Growth and Haematological Responses of Wistar Rats Administered Deoxynivalenol Extract

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ABSTRACT

Response of wistar rats to orally administered extract of Deoxynivalenol (DON) was assessed in this study. One hundred wistar rats with average weight of 166.85g were randomly allotted to 5 treatment groups and each group was replicated 4 times with 5 rats per replicate. Each group was administered varied DON concentration of 0, 250, 500, 750 and 1000µg/kg for T1 (control), T2, T3, T4 and T5 respectively. The DON extract was orally administered to each animal using canula at 0.1ml/100g body weight at 48 hours interval for a period of 28 days in a completely randomized design. Feed intake, body weight changes and feed conversion ratio were monitored. Blood was sampled at day 21 from the animals through ocular vein for haematology. Result showed that daily feed intake and feed conversion ratio were not significantly different among the treatments. The final live weight and average cumulative weight gain were significantly (p<0.05) reduced with increase in the DON concentration in the rats. Weight gain in rats administered 250 µg/kg (11.0±3.1g) and 500 µg/kg (11.5±6.3g) were significantly (p<0.05) higher than those rats treated with 750 µg/kg (5.7±12.5g) and 1000 µg/kg (5.7±6.2g) but lower than the control rats (19.3±10.4g). The packed cell volume and haemoglobin concentration in treated rats significantly (p<0.05) reduced with increase in the DON concentration than the control suggesting anaemic condition in the animals. However, erythrocytes, leukocytes, platelets, neutrophils, lymphocytes, eosinophils and monocytes were not significantly influenced by the treatments. This study suggests that exposure of rats to 250 µg/kg and above depressed growth rate, reduced blood volume and its oxygen carrying capacity.

Keywords: Growth, Haematology, Deoxynivalenol extract, Wistar rats.

Introduction

The poor performance of livestock in developing countries has been attributed to the seasonal inadequacy of feed, both in quantity and quality (Shephard, 2003). Many feed resources could have a major impact on livestock production which ultimately reduces the growth and reproductive potential of animals. Animals consume feeds which may contain toxic substances thereby exposing the entire population of people in developing countries worldwide to risk of chronic exposure to naturally occurring mycotoxin through contaminated food (Shephard, 2003). Most of these mycotoxins such as aflatoxin, fumonisn, ochratoxin and deoxynivalenol are known to be potent carcinogens and hepatotoxic agents that pose serious hazards to human and animal health (Sidhu et al., 2009).

These mycotoxins also have an impact on agricultural economy through the loss of crop production (Wu, 2004). Food and Agricultural
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Organization of United nations (CAST, 2003) reported that 25% feedstuff is polluted by mycotoxin in the world and it results in over 1 billion dollars loss for poultry industry annually. However, emphasis on mycotoxin has always been on aflatoxin produces by Aspergillus species while there is little emphasis on a lot of other mycotoxins such as Zearalenone and deoxynivalenol produce by Fusarium species with respect to their toxicity in the tropics. Deoxynivalenol (DON), also known as vomitoxin, is a trichothecene mycotoxin produced by the Fusarium genus which is commonly found in our environment. Deoxynivalenol and zearalenone belong to the most prevalent mycotoxins produced by the Fusarium species (Bucheli et al., 2008). The DON has been reported to occur in cereal grains worldwide (Wegulo, 2012) and can increase in stored grain with kernel moisture content of 22-25% (Vesonder et al., 1978, Sanden et al., 2012). One ppm or more of DON has been reported to result in reduced feed intake and weight gain in swine (Côté et al., 1984). Don has been shown to be the primary mycotoxin associated with swine disorders including feed refusal, diarrhea, emesis, reproductive failure and death (Vesonder et al., 1978, Côté et al., 1984 and Pestka, 2007). However, response of rat to DON extract in the tropics has not been adequately documented. Therefore, growth and haematological response of wistar rats to DON extract were investigated.

2.0 Materials and Methods

2.1 Experimental site

The experiment was carried out at the Animal House of the Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria (7° 20’N, 3° 50’E; 200m above sea level).

2.2 Experimental materials and layout

One hundred wistar rats with average weight of 166.85g were collected from the rat colony, Department of Veterinary Anatomy, University of Ibadan and randomly allotted to 5 treatment groups and each group was replicated 4 times with 5 rats per replicate. Deoxynivalenol (DON) extract was obtained from SIGMA Company Ltd. Each group was administered varied Deoxynivalenol concentration of 0, 250, 500, 750 and 1000 μg/kg for T1 (control), T2, T3, T4 and T5 respectively. The DON extract was orally administered to each animal using canula at 0.1ml/100g body weight at 48 hours interval for a period of 28 days in a completely randomized design. The animals were fed commercial diets with 16% CP and 2400kcal/kg digestible energy. The animals were fed the same diet ad libitum daily. Portable water was made available throughout the experimental periods. Feed intake, body weight changes, mortality and feed conversion ratio were monitored.

2.2 Blood collection and evaluation

Blood samples were collected at day 21 from the rats through the ocular vein into a set of vacutainer tubes containing a calculated amount of ethylene diamine tetraacetic acid (EDTA) for haematological study. Packed cell volume (PCV), Haemoglobin, red blood cell and leukocyte counts were determined from the blood sample in EDTA bottles as outlined in Ewuola and Egbunike (2008). Other blood indices and leukocyte differentials were determined as described by Jain (1986).

2.3 Data Analysis

Data obtained were tested using one-way analysis of variance of statistical analysis software (SAS, 2003) at p = 0.05. Treatment means were separated using Duncan Multiple Range Test option of the same software.

3.0 Results

3.1 Growth indices of the wistar rats

The growth indices of rats administered DON extract is as shown in Table 1. The daily feed intake and feed conversion ratio of rats...
administered varied doses of DON were not significantly different among the treatments. However, final live weight and cumulative weight gain of rats administered 250 and 500µg/Kg DON were significantly (p<0.05) lower than the control rats but significantly (p<0.05) higher than those treated with 750 and 1000µg/Kg. Rats treated with 750 and 1000µg/Kg recorded least final live weight (172.5g and 172.6g respectively) and body weight gain (5.7g), while the highest value of live weight (186.05g) and cumulative body weight gain (19.25g) were recorded in the control rats.

3.2 Haematological response of the wistar rats

The haematological parameters of wistar rats administered DON extract is as shown in Table 2. The packed cell volume of rats treated with DON extract was significantly (p<0.05) lower than the non treated rats (control). The packed cell volume of rats administered 250, 500, 750 and 1000µg/Kg were not significantly different from one another. Haemoglobin concentration follows the same trend with packed cell volume. The haemoglobin concentration of treated rats was not significantly different from one another, however, haemoglobin of treated rats was significantly (p<0.05) lower than the non-treated rats. The erythrocytes, leukocytes and thrombocytes count were not significantly different among the treatments. The leukocytes differentials: Neutrophils, Lymphocytes, Eosinophils and Monocytes were not significantly influenced by the treatments.

4.0. Discussion

Deoxynivalenol (DON) has been adjudged to be one of the mycotoxins produces by Fusarium species and related generals that is commonly found in agricultural commodities (Desjardins et al., 1993). In this study, feed consumption pattern of rats administered varied concentration of DON extract was not significantly influenced by toxin. This could be attributed to short period of exposure and probably the highest dose of DON (1mg/kg) was not sufficient enough to induce feed refusal effect. Besides, since the DON extract was not administered through feed, immediate effect on the feed intake within a space of 28 days has not been probably significant. This result was at variance to the report of Côté et al. (1984) who observed that DON was the primary mycotoxin associated with swine disorder including feed refusal and diarrhea. Marasas (1984) also reported that diet containing DON decreased feed consumption on a dose related basis. However, McMillan and Moran (1985) observed that poult fed 75ppm DON revealed no effect on feed consumed or growth.

The final live weight and cumulative weight gain were significantly depressed by the DON concentration administered to rats. The body weight gain in rats administered 250, 500, 750 and 1000µg DON/Kg was reduced by 42.9%, 40.3%, 70.4% and 70.4% respectively relative to mean weight gain of 19.25±10.40g in the control rats. This result corroborates the finding of Bergsjo et al. (1993) who reported a decrease body weight gain and slaughter weight in pigs fed 3.5ppm of DON in 8 weeks trial. Pigs fed diets containing 2 and 4ppm of DON exhibited a dose-related decrease in weight gain (Bergsjo et al., 1992). Rotter et al. (1995) also reported a lower feed intake and reduced weight gain in swine exposed to 4mg DON/kg diet within 42 days. Clinical data has shown an association between DON contamination of diets and poor performance in dairy herds (Whitlow et al., 1994). However, the observed result on the weight gain in this study was at variance with the reports of McMillan and Moran (1985) and Kubena et al. (1987) that DON has no effect on weight, feed consumption and growth of the animals.
Table 1: Growth indices of Wister rats administered DON extract

<table>
<thead>
<tr>
<th>Parameters</th>
<th>0µg/Kg</th>
<th>250µg/Kg</th>
<th>500µg/Kg</th>
<th>750µg/Kg</th>
<th>1000µg/Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight (g)</td>
<td>166.80±9.24</td>
<td>166.95±8.08</td>
<td>166.85±7.19</td>
<td>166.80±5.87</td>
<td>166.85±11.61</td>
</tr>
<tr>
<td>Final weight (g)</td>
<td>186.05±14.53a</td>
<td>177.95±8.55b</td>
<td>178.35±4.51b</td>
<td>172.50±15.68c</td>
<td>172.55±8.45c</td>
</tr>
<tr>
<td>Cumulative body weight gain (g)</td>
<td>19.25±10.40a</td>
<td>11.00±3.14b</td>
<td>11.50±6.33b</td>
<td>5.70±12.45c</td>
<td>5.70±6.19c</td>
</tr>
<tr>
<td>Daily feed Intake (g)</td>
<td>37.79±0.55</td>
<td>36.56±1.04</td>
<td>35.08±0.71</td>
<td>36.21±1.38</td>
<td>37.85±0.08</td>
</tr>
<tr>
<td>Feed Conversion Ratio</td>
<td>10.82±3.4</td>
<td>16.83±8.45</td>
<td>15.84±7.49</td>
<td>10.64±8.83</td>
<td>9.56±9.04</td>
</tr>
</tbody>
</table>

abc: Means along the same row with different superscript are significantly (P<0.05) different

The haematological response of rats revealed a dose-dependent effect of DON on the animal health status with depression on oxygen carrying capacity and blood volume in animals administered DON extract as evidence in significantly reduced haemoglobin concentration and packed cell volume in treated rats compared to the control. This effect has been implicated in anaemic disease condition induced by the toxin (Ewuola and Egbunike, 2008; Pereira et al., 2013). This result was in agreement with the finding of Bergsjo et al. (1993) who reported temporary fall in packed cell volume in pigs fed 3.5ppm DON within 8 weeks trial. Matejova et al. (2014) reported decrease in mean corpuscular haemoglobin of Rainbow trouts while other haematological parameters were not statistically different between the experimental and control groups. Other haematological parameters that were not significantly influenced by the DON extract in this study corroborated Modra et al. (2013) observation that DON has no effect on haematological variables in weaned pigs fed diet contaminated with 0.6 and 2 mg DON/kg except mean corpuscular volume that decrease in animals exposed to 2 mg DON/kg for 4 weeks. Pinton et al. (2008) also reported that consumption of DON-contaminated diet does not have a major effect on the haematological and biochemical blood parameters.

5.0 Conclusion
Based on the findings of this study, the deoxynivalenol extract in treated rats reduced

Please note that the text is partially obscured due to the sample nature, but the content is clear enough to understand the context and the analysis provided.
growth rate, blood volume and oxygen carrying capability of red blood cells without adverse effect on other haematological variables.

**Declaration of interest**
The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

**References**


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