Growth Performance and Slaughter Characteristics of Broiler Chickens Fed with Antibiotic, Mannan Oligosaccharide and Dextran Oligosaccharide Supplemented Diets

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Abstract: The aim of the present study was to investigate the effect of dietary supplementation with an antibiotic growth promoter (AGP) and two prebiotics; mannan oligosaccharide (MOS) and dextran oligosaccharide (DOS), respectively, on growth performance and some slaughter characteristics of broilers. One thousand and two hundred day-old broiler chicks (Ross 308) were weighed and randomly assigned to the four treatment groups, each with six replicates. Birds were housed in replicate pens (1.5 x 3.0 m) each containing 50 birds (25 male and 25 female). The four treatments were as follows: 1. Basal diet (Control); 2. Basal diet + antibiotic (10 mg avilamycin/kg diet); 3. Basal diet + mannan oligosaccharide (1 g/kg diet); 4. Basal diet + dextran oligosaccharide (1 g/kg diet). Chicks fed on basal diets were supplemented with an AGP and both of prebiotics were significantly heavier at 21 and 42 days of age than those of control chickens fed with basal diet as control. Besides, body weight of birds given MOS supplemented diet was significantly higher than those birds fed with AGP and DOS added diets (P < 0.05). Feed consumption, feed conversion ratio and liveability of birds was not affected by dietary treatments determined both at 0 to 21 d, 22-42 d and 0-42 d periods (P > 0.05). Percentage weight of carcass yield, liver, pancreas and abdominal fat pad was not affected by dietary treatments also (P > 0.05). The results obtained in the present experiment showed that birds fed with AGP, MOS and DOS supplemented diets exhibited higher body weight gain (P < 0.05) and numerically improved feed efficiency than that of the control birds fed on basal diet. In conclusion, either MOS or DOS could replace for AGP as non-antimicrobial performance enhancer feed additives without scarifying any performance goal and carcass yield of broilers.

Key words: Broiler, antibiotic, mannan oligosaccharide, dextran oligosaccharide

Introduction
For the past several decades growth promoter feed additives have been included in poultry diets to promote growth, protect health and maximize the genetic potential of modern broiler, turkey and layer hybrids. Of these, antibiotics have been used at sub-therapeutic doses in animal feed, including poultry diets, for over five decades to prevent disease, promote growth and feed conversion efficiency (Eyssen and DeSomer, 1963; Miles et al., 1984; Harms et al., 1986; Rosen, 1996; Engberg et al., 2000). Antibiotics exerted their effect by stabilizing the intestinal microbial flora thereby preventing proliferation of specific intestinal pathogens (Truscott and Al-Sheikhly, 1977; Visnek, 1978; Shane, 2005). Today, the non-prescription use of antibiotics in poultry feeds has been eliminated or severely limited in many countries because of concerns related to development of antibiotic-resistant human pathogenic bacteria and legislative action to limit their use in probable in many others. A complete ban on antibiotics in poultry feeds was brought in to force on January 1st by the European Union; thus, all of the antibiotics used at sub-therapeutic levels for growth promotion (antibiotic growth promoters or AGP’s) were withdrawn (Nollet, 2005; Cervantes, 2006; Michard, 2008). The ban on AGP’s has driven and prompted the search and development of alternatives like probiotics, yeast cultures, organic acids, prebiotics, enzymes, botanicals including extracts and essential oils of some herbs and spices (Gill, 1999; Langhout, 2000; Hertrampf, 2001; Hooge, 2006). Products such as prebiotics also have long been tested for their effects on intestinal health; general health status and zootechnical performance of commercial poultry hybrids. Prebiotics are now being considered in keeping the intestinal tract of poultry healthy and at the same time, safeguarding animal health status and performance (Gill, 2001; Kocher, 2005; Hooge, 2006). Since the early 1980’s a series of studies have been conducted to evaluate the effects of different carbohydrates as prebiotic feed additives with the aim of improving animal health and performance. There is a growing interest in use of variety of oligosaccharides to promote human and animal health (Hidaka et al., 1991; Orban et al., 1997). Among these, mannan oligosaccharides and fructo oligosaccharides have been most extensively studied for their ability to improve animal health and performance (Ammerman et al., 1989; Bailey et al., 1991; Spring, 1998; Shane, 2001; Ij et al., 2001; Hooge, 2003a). Different from fermentable oligosaccharides like FOS and inulin, interest in
mannan oligosaccharides (MOS) being non-fermentable has been steadily on increase. Feed grade MOS showed encouraging results on animal health and animal performance thereby selectively binding capability to the pathogenic bacteria (Hooge, 2003a; Shane, 2005; Kocher, 2005; Nollet, 2005). MOS is derived from the outer cell wall of selected strain of saccharomyces cerevisia. Initial researches proved that MOS has the ability to adhere to pathogenic bacteria such as Salmonella or E. coli (Oyoyo et al., 1989; Newman, 1994; Funicane et al., 1999). Subsequent researches showed that MOS has improvement effects on the immune system and intestinal morphology even with improved bird performance, profitability than only the prevention of the colonization of intestinal pathogens (Savage et al., 1996, 1997; Shafey et al., 2001; Iji et al., 2001; Shashidhara and Dewegowda, 2003).

But, on the other hand studies on other oligosaccharide varieties are sparse, even negligible when compared to scientific knowledge regarding to MOS and FOS. During the past decade, limited research activities were applied whether dietary dextran oligosaccharide (DOS) influences health aspects and performance of poultry. Feeding with dextran oligosaccharides (DOS) has been shown to reduce organ invasion of E. coli and Salmonella enteritidis (Tellez, 1997), decrease cecal bacterial count (Fukata et al., 1998), improve egg production performance and feed efficiency for egg number and egg output (Mallik et al., 2003). However, no beneficial effect on broiler body weight gain, feed conversion ratio and liveability even DOS was included in diet at three different inclusion rates ranging from 0.05% to 0.15% (Kılıçyilmaz et al., 2005).

The aim of the present study reported herein was to compare the working mechanism of AGP and two different oligosaccharides as prebiotics, DOS and MOS, as growth promoters in broiler feeding. So, the substitution dietary MOS or DOS for AGP will be evaluated testing on broilers. Therefore, feed grade AGP, MOS and DOS supplemented into diet to determine their dietary additive effects on growth performance, feed intake, feed conversion ratio, liveability, carcass yield, percentage weight of liver, pancreas and abdominal fat pad. Also, this is the first comparative study in the scientific literature that examined the performance enhancer effects of MOS versus DOS on broilers.

Materials and Methods

One thousand and two hundred day-old broiler chicks (Ross-308) were weighted and randomly assigned to the four-treatment group, each with six replicates, using a standard randomization technique. Birds were housed in replicate pens each containing 50 birds (25 male and 25 female). A commercial antibiotic growth promoter and two prebiotic feed additives were supplemented to no additive added basal diet. The four treatments were as follows:

1. basal diet (control)
2. basal diet + antibiotic, avilamycin (AGP, 10 mg/kg diet)
3. basal diet + mannan oligosaccharide, Bio-Mos® (MOS, 1 g/kg diet)
4. basal diet + dextran oligosaccharide, MIIH-Y® (DOS, 1 g/kg diet)

The birds were fed a starter diet in crumble form from days 1-21 and a grower diet in pellet form from days 22-42 (Table 1). The diets were isoenergetic and isonitrogenous and were formulated to meet the minimum nutrient requirements of broilers as recommended by the NRC (1994). All of the dietary feed additives were added at the expense of saw dust. Birds were allowed to feed ad libitum and were supplied with water during the 42-d growth period. The birds were kept in 24 pens (1.5 x 3.0 m) on wood shavings as litter material. Each pen was equipped with two hanging feeder and one drinker. Bird density was 11 chicks per square meter. The lighting cycle was 23 h/d maintained. The ambient temperature in experimental house was maintained at 32°C during the first week and gradually decreased by 3°C in the second and third week, and fixed at 22°C thereafter. Chicks were vaccinated against Infectious Bursal Disease, New Castle Disease (H5N1) and New Castle Disease (La sota) at day 14, 21, 28, respectively, via drinking water.

Growth performance of broilers was evaluated by recording body weight gain, feed intake, feed conversion ratio and mortality during the 42-d experimental period. Individual body weights of the broiler chicks were recorded at the beginning and on days 21 and 42 of trial. Feed intakes of birds were recorded per pen basis on days 21 and 42 of the experiment. Feed conversion ratio was calculated as the amount of feed consumed per unit of body weight gain on days 21 and 42. FCR was calculated as feed intake consumed per unit of body weight gain and was adjusted for weight of chicks at first day. Mortality was recorded as it occurred and was used to adjust the total number of birds to determine the total feed intake per bird and feed conversion ratio. At the end of the study, twelve female birds from each treatment were selected, based on the average weight of the group and sacrificed. Carcass yield was calculated by dividing eviscerated weight by live weight. Liver, pancreas and abdominal fat pad were also removed, weighted and as a percentage of live weight was calculated.

The standard techniques of the proximate analysis were
Bozkurt et al.: Use of Antibiotic, Mannan Oligosaccharide and Dextran Oligosaccharide in Broiler Diets

Table 1. The ingredient and chemical composition of basal starter and grower diets

<table>
<thead>
<tr>
<th>Ingredients (g/kg)</th>
<th>Starter</th>
<th>Grower</th>
<th>Chemical composition of basal diet (mg/kg)</th>
<th>Starter</th>
<th>Grower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow corn</td>
<td>433.67</td>
<td>496.25</td>
<td>Dry matter</td>
<td>90.65</td>
<td>88.62</td>
</tr>
<tr>
<td>Wheat</td>
<td>100.00</td>
<td>100.00</td>
<td>Crude protein</td>
<td>21.72</td>
<td>20.37</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>231.43</td>
<td>202.14</td>
<td>Crude fat</td>
<td>7.73</td>
<td>6.32</td>
</tr>
<tr>
<td>Full-fat soybean</td>
<td>170.00</td>
<td>138.53</td>
<td>Crude fibre</td>
<td>3.45</td>
<td>3.29</td>
</tr>
<tr>
<td>Soy oil</td>
<td>26.03</td>
<td>20.87</td>
<td>Crude ash</td>
<td>5.60</td>
<td>5.50</td>
</tr>
<tr>
<td>DCP</td>
<td>19.11</td>
<td>18.44</td>
<td>Staroh</td>
<td>36.94</td>
<td>36.89</td>
</tr>
<tr>
<td>Limestone</td>
<td>6.27</td>
<td>5.86</td>
<td>Sugar</td>
<td>3.38</td>
<td>3.41</td>
</tr>
<tr>
<td>Salt</td>
<td>3.00</td>
<td>2.13</td>
<td>Calcium</td>
<td>1.13</td>
<td>0.86</td>
</tr>
<tr>
<td>L-Lysine HCL</td>
<td>0.15</td>
<td>0.00</td>
<td>Total phosphorus</td>
<td>0.85</td>
<td>0.63</td>
</tr>
<tr>
<td>DL-methionine</td>
<td>2.34</td>
<td>1.80</td>
<td>Calculated composition (mg/kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin premix</td>
<td>2.50</td>
<td>2.50</td>
<td>Av phosphorus</td>
<td>0.45</td>
<td>0.42</td>
</tr>
<tr>
<td>Mineral premix1</td>
<td>1.00</td>
<td>1.00</td>
<td>Lysine</td>
<td>1.25</td>
<td>1.03</td>
</tr>
<tr>
<td>Anticoccidial1</td>
<td>0.50</td>
<td>0.50</td>
<td>Methionine</td>
<td>0.67</td>
<td>0.40</td>
</tr>
<tr>
<td>Antioxidant1</td>
<td>1.00</td>
<td>1.00</td>
<td>Meth.+cysteine</td>
<td>0.92</td>
<td>0.80</td>
</tr>
<tr>
<td>Saw dust</td>
<td>1.00</td>
<td>1.00</td>
<td>Linoleic acid</td>
<td>3.58</td>
<td>3.68</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1000.00</td>
<td>1000.00</td>
<td><strong>Energy (kcal/kg)</strong></td>
<td>3192</td>
<td>3219</td>
</tr>
</tbody>
</table>

1Provides per kg of diet: vitamin A 12000 IU; vitamin D, 1500 IU; vitamin E 30 mg; vitamin K, 5 mg; vitamin B. 3 mg; vitamin B. 6 mg; vitamin B. 5 mg; vitamin B. 0.03 mg; nicotine amid 40 mg; calcium-D-pantothenate 10 mg; folic acid 0.75 mg; D-biotin 0.075 mg; choline chloride 375 mg. 2Provides per kg of diet: Mn 60 mg; Fe 40 mg; Zn 60 mg; Cu 5 mg; I 0.5 mg; Co 0.2 mg; Se 0.15 mg.

used to determine the nutrient concentrations in the diets (Naumann and Bassler, 1983). The experimental diets were analyzed also for starch, sugar, total calcium and phosphorus according to chemical analyses methods of feedstuff by Association of German Agricultural Analysis and Research Institutes (VDLUFA) (Naumann and Bassler, 1993). Metabolizable energy content of the diets was calculated based on chemical composition (Anonymous, 1991). All data were subjected to ANOVA using the General Linear Models procedure of SAS software (SAS Institute, 1991). The mean differences among different treatments were separated by Duncan's multiple range tests. A level of (P < 0.05) was used as the criterion for statistical significance.

Results

Performance traits of broiler chickens including body weight, feed intake feed conversion ratio and liveability are presented in Table 2. The results from the trial showed that the substitution of the control by the alternative diets resulted in significantly higher body weight at both 21 and 42 days of age, while there was no major difference in overall feed intake. AGP, MOS and DOS supplementation to diet resulted higher body weight at the level of 3.0, 7.0, 2.3%, respectively, at day 21 (P < 0.01) than that control treatment. Similarly, dietary AGP, MOS and DOS additives were superior to a non-supplemented control at the level of 2.2, 5.1, 1.9%, respectively, at day 42 (P < 0.05). In a similar pattern, this advantage for additive programs in terms of growth rate was sustained through finisher period from 22-42 d. However, body weight of birds given MOS added diets were significantly higher than those treated with AGP and DOS at both 21 and 42 days of age and 22-42 d period. No significant differences were noticed between AGP and DOS treatments.

Feed intake of broilers was not affected by dietary treatments throughout the experimental period (P > 0.05). Indeed, there was a clear tendency that feeding with MOS added diets tended to consume more feed than those other treatments. Broilers on MOS program averaged 116 g, 98 g, 149 g more cumulative feed intake compared to those birds on the control, AGP and DOS programs, respectively, throughout the experimental period. Although feed intake was tended to increase by feeding MOS, the greater increase in weight gain (P < 0.05) resulted in an considerable improvement in feed conversion for broilers consuming the MOS added diet compared to broilers consuming no added control diet. On the other hand, MOS-treateed broilers exhibited lower feed intake in numerical basis at all stages of the experiment when compared to all other treatments.

Likewise to the feed intake trait, feed conversion ratio was not affected by dietary treatments (P > 0.05). However, it is obvious that feed conversion ratio was improved by overall experimental additives in a similar pattern at both 0-21 d and 22-42 d periods and also throughout the entire experimental period in comparison with the control. The numerical improvements on feed conversion ratio in favour of MOS and DOS programs were found as 2.39% and 2.72%, respectively, compared to control treatment for entire test period (0-42d).

The general health status of broiler chickens was excellent for all treatments throughout the entire experimental period, showing liveability more than 97.50%. There was no significant difference between the groups with respect to liveability.

Slaughter characteristics including carcass yield and relative weight of small intestines, pancreas and abdominal fat pad were not influenced (P > 0.05) by dietary treatments (Table 3).
Table 2: Body weight, feed intake, feed conversion ratio and liveability of broilers given AGP, MOS or DOS added diets

<table>
<thead>
<tr>
<th>Experimental period, d</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>Body weight (g)</td>
<td>38.6</td>
</tr>
<tr>
<td>1 d</td>
<td>691¹</td>
</tr>
<tr>
<td>21 d</td>
<td>229⁰</td>
</tr>
<tr>
<td>22-24 d</td>
<td>155⁰</td>
</tr>
<tr>
<td>Feed intake (g)</td>
<td>1003</td>
</tr>
<tr>
<td>0-21 d</td>
<td>3091</td>
</tr>
<tr>
<td>22-42 d</td>
<td>4184</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>0-21 d</td>
</tr>
<tr>
<td>22-42 d</td>
<td>1.671</td>
</tr>
<tr>
<td>Liveability (%)</td>
<td>0-21 d</td>
</tr>
<tr>
<td>0-42 d</td>
<td>98.88</td>
</tr>
</tbody>
</table>

Means with different superscript in the same row are significantly different from each other (P < 0.05).

Discussion

Results from the present study indicated that feeding broilers with AGP, MOS and DOS supplemented diets had beneficial effects on body weight gain and feed conversion ratio without affecting liveability. There was a consistent improvement in growth rate and feed conversion ratio for all experimental additives throughout the experimental period in comparison with unsupplemented control treatment. So that, similar levels of improvements were performed for AGP and DOS treatments in terms of body weight gain and feed conversion efficiency, whereas significantly more benefit was pronounced for MOS program regarding to body weight gain than those DOS and AGP programs.

Clearly, a great number of scientific works, detailed reviews and commercial field observations regarding their use in feed are available and provide useful overviews of the modes of action and performance benefits of antibiotics (Visik, 1978; Miles et al., 1984; Harms et al., 1986; Engberg et al., 2000; Parks et al., 2001; Alçıçeş et al., 2003; Bozkurt et al., 2005 a). Consistent with earlier reports, the findings of our study in response to dietary AGP supplementation confirms growth promoter and feed efficacy mechanisms of feed grade antibiotics.

The well established growth promoter effect of dietary MOS was frequently attributed its pathogenic bacteria binding ability described as strongly binding and decaying pathogens away from the intestinal lining (Oyofe, 1989; Newman, 1994; Funicane et al., 1999; Shane, 2001). Thus, more nutrient is available in the intestinal lumen for absorption to convert body mass. The overall main effect of MOS was to increase weight gain at 21 d (P < 0.01), 42 d and 21-42 d (P < 0.05) when compared to all other treatments. Body weight gain of birds fed with MOS added diets far exceeded the control bird’s weight gain over the 21 d and 42 d periods with weight gains of 49 g and 116 g, respectively. However, weight gain of AGP and DOS treatments were intermediate and did not differ significantly at all test periods.

Confirming results to those findings were evidenced in our previous study (Bozkurt et al., 2005a). We also found that body weight of male broilers given MOS added wheat based diets was significantly higher than those AGP and control treatments at both 21 d and 42 d. When compared to the present work, considerably higher benefits for weight gain were determined with 128 g at 21 d and 123 g at 42 d in terms of dietary MOS supplementation than that no added control program. In consistent with our present and earlier findings, Hooge (2004) reported that MOS addition to diet increased body weight gain at 41.8 d at an average of 1.75% evaluating the results of 29 pen trials involving 44 comparisons of negative control diets versus MOS diets. Different from the results of those studies, it was reported that MOS feeding program gave statistically equivalent body weight compared to diets containing subtherapeutic levels of antibiotics (Parks et al., 2001; Hooge et al., 2003b; Ceylan et al., 2003; Waldrup et al., 2003a, b). From a general point of view, numerous scientific results have been reported for growth promoter effect of MOS compared to unsupplemented control program even under different management procedures (Kumprecht et al., 1997; Sims and Sefton, 1999; Shafey et al., 2001; Ceylan et al., 2003; Hooge et al., 2003b; Bozkurt et al., 2005a, b).

As a consequence, performance enhancer feed additives AGP and MOS verified once again their well established working mechanism via promoting growth and improving feed efficiency in the present study. Obviously, the growth promoter effect was even more outspoken for MOS at both 21 d 42 d, whereas AGP and
Bozkurt et al.: Use of Antibiotic, Mannan Oligosaccharide and Dextran Oligosaccharide in broiler Diets

Table 3: The effect of dietary inclusion of AGP, MOS and DOS on carcass weight, carcass yield and relative weight of liver, small intestines, pancreas and abdominal fat of female broilers

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>AGP</th>
<th>MOS</th>
<th>DOS</th>
<th>SEM</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight (g)</td>
<td>2142</td>
<td>2150</td>
<td>2150</td>
<td>2157</td>
<td>7.80</td>
<td>0.6065</td>
</tr>
<tr>
<td>Carcass weight (g)</td>
<td>1628</td>
<td>1658</td>
<td>1663</td>
<td>1659</td>
<td>11.24</td>
<td>0.1635</td>
</tr>
<tr>
<td>Carcass yield (%)</td>
<td>78.00</td>
<td>77.11</td>
<td>76.88</td>
<td>76.91</td>
<td>0.42</td>
<td>0.2784</td>
</tr>
<tr>
<td>Liver (%)</td>
<td>1.96</td>
<td>1.95</td>
<td>1.98</td>
<td>1.97</td>
<td>0.05</td>
<td>0.9850</td>
</tr>
<tr>
<td>Pancreas (%)</td>
<td>0.29</td>
<td>0.26</td>
<td>0.26</td>
<td>0.27</td>
<td>0.01</td>
<td>0.8614</td>
</tr>
<tr>
<td>Abdominal fat (%)</td>
<td>1.85</td>
<td>2.02</td>
<td>2.22</td>
<td>2.18</td>
<td>0.14</td>
<td>0.2216</td>
</tr>
</tbody>
</table>

DOS provided less advantages than that MOS. Moreover, those findings clearly showed that growth performance and feed conversion ratio in diets containing either MOS or DOS was comparable to the performance of commonly used antibiotic growth promoter, avilamycin.

Different from AGP and MOS, scarce scientific knowledge is available for DOS regarding to mode of action and farm animal trials. In a recent scientific work, Kılıç et al. (2005) did not observe any growth promoter and feed efficacy effect of dietary added DOS even supplemented at three different inclusion levels.

Liveability, which ranged from 97.70-99.00% was unaffected by treatments in the present study (P > 0.05). Indeed, the mortality rates determined for all treatments were much better when compared to commercial field observations. However, it is obvious that neither AGP nor both oligosaccharide treatments could not provide better liveability than that control program. It appears that well established in vitro bacteriostatic and bactericide mode of action of such additives might not implement through practical field applications due to the less stressed environmental conditions and comfortable management procedures. Common pathogens such as E. coli, Salmonella and C. Perfringens have to overcome numerous obstacles in order to colonize in the intestinal tract and cause an infection, consequently diseases mostly in sub clinic form, in poultry under the management conditions of intensive broiler rearing system. However, less stressful housing conditions might have been existed in this study compared to commercial applications; hence, health protective and disease preventing mechanisms of additives could not be exhibited in such a more comfortable pen trial environment.

As indicated in Table 2, there were no differences (P > 0.05) in cumulative feed intake and feed conversion ratios between dietary treatments over the experimental periods. Noteworthy, MOS feeding program was in a tendency of stimulating the feed consumption of birds during the entire experimental phases, whereas absolutely converse pattern was obvious for DOS feeding program. These results are in agreement with that of Kılıç et al. (2005) who reported that the feed intake of birds were linearly decreased as the level of supplemental DOS was increased up to three fold from 500 mg/kg diet to 1500 mg/kg diet. The results of the present study in response to feeding MOS and AGP are contrast to those of other researchers (Ceylan et al., 2003; Sinovec et al., 2005), while confirmed with out former findings (Bozkurt et al., 2005a, b). As a matter of fact, even if the feed intake was considerably increased by feeding MOS, the greater increase in weight gain resulted in an improvement in feed conversion ratio compared to broilers given AGP and DOS added diets and control program also. However, it should be take into consideration that little information is available in the scientific literature still with regard to dietary suppletative effects of oligosaccharides on feed consumption traits of all poultry species.

In agreement with the results of numerous earlier studies for AGP (Miles et al., 1984; Parks et al., 2001; Engberg et al., 2000; Alçiçek et al., 2003; Bozkurt et al., 2005 a) and MOS (Kumprecht et al., 1997; Sims and Selton, 1988; Parks et al., 2001; Shafey et al., 2001; Hooge, 2003 a, b; Sinovec et al., 2005; Bozkurt et al., 2005 a, b), the present experiment also showed that dietary AGP and MOS treatments improved feed conversion ratio compared with the control. Confirming evidences was arose from another study (Hooge, 2004) who pointed out that MOS feeding programs more benefited (1.99%) than that control program according to the evaluation of 29 broiler pen trials. Contrary to those results, no improvement effect on feed conversion ratio was observed due to the decreased feed intake with depressed body weight in response to DOS supplementation to diet (Kılıç et al., 2005). Obviously, both AGP and two oligosaccharide treatments achieved to manage better conversion of diet to body mass compared to control treatment. It was clearly seen that such a response is mainly dominated by increased growth rate resulting from dietary supplementation of those additives. However, the most profound effects were attributed to their addition of MOS and DOS.

Naturally, it seems reasonable to assume that antibiotic growth promoters act on the microflora in the proximal end of the small intestine, where most nutrition absorption takes place. Furthermore, the inhibition of certain species of intestinal bacteria that produce toxins or compete with the host for available nutrients and probably depress dietary fat absorption due to bile acid deconjugation may further explain the feed efficacy mechanism of AGPs (Eyssen and DeSomer, 1963; Visek, 1978; Harms et al., 1986; Feighner and
Dashkevitz, 1987, Engberg et al., 2000). Indeed, the modes of action of growth promoting antibiotics and their alternatives can differ considerably. Subtherapeutic antibiotics results a reduction on the microbial load in gut, thus resulting in more nutrient portioning towards growth and production rather than mechanism of disease resistance (Feighner and Dashkevitz, 1987, Shane, 2005). In contrast, AGP alternative compounds alter the gut microflora profile by limiting the colonization of unfavourable species. Thus, specific pathogens that could attach to the intestinal lumen was forced to move through the gut without colonization; hence, allowing nutrient utilization at much higher levels (Ammerman et al., 1989; Bailey et al., 1991; Parks et al., 2001; Shane, 2001). Eventually, those working mechanisms of AGP and both oligosaccharides appeared to contribute to the improved utilization of dietary nutrients as being reflected to enhanced feed/weight gain ratio compared to control.

In the fact that, similar working mechanism of two experimental oligosaccharides were postulated with similar mode of actions such as resistant to gastric juice, depressing non beneficial bacteria colonization, stabilizing the gut microflora, enhancing immunological activity, preventing against infectious disease and stress, keeping health and safety, eventually improving profitability (Savage et al., 1995; Tellez, 1997; Fukata et al., 1998; Spring et al., 2001; Shane, 2001; Ferket, 2004). But, the principal mechanism in antimicrobial activity differs significantly between AGP and MOS and also DOS. So that, AGP exerts its bactericide effect by destroying the pathogenic bacteria as directly, whereas both MOS and DOS possess indirect mode of action.

Mannan oligosaccharides (MOS), derived from mannans on yeast cell surfaces, act as high affinity ligands, offering a competitive binding site for the bacteria (Ofek et al., 1977). Pathogens with the mannose-specific Type-1 fimbria absorb the MOS instead of attaching to intestinal epithelial cells and, therefore move through the intestine without colonization (Newman, 1994; Shane, 2001). Thus, the presence of dietary MOS in the intestinal tract removed pathogenic bacteria, S. enteritidis and S. typhimurium with E. coli in particular, that could attach to the lumen of the intestine in this manner (Newman, 1994; Spring et al., 2001). Similar pathogen binding mechanism was also demonstrated by Ofek et al. (1977) and Cyofo et al. (1989) for mannose. Different from the mechanism of MOS, DOS stimulates the organic acid production thereby ensuring as energy sources for lactic acid producing bacteria in the intestinal lumen. It was considered that dietary DOS ensures the proliferation of beneficial intestinal bacteria, Bifidobacterium and Lactic acid producing Lactobacillus species, in particular. Thus, adding DOS to diet inhibits proliferation of intestinal pathogenic bacteria, particularly the Salmonella and E. coli, thereby increasing organic acid production with pH reduction (Tellez, 1997; Fukata et al., 1998). Eventually, more acidic intestinal digesta unable to colonization of pathogenic bacteria since the oligosaccharide dextran was used as energy source by those beneficial microorganisms.

As a matter of fact, those assertions were proven with numerous scientific works, animal trials and field experiences in response to dietary MOS supplementation to broiler chicken diets, whereas scarce scientific evidence was obvious for DOS feeding program. Whatever the mode of action is, it was postulated that all of the experimental additives had beneficial effect on growth rate and feed efficiency of broiler chickens via exerting their working mechanisms of own. Furthermore, it was concluded that both of the oligosaccharides, MOS and DOS, could be promising alternatives to AGPs because they improved growth performance and feed conversion ratio of broiler chickens to a similar extent.

Different dietary oligosaccharides and AGP regimens had no significant effect on slaughter characteristics examined in this study (Table 3). It is predictable that better health status of the intestinal mucosa due to feeding AGP, MOS and DOS diets may improve carcass yield of broilers. However, such a pattern was not evident during the current trial. Some workers reported significant improvements in carcass yield and breast yield of broilers fed antibiotic added diets (Izat et al., 1990; Leeson, 1984; Alçıçek et al., 2003). Contrasting to those reports, some other authors failed to observe any differences in overall broiler carcass yield or carcass parts when supplementing diets with antibiotics (Hernandez et al., 2004; Bozkurt et al., 2005 a; Sarica et al., 2005). On the other hand, research pertaining to the effects of dietary MOS on slaughter characteristics and carcass yield is lacking. It was hypothesized that a decrease in intestinal pathogen challenge provided by MOS would result in improvement nutrient utilization and allocation leading to benefits in lean muscle gain (Ferket, 2004). In consistent with that prediction, only one earlier study suggested significantly improvement for breast yield in terms of MOS feeding (Clementino dos Santos et al., 2002), whereas no benefit was determined for carcass yield in other trials (Ceylan et al., 2003; Waldrup et al., 2003a, b; Bozkurt et al., 2005a, b). In a rare recent study (Kuşçuylıma et al., 2005), no benefit for carcass yield was determined in response to dietary DOS supplementation even at three inclusion levels when compared to no treated control. Similarly, the authors could not find any significant effect on relative weight of liver, pancreas and abdominal fat with respect to dietary DOS supplementation.

Unfortunately, little scientific report is available regarding to intestinal organ weights of broilers in terms of feeding with AGP and MOS added diets. The relative weight of
liver, pancreas and abdominal fat were not affected by dietary treatments in agreement with the findings of our two previous works in which we tested the supplementation of MOS (Bozkurt et al., 2005b) and MOS with AGP (Bozkurt et al., 2005a) to broiler diets. Consistent with our results, Hernandez et al. (2004) and Sarica et al. (2005) found no differences in liver and pancreas weight of broiler chickens fed diets supplemented with an antibiotic. A similar observation was reported by Alçöçek et al. (2003) and Waldroup et al. (2003a, b). They concluded that abdominal fat pad weight was not affected by antibiotic or antibiotic plus MOS treatment compared to control diet.

As a consequence, it is evident that broilers more benefited from dietary AGP, MOS and DOS additive regimens in terms of weight gain and feed efficiency than unsupplemented control program. However, the obtained advantage for weight gain with feeding MOS added diets outperformed both AGP and DOS programs. The results of this study also demonstrated that either MOS or DOS, a non-antibiotic additive, was equivalent to AGP (avilamycin) with respect to technical performance while giving hopeful signs replacing for AGPs. Improved broiler live performance regarding to either AGP or MOS feeding treatments confirms similar results reported formerly in a great deal of study. Consequently, more research is needed in order to bring up mechanism of DOS on broiler growth performance in both animal experimental studies and in vitro examinations including microbiological, immunological and intestinal histology works.

References


