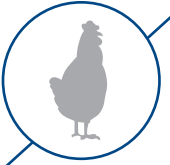


Research Notes P-101

Arm & Hammer Animal and Food Production



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

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

STUDY OVERVIEW

A study¹ was conducted to determine the effect of CELMANAX™ 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 [CELMANAX (CEL)] received CELMANAX 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 CELMANAX 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 CELMANAX 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.

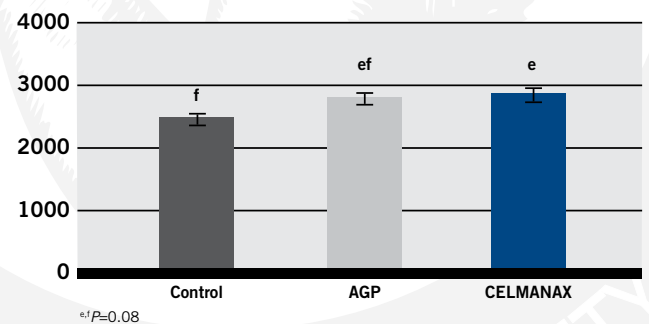
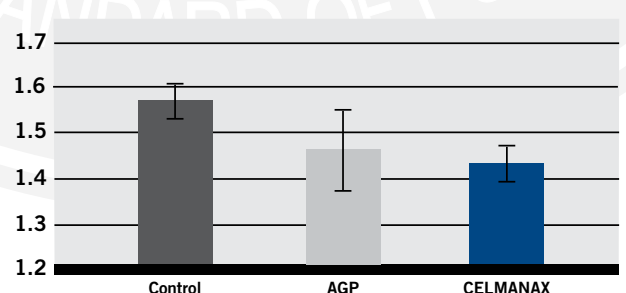


FIGURE 2: Effect of treatments on feed conversion ratio (FCR), feed/gain.



or AGP-treated groups. Broilers fed CELMANAX™ 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 CELMANAX 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).

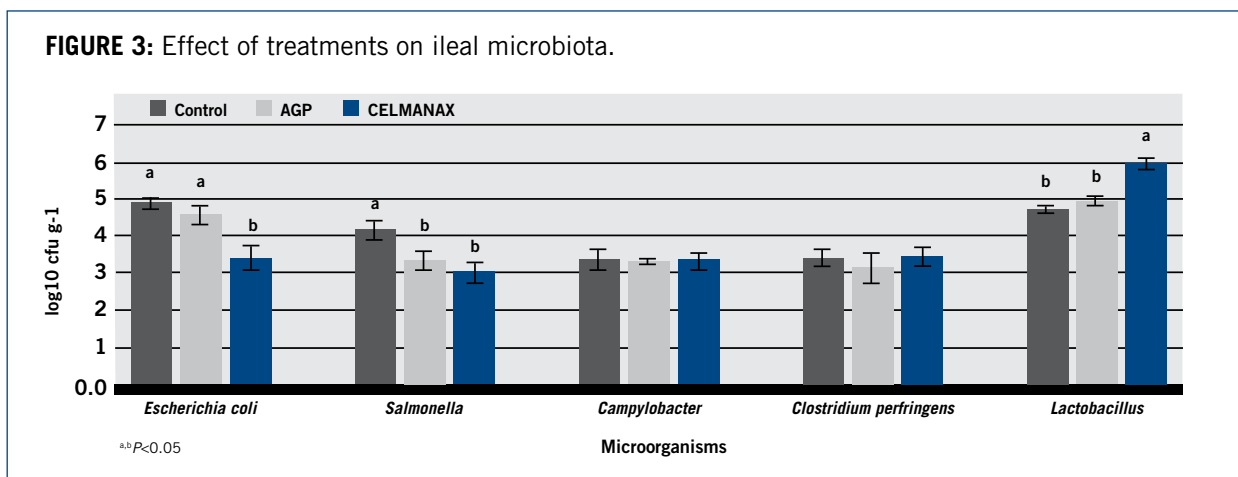
TABLE 1	Effect of treatments on intestinal morphology.				
	CON	AGP (BMD)	CEL	SEM	P-values
Jejunum					
VH, um	1215.1	1197	1186.2	54.88	0.612
CD, um	175	156.7	135.4	11.58	0.4
VW, um	142.1	109.6	151.5	8.53	0.105
V/C	7.01 ^b	7.64 ^b	8.78 ^a	0.321	0.045
VSA, um ²	558960 ^a	414635 ^b	568615 ^a	40378	0.026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

^{ab} 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 CELMANAX 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

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

TABLE 2		Effect of treatments on fold change in mRNA levels of immune function related genes in the spleen.			
Immune function related genes	CON	AGP (BMD)	CEL	Data Analysis	
Fold change				SEM	P-value
TLR2	1.21±0.31	0.60±0.08	0.59±0.23	0.142	0.124
TLR4	1.03±0.10 ^b	0.54±0.13 ^a	0.61±0.13 ^a	0.087	0.022
NF-κB	1.10±0.21 ^f	0.68±0.08 ^e	0.76±0.06 ^{ef}	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 ^a	0.92±0.20 ^a	2.23±0.59 ^b	0.236	0.051

Different superscripts within a row indicate differences between treatments. ^{a,b} $P < 0.05$, ^{e,f} $P = 0.05-0.1$

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

TABLE 3		Effect of treatments on serum antibody titers and intestinal IgA levels in broilers (at 42 days).			
Parameter	CON	AGP (BMD)	CEL	SEM	P-value
Avian influenza H5, Log ₂	9.67 ^f	10.17 ^{ef}	10.67 ^e	0.185	0.08
Avian influenza H9, Log ₂	9.17 ^b	10.83 ^a	11.67 ^a	0.345	0.003
Newcastle disease, Log ₂	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. ^{a,b} $P < 0.05$, ^{e,f} $P = 0.05-0.1$

CONCLUSIONS

These results suggest that CELMANAX 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. CELMANAX also showed improvement in some gut morphology parameters. Additionally, CELMANAX supplementation in broiler diets could modulate intestinal immune responses and enhance humoral immunity in broilers.



To learn more about CELMANAX contact your nutritionist, veterinarian or ARM & HAMMER™ representative or visit AHfoodchain.com.

¹ 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.

