

# Research Notes P-101

Arm & Hammer Animal and Food Production



## AVIATOR improved performance, gut microbial balance, and immunity of commercial broilers raised without antibiotic growth promoters.

AVIATOR™ is a multicomponent, all-natural feed supplement containing Refined Functional Carbohydrates™ (RFCs™) that has Generally Recognized as Safe (GRAS) status as a feed ingredient.

### STUDY OVERVIEW

A study<sup>1</sup> was conducted to determine the effect of AVIATOR™ on immune function, performance, and microbial populations in the guts of commercial broilers raised without antibiotic growth promoters (AGP). One-day-old Arbor Acres commercial broiler chickens were assigned into 3 experimental treatments with 4 replicate houses per treatment, each with about 25,000 birds.

- Group 1 [Control] was the control group
- Group 2 [AVIATOR (AVI)] received AVIATOR SCP at a dose of 100 g/MT
- Group 3 [BMD (AGP)] received BMD (Bacitracin methylene disalicylate) at a dose of 250 g/MT (15% purity)

All the birds were vaccinated against the Newcastle disease virus and infectious bronchitis virus at one day of age and 20 days of age. They were also vaccinated for infectious bursal disease virus and subcutaneously vaccinated with inactivated bivalent vaccines for avian influenza H5 and H9 at 14 days of age. Growth performance, intestinal morphological structure, and microbiota, as well as intestinal immune and barrier functions of broiler chickens, were evaluated through 45 days of production. All the data were analyzed using ANOVA and treatment effects were considered significant at  $P \leq 0.05$  and showing a trend for  $0.05 < P < 0.10$ .

### RESULTS

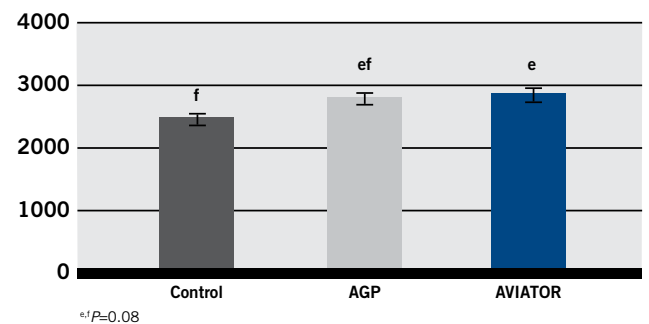
#### Growth Performance

- Supplementation with AVIATOR tended to increase body weight and average daily gain (ADG) ( $P=0.08$ ) but had no effect on average daily feed intake (ADFI) and feed conversion ratio compared to broilers fed the control treatment. Performance of broilers fed the antibiotic growth promoter treatment (AGP) was intermediate (Figs. 1 and 2).

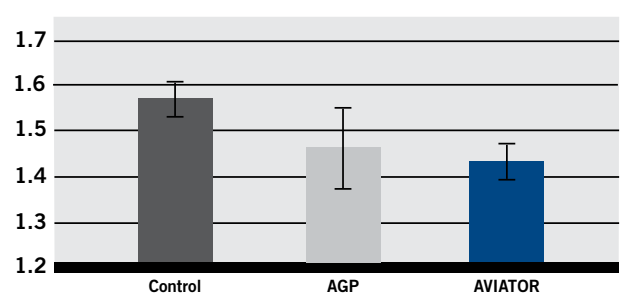
#### Intestinal Morphology and Barrier Function

- Feeding AVIATOR increased the ratio of villus height to crypt depth in the jejunum compared with the broilers fed the control

**FIGURE 1:** Effect of treatments on body weight at 45 days of production.



**FIGURE 2:** Effect of treatments on feed conversion ratio (FCR), feed/gain.



or AGP-treated groups. Broilers fed AVIATOR™ also had increased villous surface areas (VSA) of the jejunum compared to AGP fed broilers (Table 1).

- In the ileum, broilers fed the AGP treatment had increased villus height, but decreased villus width and surface area compared to broilers fed AVIATOR or control treatments (Table 1).
- No treatment effects were noted on expression of intestinal tight junction genes, claudin-1, ZO-1, MUC2, and occludin (data not shown).

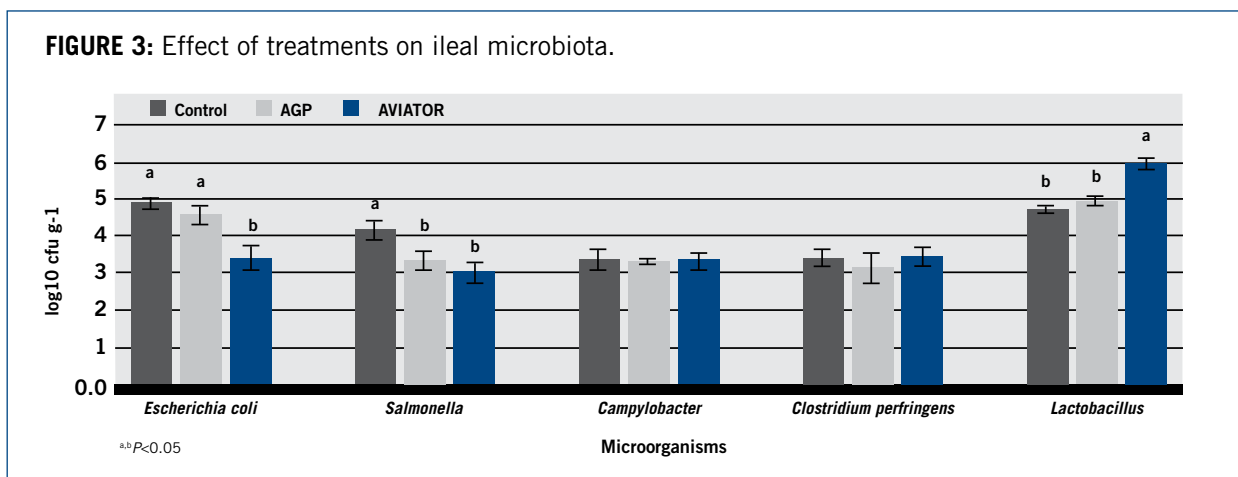
<b>TABLE 1</b>		Effect of treatments on intestinal morphology.				
	<b>CON</b>	<b>AGP (BMD)</b>	<b>AVI</b>	<b>SEM</b>	<b>P-values</b>	
<b>Jejunum</b>						
VH, um	1215.1	1197	1186.2	54.88	0.612	
CD, um	175	156.7	135.4	11.58	0.4	
VW, um	142.1	109.6	151.5	8.53	0.105	
V/C	7.01 <sup>b</sup>	7.64 <sup>b</sup>	8.78 <sup>a</sup>	0.321	0.045	
VSA, um <sup>2</sup>	558960 <sup>a</sup>	414635 <sup>b</sup>	568615 <sup>a</sup>	40378	0.026	
<b>Ileum</b>						
VH, um	671.0 <sup>ab</sup>	800.0 <sup>a</sup>	627.8 <sup>b</sup>	29.61	0.035	
CD, um	119.4	114.4	95.9	7.07	.383	
VW, um	146.0 <sup>a</sup>	85.9 <sup>b</sup>	131.5 <sup>a</sup>	7.16	<0.001	
V/C	5.89	7.49	6.41	0.43	0.317	
VSA, um <sup>2</sup>	305830 <sup>a</sup>	218637 <sup>b</sup>	247945 <sup>ab</sup>	14949	0.042	

<sup>ab</sup> Different superscripts within a row indicate significant differences between treatments ( $P < 0.05$ ).

VH: Villus height; CD: Crypt depth; VW: Villus width; V/C: Villus: crypt ratio; VSA: Villus surface area

### Gut Microbiota

- Broilers fed diets supplemented with AVIATOR had reduced loads of *E. coli* and *Salmonella*, and increased *Lactobacillus* concentration in the ileum compared to broilers fed the control treatment (Fig. 3).



### Immunity

- AVIATOR or AGP fed broilers had down-regulated intestinal TLR4 expression compared to the control group.
- Broilers fed AVIATOR had up-regulated IFN- $\gamma$  gene expression compared to broilers fed the control or AGP treatment (Table 2).

<b>TABLE 2</b>		Effect of treatments on fold change in mRNA levels of immune function related genes in the spleen.			
<b>Immune function related genes</b>	<b>CON</b>	<b>AGP (BMD)</b>	<b>AVI</b>	<b>Data Analysis</b>	
<b>Fold change</b>				<b>SEM</b>	<b>P-value</b>
TLR2	1.21±0.31	0.60±0.08	0.59±0.23	0.142	0.124
TLR4	1.03±0.10 <sup>b</sup>	0.54±0.13 <sup>a</sup>	0.61±0.13 <sup>a</sup>	0.087	0.022
NF-κB	1.10±0.21 <sup>f</sup>	0.68±0.08 <sup>e</sup>	0.76±0.06 <sup>ef</sup>	0.085	0.091
IL-1β	1.48±0.50	1.00±0.20	1.20±0.37	0.21	0.664
TGF-β4	1.11±0.22	0.67±0.13	1.00±0.33	0.137	0.424
IFN-γ	1.13±0.24 <sup>a</sup>	0.92±0.20 <sup>a</sup>	2.23±0.59 <sup>b</sup>	0.236	0.051

Different superscripts within a row indicate differences between treatments. <sup>a,b</sup>  $P < 0.05$ , <sup>e,f</sup>  $P = 0.05-0.1$

- Broilers fed AVIATOR™ or AGP treatments had increased antibody concentrations against avian influenza H9 vaccine compared to the control group (Table 3).

<b>TABLE 3</b>		Effect of treatments on serum antibody titers and intestinal IgA levels in broilers (at 42 days).			
<b>Parameter</b>	<b>CON</b>	<b>AGP (BMD)</b>	<b>AVI</b>	<b>SEM</b>	<b>P-value</b>
Avian influenza H5, Log <sub>2</sub>	9.67 <sup>f</sup>	10.17 <sup>ef</sup>	10.67 <sup>e</sup>	0.185	0.08
Avian influenza H9, Log <sub>2</sub>	9.17 <sup>b</sup>	10.83 <sup>a</sup>	11.67 <sup>a</sup>	0.345	0.003
Newcastle disease, Log <sub>2</sub>	6.67	7.67	7	0.312	0.437
Infectious bursal disease	31332.58	44564.05	35148.42	0.307	0.717
Serum IgA, ng/mL	684.47	709.51	680.93	13.73	0.678
Intestinal IgA, ng/mg	658.8	673.11	668.01	10.96	0.878

Different superscripts within a row indicate differences between treatments. <sup>a,b</sup>  $P < 0.05$ , <sup>e,f</sup>  $P = 0.05-0.1$

## CONCLUSIONS

These results suggest that AVIATOR could replace antibiotic growth promoter treatments such as BMD in broiler diets, while maintaining production performance, reducing intestinal pathogenic bacteria, and promoting the growth of beneficial bacteria. AVIATOR also showed improvement in some gut morphology parameters. Additionally, AVIATOR supplementation in broiler diets could modulate intestinal immune responses and enhance humoral immunity in broilers.



To learn more about AVIATOR contact your nutritionist, veterinarian or ARM & HAMMER™ representative or visit [AHfoodchain.com](http://AHfoodchain.com).

<sup>1</sup> Zhen W, Zhu T, Wang P, Abbas W, Guo Y, Zhang T, Jalukar S, Wang Z. Effect of dietary *Saccharomyces*-derived prebiotic refined functional carbohydrates as antibiotic alternative on growth performance and intestinal health of broiler chickens reared in a large-scale broiler chickens farm. State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University. Data on file. 2021.

