Impact of Yeast Derived Nucleotides Supplementation on Intestinal Health of Japanese Quail


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Abstract

The impact of supplementing yeast derived nucleotides on intestinal morphology was studied over a period of 6 weeks in Japanese quail. In this trial, 3 day old Japanese quail chicks were randomly distributed in completely randomized design into 4 treatment groups each with 3 replicates of 10 Japanese quails. The Japanese quails of treatment groups T1, T2, T3 and T4 were provided feed containing 0, 0.5, 1.0 and 1.5 per cent nucleotide respectively. At the end of experiment, two quails from each replicate were randomly selected and slaughtered. After evisceration the length of the intestine from duodenum to end of the cloaca was measured and a sample of two cm from proximal jejunum was collected to study the histological changes in the cross section of intestine. The results indicated that nucleotide supplementation showed significant (P<0.01) effect on intestinal morphology of Japanese quail. Villous height and villous crypt ratio were highest and duodenal crypt was lowest at 0.5 per cent level of nucleotide supplementation whereas relative intestinal length was maximum at 1.0 per cent level of nucleotide supplementation. It is concluded that dietary supplementation of nucleotides at 0.5 per cent level may improve the intestinal health in birds and ultimately the production performance.

Key words: Intestinal morphology, Japanese quails, Nucleotide supplementation.

1. Introduction

Poultry production is the most dynamic livestock sector worldwide. There has been a continuous rise in poultry production in the global as well as Indian scenario. Today, the poultry sector is not only vibrant but also one of the best in the world. The poultry industry continues to grow in accordance with the demand for poultry products in the world markets to meet the rise in human population. In addition to contributing to improved human nutrition and food security by being a leading source of high quality protein, poultry/chicken is of economic, social and cultural significance in small societies (FAO, 2010). According to Watt Executive Guide, 2013 India ranked 3rd in global egg production and 5th in broiler meat production with a growth rate of around 7.8%.

This enormous growth in poultry production is achieved mainly by the improvements adopted in genetics, nutrition and managerial practices. It is inevitable to provide well nutritious feed for modern broilers to maintain the high growth rate, that eventually leads to demand for human food grains and increase in feedstock (mainly soya and maize) prices. This drives the poultry industry to adopt practices such as use of non conventional feed materials, novel feeding practices to avoid wastage, better assimilation of feed by means of improving gut integrity, probiotics and enzymes. Various prebiotics and nutritive additives are added in feed to improve bird’s intestinal health. Of these, nucleotides are gaining prime importance by enhancing the villous growth in intestine.

Nucleotides are the monomers and building blocks of nucleic acids and are therefore necessary for the cell replication. Their molecular structure is based on the combination of a monosaccharide, a nitrogen base and between one and three phosphate groups. They are further classified into two different classes, based on the type of sugar and the nitrogen base. Research studies suggest that dietary nucleotide deficiency may impair liver, heart, intestine and immune functions (Grimble and Westwood, 2000). Dietary nucleotides are of main significance in the growth and development of tissues with rapid turnover like intestinal mucosa, red blood cells, white blood
cells, bone marrow cells and some brain cells because of their inability to produce sufficient amount of nucleotides, hence nucleotides are described as ‘conditionally essential’.

In nature they are obtained by two basic ways, de novo synthesis, i.e. synthesized from small precursors, salvage pathway in which they are synthesized from intermediates in the degradative pathway for nucleotides and also through the diet i.e. digestion of nucleic acids present in the feed ingredients. It is important to note that nucleic acids in the non free form are tremendously stable and difficult to digest. All of which will consume large amount of energy. Hence, supplementation of easily available nucleotides through diet is necessary, as it provide substrate for the growth of rapidly dividing cells without the expense of energy and thereby improves the productivity in birds. The present study reveals the beneficial effects of supplementing nucleotides in view of overall intestinal health of Japanese quail.

2. Material and Methods

In a completely random designed (CRD) experiment, yeast derived nucleotides were supplemented at graded levels through feed to different groups of quail chicks for a period of 6 weeks. In the trial there were four treatments each with 3 replicates and each replicate having 10 Japanese quails of three day old. The treatment T1 served as control in which feed was offered devoid of nucleotide supplementation while T2, T3 and T4 were treated groups in which nucleotide in the form of yeast extract procured from A.A. Biotech Pvt. Ltd., Chennai was provided through feed at the levels of 0.5, 1.0 and 1.5 per cent respectively. In the trial period, feed was provided in two different phases to the quails i.e. starter (1-2 weeks) and finisher (3-6 weeks). The quail chicks were reared in deep litter system with similar housing and managemental conditions for different treatment groups. Feed and water were provided ad lib to the chicks throughout the feeding trial period of 42 days. At the end of experiment on 45th day of age, two quails from each replicate (6 quails per treatment) were randomly selected, weighed and slaughtered. After evisceration the intestine of the birds were carefully separated and the length of the intestine from duodenum to end of the cloaca was measured using a measuring tape and converted into relative intestinal length (intestinal length/100 g of body weight).

A sample of two cm from proximal jejunum was collected and preserved in 10 per cent formalin to study the histological changes in the cross section of intestine. Two cross sections (4-5 μm) of 10 per cent formalin-preserved and processed segments from each jejunum sample were then prepared using microtome for staining with haematoxylin and eosin using standard paraffin embedding procedures (Uni et al., 1995). A total of three intact well-oriented villi were selected in two replicates from each jejunum cross section (six measurements for each jejunum sample, with thirty six measurements per treatment). Villous height was measured from the tip of the villous to the bottom of the villous, and crypt depth was measured from the villous bottom to the crypt base. Villous height and crypt depth ratio was also calculated.

All the observation recorded in this study were subjected to statistical analysis using one way ANOVA technique described by Snedecor and Cochran (1994). Differences between group means were considered significant at P<0.01.

3. Results

In the present investigation effect of supplementation of nucleotides on certain morphological parameters of intestine viz. relative intestinal length i.e., intestinal length/100 g of body weight (from duodenum to cloaca), duodenal villous height, duodenal crypt depth and villous height: crypt depth ratios were recorded.

3.1 Relative Intestinal Length

Supplementation of nucleotide in Japanese quails showed a significant impact on relative intestinal length. The relative intestinal length in Japanese quails of supplemented groups were significantly (P<0.01) higher than the control group quails (Table 1). Maximum (32.31 ± 0.43 cm) and significantly higher relative length of intestine was recorded in Japanese quails of T3 group while minimum (28.76 ± 0.12 cm) and significantly lower relative intestinal length was noted in Japanese quails of T1 group (Fig 1). Relative intestinal lengths in Japanese quails were statistically similar between T2 and T4 groups.

3.2 Duodenal Villous Height

Supplementation of nucleotide in Japanese quails showed a significant impact on duodenal villous height (μm). The villous height were significantly (P<0.01) different among various groups of Japanese quails (Table 1). Maximum (823.75 ± 7.80 μm) and significantly higher villous height was recorded in Japanese quails of T2 group whereas significantly lower and minimum (557.50 ± 8.78 μm) villous height was noted in Japanese quails of T1 group (Fig 2).

3.3 Duodenal Crypt Depth

Supplementation of nucleotide in Japanese quails showed a significant impact on duodenal crypt depth (μm). The duodenal crypt depth in Japanese quails of supplemented groups were significantly (P<0.01) lower than the control group quails (Table 1). Maximum (205.00 ± 2.50 μm) and significantly higher
Table 1: Effect of nucleotide supplementation on intestinal morphological values of Japanese quails

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Relative intestinal length** (cm)</th>
<th>Villous height** (µm)</th>
<th>Crypt depth** (µm)</th>
<th>Villous height : Crypt depth ratio**</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>28.76±0.12</td>
<td>557.50±8.78</td>
<td>205.00±2.50</td>
<td>2.77±0.09</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>30.62±0.25</td>
<td>823.75±7.80</td>
<td>180.00±3.71</td>
<td>4.64±0.11</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>32.31±0.43</td>
<td>790.00±10.00</td>
<td>191.25±1.25</td>
<td>4.20±0.07</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>29.94±0.28</td>
<td>695.00±12.92</td>
<td>187.50±1.25</td>
<td>3.80±0.06</td>
</tr>
</tbody>
</table>

Values bearing different superscripts in a column differ significantly (** P<0.01)

Fig 1: Effect of nucleotide supplementation on relative intestinal length and VC ratio of Japanese quails

Fig 2: Effect of nucleotide supplementation on Villous height and Crypt depth of Japanese quails
crypt depth was recorded in Japanese quails of T1 group and minimum (180.00 ± 3.71 μm) crypt depth was noted in Japanese quails of T2 group (Fig 2). Duodenal crypt depth of T3 and T4 groups as well as T2 and T4 groups were statistically (P>0.05) similar.

3.4 Villous Height-Crypt Depth Ratio (V/C Ratio)

The villous height and crypt depth ratio of Japanese quails showed a significant impact of nucleotide supplementation. The V/C ratio of Japanese quails were significantly (P<0.01) different among various treatment groups (Table 1). Maximum (4.64 ±0.11) and significantly higher V/C ratio was recorded in Japanese quails of T2 group while significantly lower and minimum (2.77 ± 0.09) V/C ratio was noted in Japanese quails of T1 group (Fig 1).

4. Discussion

The results of the present experiment in relation to relative intestinal length are in contrast with the findings of Jung and Batal (2012) who found no significant effect of nucleotide supplementation on relative length of intestine in broilers. In terms of intestinal villous height and crypt depth, the results are supported by Puig et al. (2007) who found increased villous height and decreased intestinal crypt depth in piglets supplemented with nucleotides. In contrast, Giancamillo et al. (2003), Domeneghini et al. (2004) and Moore et al. (2011) found significant (P<0.01) increase in both villous height and crypt depth of ileum and decreased V/C ratio in weaned piglets supplemented with nucleotides.

The increased V/C ratio results are in accordance with Zhang et al. (2005) and Jung and Batal (2012) who found significant effect of nucleotide supplementation on V/C ratio in broilers though they found no significant effect of yeast supplementation on intestinal crypt depth of broilers. As Intestinal mucosa (enterocytes) multiply at a rapid rate, the natural pathways are incapable to substantiate the necessary nucleotide requirement. Therefore, improvement in intestinal morphology may be attributed to high availability of nucleotides in quails provided with supplementary nucleotides.

5. Conclusion

From results of the experiment, it is concluded that the supplementation of nucleotides as yeast extract at 0.5 per cent level enhanced the production performance of Japanese quails by improving the intestinal morphology. Further studies on layer and broiler chicken, Japanese quail layers and other poultry species are recommended.

References