of different groups although heavier than the controls, were not significantly different from them.

The HSI, increased from zero day to 10th day of age in the controls and thereafter there was a steady decrease in it with the advancement in age. Nearly similar trend was seen in all the experimental groups, except that the peak values for HIS were encountered between 10-14 days of life for different groups. At the end of experiment, the minimum values were seen in groups given 25% 0f the mustard seed meal ($P<0.01$). These observations on HIS clearly show that liver grew in weight faster than the body weight during the first 14 days. After this time, the body weight seemed to have taken over resulting in the downward trend of the HIS seen. This behaviour of the liver is similar to other vital organs of the body studied, that is, kidney and heart, but differed from brain, which seemed to have mustard at the time of hatching or just prior to hatching.

Another point that warrants further comments is the relative weight of liver HSI in the groups, fed 15 and 25% of the mustard seed meal in the diet. The HSI of these groups as reported above was lower than the controls and that 25% group had values significantly lower than the controls and 5% groups. This observation probably points to the fact that the body weights in these groups grew comparatively faster than the corresponding liver weight. This decrease in HSI can also be due to the damage to the hepatic tissue because the presence of the excessive amounts of glucosinolates present in these rations. The presence of glucosinolates in the rations of mammals and *Gallus domesticus* has been shown to induce severe liver damage, liver haemorrhage and greenish-yellow coloration (Hill, 1979). Nevertheless, the possibility for this later alternative is quite low, because firstly, the liver weights of these groups were comparable to the controls and no clear cut liver damage signs were noted at the time of taking sample. May be the toxicity was just starting at this time and a further feeding phase was needed to observe this effect.

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