

Nutritional and toxicological evaluation of Jojoba (*Simmondsia chinensis*) oil meal in the complete feed of rabbits



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Abstract

Fourty New Zealand white rabbits were randomly allotted to four equal dietary treatments consisting of complete mixed rations (16% CP; 15% CF) without (T_0) and with 5 (T_1), 15 (T_2) and 25 (T_3) per cent jojoba (*Simmondsin chinensis*) oil meal to study the toxicity as well as bone and meat characteristics. Supplementation of jojoba oil meal caused absolute mortality and the extent of mortality followed the dose response pattern. Fifty per cent of mortality rate was documented in T_3 as early as 3rd week of experiment and at the end of 3rd week all experimental animals succumbed to death while no mortality recorded in control group. Chemical composition of meat and bone indicated significantly lower crude protein and ether extract contents in treated rabbits. Autopsy of rabbits which died in jojoba oil meal incorporated complete feed showed mild to severe dilated and congested mesenteric blood vessels and enlarged liver and kidney. Toxicopathological changes include hepatocellular swelling, bile duct hyperplasia, glomerular nephritis and thyroiditis indicative of simmondsin toxicity in rabbits due to jojoba oil meal.

Key words: jojoba oil meal, nutrition, rabbits, toxicity

Introduction

There is a significant scope for the utilization of various unconventional feed resources for profitable rabbit production. Partial replacement of costly protein sources with locally available protein supplements has to be explored and study in this line by using Jojoba meal, a new unconventional feed resource, for its nutritive value and dose response study for safe level for sustained production. Very few animal experiments have been conducted to ascertain the feeding value as well as extent of toxic effects of Jojoba meal.

Jojoba (*Simmondsia chinensis*) is an evergreen native oil seed shrub of the Sonora deserts of Arizona, California in the United States and Mexico. In India it is grown in some

parts of Kutch in Gujarat, Jodhpur and Jaipur in Rajasthan. Jojoba oil meal, a high protein residue, which remains after oil extraction is a potential unconventional protein feed supplement. Toxic and anti-nutritional substances make the meal unsuitable for livestock feeding. Toxicity of the incriminating factors such as simmondsin, simmondsin-2-ferulate and related cyanomethylene glycosides however has never been fully proved nor understood the physiological mechanisms by which these factors bring about adverse effects. Very few animal experiments have been conducted to ascertain the feeding value as well as extent of toxic effects of jojoba meal. Keeping this in view, the present study was conducted to study the effect of feeding graded levels of jojoba oil meal on nutrient composition of meat and bone and toxicopathology of vital organs of rabbits.

Materials and methods

Fourty weaned (4 weeks old) New Zealand white rabbits of comparable body weights were selected for the study. They were randomly allotted to four dietary treatment groups of ten rabbits in each group namely, T₀ (Complete feed with no Jojoba), T₁ (Complete feed with 5% Jojoba), T₂ (Complete feed with 15% Jojoba) and T₃ (Complete feed with 25% Jojoba). The rabbits were kept in individual cages (15" x 18" x 11") and housed in a well ventilated laboratory animal house.

At the end of the experiment all the animals survived were euthanized and following parameters such as live weight slaughter weight dressing percent, total meat, bone weight and weight of offal, viz., liver, kidney, heart, lungs with trachea were studied. Chemical composition of meat and bone were proximate analyzed from the meat sample. *Longissimus dorsi* muscle was analyzed for protein and fat. Calcium and phosphorus were analysed in femur bone according to AOAC (1990).

The vital organs viz: liver, kidney and thyroid were collected immediately after the death of the animals and subjected them to toxicopathological study.

Results

Mortality rate:

The early mortality of the experimental animals among the test diet groups observed first in T₃ followed by T₂ and T₁ group. Around 50% of mortality rate was documented as early as 3rd week of the experiment in T₃ and at the end of the 5th week all the experimental animals were succumbed to death while in T₂ 100% mortality recorded on 6th week. Occurrence of early mortality was in tune with increased level of jojoba oil meal indicating dose related effect of simmondsin toxicity. Rabbits were found to be very much sensitive to the toxicant present in jojoba and level of jojoba oil meal even as low as 5 per cent level containing mixed toxicant concentration of one per cent proved to be totally detrimental. Sustenance of 20 per cent of the animals in group T₁ up to 12th week of the experiment might probably due to their innate strong immune status.

Nutrient composition of meat and bone:

Nutrient composition of carcass of all the four groups was available for comparative study (Table 1). Analysis of meat composition revealed a decrease in dry matter, crude protein and fat content of T₁, T₂ and T₃ groups as compared to control group.

From the foregoing, it is concluded that the supplementation of jojoba oil meal as low as 5% of diet may severely depress dry matter intake with concomitant loss of body weight leading to high mortality in rabbits. Nutrient utilization is also affected in terms of reduced DCP and TDN intake. Jojoba oil meal, a new unconventional protein supplement found to be of limited nutritional value in rabbit production particularly beyond 5% inclusion levels.

Toxicopathology:

Autopsy findings of experimental rabbits depicted mild to severe dilation and congestion of mesenteric vessels (Plate 1), mild to severe congestion and hemorrhages in liver (Plate 2). No gross changes were noted in control group.

Toxicopathological changes in liver tissue of different test diet groups included venous congestion to hepatic cellular atrophy (Plate 3) and bile duct hyperplasia. Similarly, histopathological study of kidney of T₁, T₂ and T₃ groups showed nephritis and hemorrhages and congestion in Bowman's and between tubules (Plate 4).

Discussion

Supplementation of jojoba oil meal in the complete diets of rabbits in the present study caused absolute mortality and the pattern of mortality rate was dose dependent. Nutrient composition of meat and bone revealed that the mean crude protein and ether extract content in jojoba fed groups were significantly less ($p \leq 0.05$) compared to control. Booth *et al.* (1974) also recorded 100 per cent mortality in rats. Ngoupayou *et al.* (1982) observed 5.6 per cent and 55.6 per cent mortality at 5% and 10% jojoba meal in chicks. The reason for absolute mortality could be due to the severe voluntary feed intake depression associated with marked reduction in weight gain caused by simmondsin and simmondsin 2-ferulate (Elliger *et al.*, 1974; Booth *et al.*, 1974 and Cokelaere *et al.*, 1992) and benzyl cyanide derivative of simmondsin produced in the body (Booth *et al.*, 1974 and Williams, 1980). The meat composition in control group of rabbits is similar to Angora rabbits fed with different vegetable protein supplements (Gowda *et al.*, 1996).

Toxicopathological changes in tissues of various organs examined may be attributed to the toxicological impact of simmondsin and other related compounds present on jojoba oil meal. Similar findings were also observed in rats fed with simmondsin (Cokelaere *et al.*, 1993).

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Table 1: Average chemical composition of the meat and bone of rabbits (% DM)

Nutrient	T ₀	T ₁	T ₂	T ₃
Dry matter	26.05±0.38	24.63±0.41	19.85±0.20	20.39±0.10
Crude protein	21.52 ^a ±0.18	18.95 ^b ±0.04	18.52 ^b ±0.24	15.12 ^c ±0.02
Fat	4.12 ^a ±0.09	3.74 ^b ±0.05	2.0 ^c ±0.09	2.22 ^c ±0.07
Total ash	43.59±0.21	43.26±0.25	45.38±0.12	45.49±0.80
AIA	0.21±0.007	0.21±0.003	0.18±0.003	0.21±0.003
Calcium	16.27±0.31	15.86±0.10	15.64±0.25	14.47±0.32
Phosphorus	6.17±0.24	6.05±0.10	5.96±0.09	5.91±0.06

Note: Mean value bearing different superscripts in a row differ significantly (P≤0.05)

Plate 1: Representative photograph of rabbit belonging to T₃ group showing severe congestion of mesenteric blood vessels



Plate 2: Enlargement and hemorrhages in liver and kidney of rabbit belonging to T₂ group



Plate 3: Photomicrograph of liver (T₂ group) showing hepatocellular swelling, bile duct hyperplasia and areas of congestion (H&E; 400X)

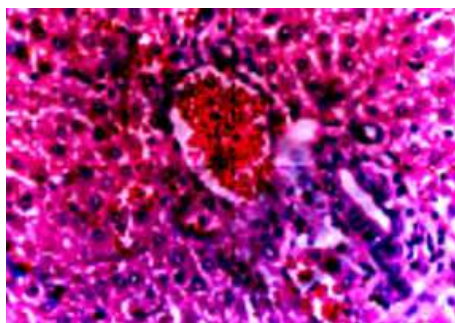


Plate 4: Photomicrograph of kidney of rabbit (T₂ group) showing lymphocytic infiltration in Bowman's capsule and haemorrhagic areas (H & E; 400X)

