Influence of Prebiotics Supplementation on Lipid Profile of Broilers

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Abstract: The prebiotic - Mannanooligosaccharide (MOS) was extracted from yeast and copra meal and evaluated for their prebiotic potentiality on serum lipid profile and abdominal fat pad. The treatment groups were fed with basal diet (T₀). The basal diet was supplemented with extracted MOS from yeast [@ 0.5 g/kg (T₁); 1 g/kg (T₂)] and from copra meal [@ 1 g/kg (T₃); 1.5 g/kg (T₄)] and with MOS sources such as yeast [MOS equivalent of 0.5 g/kg (T₅); 1 g/kg (T₆)] and copra meal [MOS equivalent of 1 g/kg (T₇); 1.5 g/kg (T₈)]. A broiler trial was conducted for a period of five weeks. The results revealed that serum total cholesterol concentration was significantly (P<0.01) lowered by 10, 12 and 12 per cent in birds fed with T₁, T₃ and T₄, diet respectively when compared with control diet in broiler chicken at 5th week of age. There was no significant difference in serum HDL cholesterol of birds fed with extracted MOS / MOS equivalent source except T₆ which was found significantly (P<0.05) lower than control groups. LDL cholesterol level was similar in all treatment groups except higher value observed in T₆(19 69±13.54mg/dl). The abdominal fat pad (percentage of live weight) was found to be significantly (P<0.01) lowest in T₃. This study indicates that the supplementation of prebiotic extracted from yeast at 0.5 and 1 g/kg and copra meal at 1.5 g/kg and yeast source at 1 g/kg level respectively reduced the abdominal fat content.

Key words: Prebiotics, broiler chicken, serum lipid profile, abdominal fat pad

Introduction
In the recent past, in view of consumer awareness and restriction or total ban on the use of antibiotic as growth promotant in poultry industry, probiotic has been introduced as an alternative. However, it has some constraints like lack of viability, stability and inability to be established in intestinal eco-system due to the barriers like gastric acid, bile acid, during its transit etc., Alternatively, prebiotics have been suggested to acquire all probiotic mediated beneficial effects while overcoming all its constraints.

Prebiotics have been defined as non digestive feed ingredients, which are growth substrates, specifically directed towards potentially beneficial bacteria already existing in caecum and colon. Several studies have shown that addition of prebiotics to the diet of broiler, layer and pig leads to improved performance through improving gut microflora (Xu et al., 2003; Spring et al., 2000 and Pelicano et al., 2004). Research on poultry genetics, feeding and management for body weight gain, feed conversion ratio, etc. resulted in fast growth but decreased the quality of poultry products as modern fast growing broilers have been found to contain higher amount of abdominal fat (Chambers et al., 1981).

Most recently, considerable attention has been paid to test the potency of growth promotants on altering lipid metabolism, because, World Health Organization suggested that excess fat deposition is undesirable in human body which ended in fatal diseases like atherosclerosis. Now-a-days, consumers are also well aware of this fact and prefer lean meat. On the other way, excess fat is an economic burden to poultry producers, because fat is lost during processing of the carcass resulting in lower meat yields and further more the discarded abdominal fat and visceral fat increases waste management problems.

Several growth promotants have been tried in our laboratory. (Mohan et al., 1995; Mohan et al., 1996). Probiotic supplementation has been shown to reduce the cholesterol concentration in egg yolk (Mohan et al., 1995; Abdurahim et al., 1996; Haddadin et al., 1996) and serum in chicken (Mohan et al., 1996; Jin et al., 1998). Recent report suggested that feeding of chicory beta fructans – an oligosaccharide, a prebiotic, reduced the serum cholesterol and abdominal fat of broiler chicken (Yusrizal and Chen, 2003). However, the effect of prebiotic is scanty, hence the present study was undertaken to study the effect of Mannanoligosaccharide (MOS), a prebiotic, extracted from various sources (yeast and copra meal) on abdominal fat, serum total cholesterol, high density lipoprotein (HDL) cholesterol, low density lip protein (LDL) cholesterol and triglyceride levels in broiler chicken with the objective of optimizing

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Table 1: Percent ingredient composition of broiler ration

<table>
<thead>
<tr>
<th>Table 1: Percent ingredient composition of broiler ration</th>
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<tr>
<td></td>
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<tr>
<td>Maize</td>
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<tr>
<td>Broken rice</td>
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<tr>
<td>Casen</td>
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<tr>
<td>Fish meal</td>
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<tr>
<td>Test Mn&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>DCP</td>
</tr>
<tr>
<td>Oil</td>
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<tr>
<td>Yeast</td>
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<td>Copra meal</td>
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</table>

CALCULATED:

- CP (%) 22.27 22.27 22.27 22.27 22.27 22.27 22.27 22.27 22.27
- ME (Kcal/kg) 2912 2912 2912 2912 2912 2912 2912 2912 2905
- MOS (g/kg) supplement (g/kg) 0.50 1.00 1.00 1.50 1.00 1.50 1.00 1.50 1.00

1. The control diet was formulated in such a way that it contains negligible level of Mannan. The feed ingredients are selected in order to have a negligible level of Mannan as maize and broken rice have a maximal level of 0.0842 and 0.0906 per cent.

2. A test mix was formulated with wheat bran and fish meal in order to arrive with 35 per cent crude protein level, so as to equally replace the copra meal with this mixture. Composition: Fish meal: 71.40 per cent and Wheat bran: 26.80 per cent.

Mineral Mix: Vitamin—Mineral premix (200g/Quintal of feed)

- Ferrous sulphate 2.00 g
- CuSO₄ 1.90 g
- ZnSO₄ 6.00 g
- MnSO₄ 15.00 g
- KI 100 mg
- Vitamin A 82500 IU
- Vitamin B₁ 50 mg
- Vitamin D₃ 120000 IU
- Vitamin K 10 mg
- Vitamin B₁₂ 4 ng
- Vitamin B₆ 8 ng
- Vitamin B₂ 12 μg
- Vitamin E 40 IU
- Niacin 60 mg

the level of prebiotics supplementation on reducing the abdominal fat pad content.

Materials and Methods

Birds and diet: Ninety (day old), straight run, hatchery vaccinated (Mareks disease vaccine) chicks (COBB) were wing banded and weighed. They were randomly distributed on nine treatment groups with 5 triplicates per group and each replicates had 2 birds. Birds were assigned to forty five numbers of 40x30x35 cm cages with 2 birds per cage. The different treatment groups were fed with basal diet (T₀) and each of them supplemented with extracted MOS from yeast [@ 0.5 g/kg (T₁); 1 g/kg (T₂); 1.5 g/kg (T₃)] and from copra meal [@ 1 g/kg (T₄); 1.5 g/kg (T₅)] or supplemented with MOS sources such as yeast [MOS equivalent of 0.5 g/kg (T₆); 1 g/kg (T₇); 1.5 g/kg (T₈)] and copra meal [MOS equivalent of 1 g/kg (T₉); 1.5 g/kg (T₁₀)]. (Table 1)

Housing and management: Birds were housed in well ventilated with electricity illuminated asbestos roofed house. They were maintained under uniform managerial condition and vaccinated as per recommended standard programme. Chicks had free access to antibiotic free respective feed (Table 1) and potable, whole some drinking water during the 5 week grow out period.

MOS extraction: MOS was extracted from autolyzed yeast by separating cell wall and cell contents and freeze dried. Similarly, from copra meal, MOS was extracted by sequential removal of fat, soluble carbohydrate, lignin and protein as per Saititagaroon et al. (1983).

Sample collection: A day prior to slaughter, blood samples were collected randomly from 5 birds in each treatment. At the end of the experiment (5th week) 5 birds from each treatment, one bird from each replicate were weighed individually and transferred to a processing plant and were slaughtered, bled, scalded by hot water and mechanically defeathered. Then the dressed carcasses were measured for abdominal fat. After obtaining the measurement, carcass were eviscerated and the head, neck and feet removed for ready-to-cook
Table 2: The effect of different dietary levels of MOS on per cent abdominal fat pad, total cholesterol, triglycerides, HDL and LDL cholesterol of broiler chicken at 5 week of age (Mean ± SE)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
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<tbody>
<tr>
<td>Abdominal fat pad</td>
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<td></td>
</tr>
<tr>
<td>As (%) carcass weight **</td>
<td>3.18±0.13</td>
<td>2.54±0.09</td>
<td>2.02±0.06</td>
<td>2.29±0.09</td>
</tr>
<tr>
<td>As (%) live weight **</td>
<td>2.28±0.09</td>
<td>1.81±0.06</td>
<td>1.45±0.01</td>
<td>1.62±0.04</td>
</tr>
<tr>
<td>Total cholesterol (mg/dl)**</td>
<td>166.77±2.13</td>
<td>178.60±3.42</td>
<td>188.91±3.33</td>
<td>185.37±3.00</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)**</td>
<td>62.52±4.55</td>
<td>68.72±1.74</td>
<td>61.44±8.67</td>
<td>59.03±5.43</td>
</tr>
<tr>
<td>HDL (mg/dl) *</td>
<td>111.34±3.90</td>
<td>93.16±2.89</td>
<td>88.39±3.24</td>
<td>87.20±1.46</td>
</tr>
<tr>
<td>LDL (mg/dl) *</td>
<td>88.67±1.45</td>
<td>71.79±1.89</td>
<td>88.24±3.49</td>
<td>84.59±1.70</td>
</tr>
<tr>
<td>Treatment</td>
<td>T5</td>
<td>T6</td>
<td>T7</td>
<td>T8</td>
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<tr>
<td>Abdominal fat pad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As (%) carcass weight **</td>
<td>2.47±0.21</td>
<td>2.92±0.26</td>
<td>2.69±0.19</td>
<td>2.88±0.12</td>
</tr>
<tr>
<td>As (%) live weight **</td>
<td>1.76±0.13</td>
<td>2.02±0.14</td>
<td>1.53±0.14</td>
<td>2.11±0.09</td>
</tr>
<tr>
<td>Total cholesterol (mg/dl)**</td>
<td>183.51±7.32</td>
<td>173.62±3.36</td>
<td>173.21±1.47</td>
<td>195.71±3.78</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)**</td>
<td>61.44±7.00</td>
<td>60.84±7.48</td>
<td>68.07±7.12</td>
<td>60.24±6.37</td>
</tr>
<tr>
<td>HDL (mg/dl) *</td>
<td>91.34±4.38</td>
<td>86.92±1.29</td>
<td>100.59±5.64</td>
<td>96.20±5.63</td>
</tr>
<tr>
<td>LDL (mg/dl) *</td>
<td>91.69±15.34</td>
<td>74.86±7.95</td>
<td>59.01±5.38</td>
<td>84.46±7.69</td>
</tr>
</tbody>
</table>

Mean of five observations. **P<0.01; *P<0.01. **Non significant

(RTC)/dressed carcasses weight determination. Abdominal fat percentage calculated as follows:

Abdominal fat per cent of live weight = [Weight of abdominal fat (g) / Live weight (g) X 100

Abdominal fat per cent of dressed weight = [Weight of abdominal fat (g) / Dressed weight (g)] X 100

Serum cholesterol assay: Blood samples were centrifuged at 2000 xg for 10 minutes and the serum was decanted into aseptically treated vials and stored at –20°C until further analysis. Serum samples were analyzed for total cholesterol, HDL cholesterol and triglycerides by enzymatic diagnostic kits (AGAPP diagnostic kits). The LDL cholesterol calculated by difference between total cholesterol and HDL cholesterol.

Statistical analysis: The design for this experiment was completely randomized design (CRD) with five replications. Data were analyzed with analysis of variance (ANOVA) procedure of statistical analysis system (SAS/SPSS version 10.0 for Windows). When significant difference (P<0.05) were detected the multiple range test was used to separate the mean value.

Results

Abdominal fat pad content: The effect of different dietary levels of MOS on dressing percentage and abdominal fat percentage are presented in Table 2. The abdominal fat pad, (percentage live weight) was found to be significantly (P<0.01) lowest in T3 (1.45 ± 0.01 per cent). With increased level of MOS extracted from yeast had significantly (P<0.01) lower abdominal fat pad percentage as expressed as carcass weight. However, the similar trend was not observed in MOS extracted from copra meal.

Serum lipid profile: The effect of MOS on total cholesterol, HDL and LDL cholesterol and triglyceride level is shown in Table 2.

Serum total cholesterol concentration were significantly lower (P<0.01) by 10, 12 and 2 per cent in broiler fed with T5, T6 and T7 treatment diet when compare with control diet in broiler chicken at 5th week of age. Adding Prebiotic from Yeast (0.5 and 1g/kg) and copra meal (1 and 1.5g/kg) significantly (P<0.01) reduced the serum cholesterol. There was no significant difference in serum HDL cholesterol of birds fed with extracted MOS / MOS equivalent source except T6 which was found significantly (P<0.05) lower than control groups. The variable results were observed with regards to LDL cholesterol. It was similar in all treatment groups except higher value observed in T5 and T7. In contrary, Kalavathy et al. (2003), who found that probiotic (Lactobacillus spp.) supplementation increase serum HDL cholesterol, but serum LDL cholesterol was less. Serum triglycerides were also lower (P<0.05) in MOS extracted / MOS source fed broiler than in the control broiler at 5th week of age (Table 3).

Discussion

Abdominal fat pad content: The observation obviously indicates that abdominal fat pad per cent might be reduced due to increasing beneficial bacteria as result of supplementation with the prebiotics. In recent study, Kalavathy et al. (2003) found that supplementation of Lactobacillus culture reduces (P<0.05) abdominal fat pad. Similarly, Yusriizal and Chan (2003) reported that supplementation of beta fructans from chicory had produced low level (P<0.05) of abdominal fat pad. Santos et al. (1995) also found that abdominal fat contents were reduced in female broilers supplemented with B. subtilis at 42 days of age and that B. subtilis culture decreased the activity of acetyl-CoA carboxylase. Acetyl-CoA carboxylase has been widely suggested as the rate limiting enzyme in fatty acids synthesis.
Serum lipid profile: The decrease in cholesterol level could be due to the cholesterol assimilation by *Lactobacillus*. (Gilliland et al., 1985) as the Prebiotic supplementation could have enhanced the Lactobacilli count. Similar results have been reported by Mohan et al. (1996) and Kalavathy et al. (2003) and a similar hypocholesterolaemic effect was observed in broiler chicken supplemented with beta fructans from chicory as a source of Prebiotic (Yusrizal and Chan, 2003). The mechanism(s) involved in the overall hypocholesterogenetic effect of MOS supplementation is not fully documented. However, MOS is considered as substrate for lactic acid producing bacteria like *Lactobacillus spp.* and *Bifidobacterium bifidum* (Van Loo, 2004). Increasing level of MOS also increase the CFU of this lactic acid producing bacteria (Xu et al., 2003). Gilliland et al. (1985) hypothesized that some *Lactobacillus spp.* are able to incorporate cholesterol into the cellular membrane of the organism, thus, cholesterol assimilation by *Lactobacillus* in turn reduce cholesterol absorption in the system. The lower level of serum triglyceride might be due to increased level of lactic acid producing bacteria in the gut of broiler chicken. The results of Santos et al. (1995) reported that supplementation of *B. Subtilis* in broiler diets decreased triglycerides in the serum.

Conclusion: The serum cholesterol concentration was significantly ( P<0.01 ) reduced in prebiotic extracted from Yeast and Copra Meal as well in Yeast source, no such reduction noticed in Copra Meal fed birds. Likewise the percentage reduction in abdominal fat pad content was lowest among the group supplemented with extracted yeast. This study indicates that the supplementation of prebiotic extracted from Yeast at 0.5 and 1g/kg Copra Meal at 1 and 1.5kg and the Yeast source at 1g/kg level helps in reduction of the Abdominal fat pad content.

References


