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*Full length Research paper*

# Effect of cottonseed meal supplemented with tryptophan on growth performance and organ development of rabbit bucks

**Alaba O[1*], Adenuga B[1], Odu O[2] and Adejumo DO[1]**

[1]Animal Physiology and Bioclimatology Unit, Department of Animal Science, University of Ibadan, Nigeria.,
[2]Agricultural Biochemistry and Nutrition Unit, Department of Animal Science, University of Ibadan, Nigeria.

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**The effect of cottonseed meal supplemented with tryptophan on growth performance and organ development of rabbit bucks was studied using a total of 35 weaned male rabbits weighing 1182.3 – 1419.0g. Seven diets with 3 different inclusion level of 0.0, 0.2, and 0.4% tryptophan with 0.0, 10, and 20% cottonseed meal based diets were fed to a group of 5 rabbits each. Rabbits were allotted in a completely randomized design. Experimental diets and water were supplied *ad- libitium* for the period of 5weeks. During the feeding trial, weekly growth performance (body weight gain, feed intake and feed conversion ratio) and organ weights were determined. All the growth parameters were not affected (*p*>0.05) by the different inclusion of the dietary treatment and in the organ (*p*>0.05) weights. However, liver weight in T1 (2.68g) was better (*p*<0.05) than T6 (1.98g). Also, the left and right testes in T1 (0.31g) were better (*p*<0.05) than T5 (0.17g) and T6 (0.20g). This experiment showed that cottonseed meal supplemented with tryptophan did not have any effect on the growth performance and organ weight of the rabbit buck at the dietary inclusion levels.**

**Keywords:** experimental diets, feeding trials, gossypol, weaner rabbits, performance, monogastric

## INTRODUCTION

In a quest to get a cheaper and higher protein source for livestock, farmers over the years have taken non-conventional feedstuff into consideration. One of such non-conventional feedstuff is cottonseed. Cottonseed cake is a by-product obtained by extracting oil from the cottonseed. It is a good source of protein and energy and is abundant in central African countries. For those reasons, it is generally used in the ration of domestic animals (Kenfack et al 2015). Cottonseed meal (CSM) is a potential source of protein for livestock and it is not consumed by man. According to NCPA, (1995) CSM is an excellent source of protein, energy and fibre for a variety of livestock species, it is rich in crude protein (35 – 46%), contains over 1% phosphorus and 70 – 80% TDN. Despite the rich nutritional potential of the CSM, its utilization for animal feeding has been largely restricted to ruminant feeding. However, the main problem that has limited its utilization in monogastric animal feeding thus far is the presence of gossypol, a toxic polyphenol compound that is naturally found in the pigment glands of the cottonseed (Zotte et al 2013), and this is present in free and bound forms. The free form is more toxic to monogastric animals. It can negatively affect animal growth, digestive, and reproduction organs (Zheng et al 2012). Gossypol will become harmless if the free radical in it is transformed into bound gossypol as bound gossypol cannot be absorbed by the digestive tract (Khalaf and Meleigy2008).

Tryptophan (TRP;L-α-aminoindole-3-propionic acid) is a nutritionally essential amino acid for monogastric animals (e.g. pigs, dogs, rats, mice, and chickens) plays an important role in metabolism, physiology, growth and development of organisms (Nathalie and Bernard, 2007). The primary function of tryptophan is to serve as a building block in protein biosynthesis. Tryptophan is considered as the third or fourth limiting amino acid in typical corn and soybean meal based diets for young pigs after lysine, methionine, and threonine (Jansman

Corresponding author's Email: femialaba@gmail.com

et al 2010). Feeding a tryptophan-supplemented diet to pigs increased feed intake, the amounts of Cl- and H+ secreted from the intestinal mucosa, efficiency of nutrient utilization for protein accretion, and growth performance, when compared with unsupplemented controls (Ettle and Roth, 2004). This study was therefore conducted to evaluate the effects of feeding CSM to rabbit bucks on the performance and organ development using weight changes as an index of development.

The possibility of using tryptophan to counteract any adverse effect by the CSM on the relative body and organs weight of the bucks was also investigated.

## MATERIALS AND METHODS

### Experimental site

This experiment was carried out at the rabbitry unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. It is situated in rainforest agro-ecological zone, Southwest of Nigeria, between lat. 7° 27′ 18.74″ N and 7° 27′ 19.17″ N and long. 3° 53′ 13.98″ E and 3° 53′ 32.69″ E.

### Experimental animal and management

Thirty five (35) male weaned rabbits weighing 1182.3g – 1419.0g were randomly assigned to 7 experimental diets containing CSM supplemented with tryptophan at varying inclusion levels, having CSM at 0, 10,20% and tryptophan at 0,0.2 and 0.4% respectively, having 5 rabbits per treatment (n=5). Feed and water were provided *ad libitum* throughout the experimental period. Body weight gain (BWG) and Feed intake (FI) were recorded weekly. At the end of the experiment, before slaughtering, the animals were weighed. The carcass was opened to harvest the internal organs and weighed.

The actual weight of each organ was measured using sensitive scale and the relative weight was calculated.

The experimental design is completely randomized design.

Treatment 1: Basal diet
Treatment 2: Basal diet + 10% of cotton seed meal
Treatment 3: Basal diet + 10% of cotton seed meal + 0.2 Tryptophan
Treatment 4: Basal diet + 10% of cotton seed meal + 0.4 Tryptophan
Treatment 5: Basal diet + 20% of cotton seed meal
Treatment 6: Basal diet + 20% of cotton seed meal + 0.2 Tryptophan
Treatment 7: Basal diet + 20% of cotton seed meal + 0.4 Tryptophan

### Statistical analysis.

Data collected was subjected to one-way analysis of variance (ANOVA) in completely randomized design (CRD) using SAS 9.2 (2012). Means were separated by Duncan multiple range test to determine differences among treatment means at 5% probability.

## RESULTS

**Table 1:**Composition of the experimental diet fed to rabbits

| Ingredients | T1 (%) | T2 (%) | T3 (%) | T4 (%) | T5 (%) | T6 (%) | T7 (%) |
|---|---|---|---|---|---|---|---|
| Maize | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Soya bean meal | 10 | 10 | 10 | 10 | _ | _ | _ |
| CSM | _ | 10 | 10 | 10 | 20 | 20 | 20 |
| PKC | 20 | 10 | 10 | 10 | 10 | 10 | 10 |
| Wheat Offal | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Rice Bran | 14.45 | 14.45 | 14.25 | 14.05 | 14.45 | 14.25 | 14.05 |
| Premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Salt | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Lime Stone | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Tryptophan | _ | _ | 0.2 | 0.4 | _ | 0.2 | 0.4 |
| Bonemeal | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Calculated analysis | | | | | | | |
| ME(Kcal/kg) | 2234 | 2131 | 2131 | 2131 | 2101 | 2101 | 2101 |
| Crude protein (%) | 17.87 | 18.20 | 18.20 | 18.20 | 18.00 | 18.00 | 18.00 |
| Crude fiber (%) | 10.21 | 10.21 | 10.21 | 10.21 | 10.18 | 10.18 | 10.18 |

Premix composition (per kg od diet): vitamin A, 12,500 IU; vitamin D3, 2500 IU; vitamin E, 50.00; K3, 2.50mg; vitamin B1, 3.00mg; vitamin B2, 6.00mg; vitamin B6, 6.00mg; niacin, 40mg; calcium panthenate, 10mg; biotin, 0.08mg; vitamin B12, 0.26mg; selenium, 0.1mg; folic acid, 1.0mg; chloride, 300mg; manganese, 100mg; iron, 50mg; zinc, 45mg; copper 2.0mg; iodine, 155mg; cobalt, 0.25mg; antioxidant, 200mg.

**Table 2**: Growth performance of rabbit bucks fed cottonseed meal based diet supplemented with different inclusion level of tryptophan.

| parameters | T1 | T2 | T3 | T4 | T5 | T6 | T7 | SEM |
|---|---|---|---|---|---|---|---|---|
| **initial body weight(g)** | 1393.3 | 1322.0 | 1318.7 | 1166.3 | 1238.3 | 1419.0 | 1182.3 | 49.716 |
| **final body weight(g)** | 1688.7 | 1588 | 1659.7 | 1562.3 | 1470.0 | 1674.0 | 1445.7 | 53.994 |
| **Average weekly gain(g)** | 337.73 | 317.60 | 331.93 | 312.47 | 294.00 | 334.80 | 289.13 | 10.798 |
| **Average weekly feed intake (g)** | 109.34 | 100.75 | 108.78 | 109.54 | 105.13 | 103.27 | 107.00 | 4.241 |
| **FCR** | 3.09 | 3.15 | 3.05 | 2.85 | 2.80 | 3.24 | 2.70 | 0.20 |

FCR: Feed conversion ratio; SEM: Standard error of mean

Table 2 shows the growth performance of rabbit bucks fed cottonseed meal based diet supplement with different inclusion levels of tryptophan. All the parameters were not significantly ($p>0.05$) affected by the dietary treatment. The initial body weight was observed to be highest in T6 (1419.0) and lowest in T4 (1166.3). Highest final body weight was observed in T1 (1688.7) while the lowest final live weight was recorded in T7 (1445.7). This same trend was observed in the average weekly weight gain, with T1 (337.73) having the highest and T7 (289.13) having the lowest value. The average weekly feed intake was observed to be highest in T4 (109.54) and lowest in T2 (100.75). The feed conversion ratio FCR as observed from the experiment gave the highest value in T5 (2.6538) and the least value was recorded in T4 (1.4758)

**Table:3** showing the organ weight indices of rabbit bucks fed cottonseed meal supplemented with tryptophan

| Parameter(g) | T1 | T2 | T3 | T4 | T5 | T6 | T7 | SEM |
|---|---|---|---|---|---|---|---|---|
| **Liver** | $2.683^{a}$ | $2.360^{ab}$ | $2.220^{ab}$ | $2.270^{ab}$ | $2.120^{ab}$ | $1.977^{b}$ | $2.403^{ab}$ | 0.019 |
| **Left kidney** | $0.283^{a}$ | $0.270^{a}$ | $0.260^{a}$ | $0.387^{a}$ | $0.333^{a}$ | $0.267^{a}$ | $0.307^{a}$ | 0.0003 |
| **Right kidney** | $0.287^{a}$ | $0.263^{a}$ | $0.270^{a}$ | $0.383^{a}$ | $0.313^{a}$ | $0.267^{a}$ | $0.293^{a}$ | 0.0003 |
| **Heart** | $0.237^{a}$ | $0.290^{a}$ | $0.250^{a}$ | $0.287^{a}$ | $0.263^{a}$ | $0.270^{a}$ | $0.257^{a}$ | 0.0005 |
| **Left adrenal** | $0.013^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.010^{a}$ | $0.010^{a}$ | 0.0000 |
| **Right adrenal** | $0.001^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.001^{a}$ | $0.008^{a}$ | 0.0128 |
| **Left testes** | $0.310^{a}$ | $0.250^{ab}$ | $0.233^{ab}$ | $0.260^{ab}$ | $0.170^{b}$ | $0.203^{b}$ | $0.270^{ab}$ | 0.0003 |
| **Right testes** | $0.300^{a}$ | $0.253^{ab}$ | $0.240^{ab}$ | $0.247^{ab}$ | $0.200^{b}$ | $0.200^{b}$ | $0.287^{ab}$ | 0.0002 |
| **Live weight(g)** | $1693.000^{a}$ | $1559.300^{a}$ | $1517.700^{a}$ | $1417.000^{a}$ | $1460.300^{a}$ | $1551.300^{a}$ | $1307.000^{a}$ | 2129.1315 |

a,b : Mean with different superscript on the same row are significantly different ($p<$

## DISCUSSION

The growth performance of rabbit bucks as pointed out by final live weight, total live weight, weekly weight gain and weekly feed intake and feed conversion ratio were not significantly ($p> 0.05$) influenced by CSM and tryptophan inclusion levels. This result proposed that cottonseed meal with or without tryptophan supplementation did not have any significant effect on the growth performance of rabbit bucks. This is an indication that the test ingredient did not generate any inadequate nutrient utilization that could have caused a response in the growth performance of the buck negatively.

This also indicates that cottonseed meal supported the growth of rabbit bucks at the levels of inclusion used in this study. This result disagrees with the report of Taha et al (2006) who reported that body weight of rabbits that were given high dose of gossypol was significantly reduced compared with the control, while the low dose of gossypol (4 mg/kg LW) had no effect. However, the observation that feed intake was not significantly affected from this study by dietary CSM, is in agreement with the report of Taha et al (2006) who reported no significant difference in the acceptability of graded levels of cotton seed meal as compared to the control.

The significance difference in the liver of rabbit buck fed with diet containing CSM supplemented with tryptophan might be related to the effect of gossypol on the organs This shows that there is a relationship between the gossypol level in CSM and the liver weights (Ikurior and Fetuga 1985). The varying inclusion levels of CSM and tryptophan does not have any significant effect on the weight of organ such as kidney, heart and the adrenal which is in contrast with the findings of Jegede et al (2013) who reported differences in the weight of these organs of pigs fed cottonseed meal. This might be as a result of tryptophan inclusion in the feed that helped to alleviate

the adverse effect of gossypol contained in cottonseed meal on the kidney, heart and the adrenal.

Chenoweth et al (1994) found a similar trend where bulls fed gossypol had the lowest testicular volumes and weights, but they failed to find statistical differences. These results are consistent with studies that did not find any effect of gossypol on testicular weights (Jimenez et al 1989; Chase et al1994; Chenoweth et al 1994).

## CONCLUSION

Growth performance and organ development of rabbit bucks fed cottonseed meal supplemented with or without tryptophan were not affected significantly. It can be inferred that the test ingredient did not generate any inadequate nutrient utilization that could have caused a response in the growth performance of the buck negatively. This also indicates that cottonseed meal supported the growth of rabbit bucks at the levels of inclusion used in this study.

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