Technical Bulletin

Arm & Hammer Animal and Food Production

CELMANAX augmented *Salmonella* vaccine response in broilers.

CELMANAX™ has been shown to be efficacious at reducing *Salmonella* infections in many published studies.[1-7]

STUDY OVERVIEW

- Two broiler studies[8,9] evaluated the effect of live *Salmonella* vaccine, AviPro® Megan® Vac 1, alone or combined with CELMANAX SCP.
- The studies were conducted in two isolation rooms, each divided into three pens, with 35 birds/pen. Each of the three treatments (Table 1) were represented in both rooms.
- Upon arrival, 210 day-of-hatch Ross male broiler chicks received routine vaccinations, waited 30 minutes, and were then given Megan Vac 1 as a coarse spray, 0.25 ml/bird for treatments 2 and 3. Two hours after *Salmonella* vaccination, birds were placed on feed.

TABLE 1 Study design.

	Treatment	*S. heidelberg* Challenge	Isolation Room (Replicates)
1	Challenge Control	Yes	1 and 2
2	Megan Vac 1 Alone	Yes	1 and 2
3	Megan Vac 1 and CELMANAX SCP at 100 g/MT	Yes	1 and 2

- Broilers were fed standard unmedicated commercial starter and grower diets (control diet) for treatments 1 and 2 and control diet supplemented with CELMANAX SCP, 100 g/MT for treatment 3.

Study 1[8]

- This study evaluated the effect of CELMANAX on uptake and colonization of the vaccine.
- At two days of age, four birds/pen (eight birds/treatment) were euthanized, and liver/spleen and ceca were cultured to measure Megan Vac 1 uptake and colonization.

Study 2[9]

- This study evaluated the effect of vaccine alone or vaccine plus CELMANAX on protecting the broilers from a *Salmonella heidelberg* challenge.
- At two days of age all birds were orally dosed (gavaged) with a $5x10^7$ CFU nalidixic acid-resistant *Salmonella heidelberg*.
- At 42 days of age, 15 birds per pen were bled (~1 ml/bird) for Biocheck SE/ST ELISA testing.
- At 42 days of age, 15 birds per replicate (30/treatment) were taken from each individual pen, euthanized, and the ceca aseptically removed and cultured for prevalence and MPN for the challenge strain.
- All data were analyzed statistically.

RESULTS

Study 1: Vaccine recovery (two days of age):

- In ceca, the vaccine strain was not recovered from any birds in the unvaccinated group (0/8, 0%), but it was recovered from 7 birds in the Megan® Vac only group (7/8, 87.5%) and from 5 birds in the Megan Vac + CELMANAX™ SCP group (5/8, 62.5%). In liver/spleen samples, the vaccine strain was not recovered from any birds in the unvaccinated group (0/8, 0%), but it was recovered from 7 birds in the Megan Vac only group (7/8, 87.5%), and from 8 birds in the Megan Vac + CELMANAX SCP group (8/8, 100%).

Study 2: Ceca *Salmonella* prevalence (42 days of age):

- The *Salmonella* prevalence in the Megan Vac + CELMANAX SCP group was significantly lower than that of both the Megan Vac Only group and the unvaccinated group, while the Megan Vac Only group and the unvaccinated group were not significantly different from one another (Table 2).

TABLE 2 *Salmonella* prevalence (%) in ceca samples by treatment group. Ceca were collected from 15 birds in each of two pens per group on day 42.

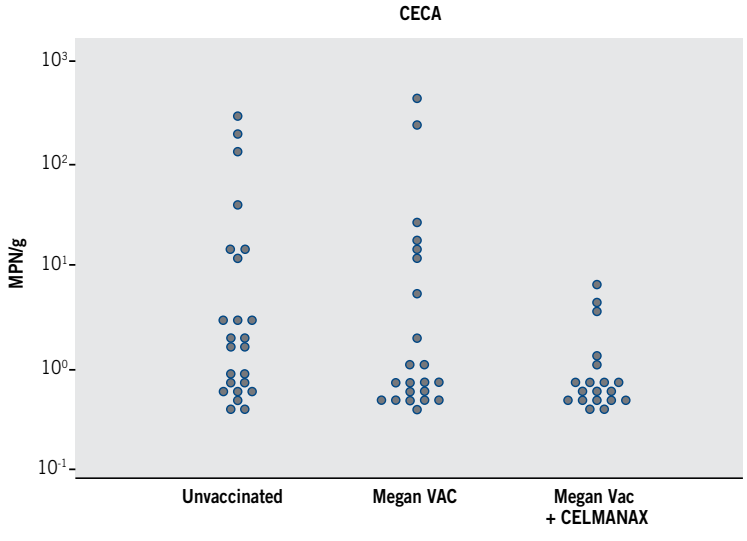
Treatment	No. Samples	No. Positive (%)	*P*
Unvaccinated	30	24 (80.0)[b]	<0.001
Megan Vac Only	30	23 (76.7)[b]	
Megan Vac + CELMANAX SCP	30	19 (63.3)[a]	

[a,b]Percentages with a superscript in common do not differ with a level of significance of 5% over all comparisons.

Ceca *Salmonella* MPNs– culture-positive samples (42 days of age):

- Distribution of *Salmonella* MPNs is represented in Figure 1. There was no significant difference between treatments with respect to the mean $\log_{10}$ MPN/g in culture-positive ceca samples.

FIGURE 1: Dot plot of *Salmonella* MPNs in culture-positive ceca samples by treatment.



Ceca *Salmonella* MPNs– *Taking the culture-negative samples into account* (42 days of age):

- The estimated mean $\log_{10}$ MPN/g of the Megan® Vac + CELMANAX™ SCP group was significantly lower than that of the unvaccinated group, while the mean of the Megan Vac Only group was intermediate and did not significantly differ from the other groups (Table 3).

TABLE 3 Estimated mean (SE) *Salmonella* $\log_{10}$ MPN/g in ceca samples by treatment based on a Tobit censored regression model. There were 24 left-censored (culture-negative) observations and 66 uncensored (culture-positive) observations.

Treatment	Samples, n	Mean (SE) $\log_{10}$ MPN/g	Mean MPN/g	*P*
Unvaccinated	30	0.18^{b} (0.17)	1.51	0.012
Megan Vac Only	30	$-0.02^{a,b}$ (0.17)	0.95	
Megan Vac + CELMANAX SCP	30	-0.52^{a} (0.17)	0.30	

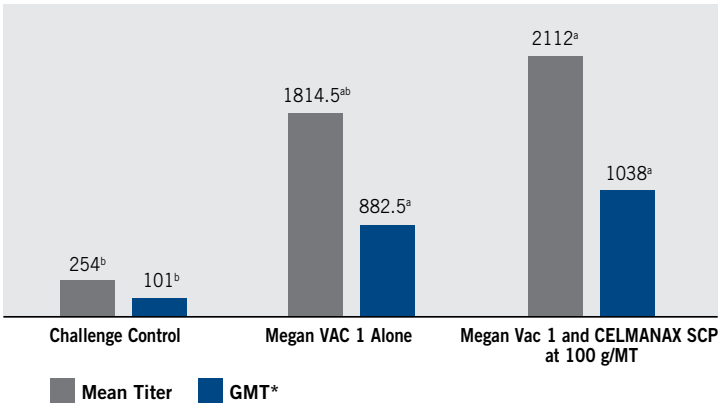
[a,b]Means with a superscript in common do not differ with a level of significance of 5% over all comparisons.

A Tobit regression model was used to estimate the true mean MPN/g based on the distribution of MPNs in the culture-positive samples as well as the proportions of culture-negative samples in the different treatment groups.

***Salmonella* serology results (42 days of age):**

- *Salmonella* antibody titers were compared between the three treatments. Antibody titers were significantly higher in the Megan Vac Only and Megan Vac + CELMANAX SCP group compared to the control group but were similar between Megan Vac Only and Megan Vac + CELMANAX SCP group (Fig. 2).

FIGURE 2: *Salmonella* antibody titer.



[a,b]Means with a superscript in common do not differ with a level of significance of 5% over all comparisons.

*Geometric mean titer.

CONCLUSIONS

CELMANAX™ had no negative effect on the ability of the live *Salmonella* vaccine, Megan® Vac 1, to reduce colonization of the *Salmonella heidelberg* challenge. There appears to be a synergistic or additive effect with these two combined interventions having significantly lower *Salmonella* in the 42-day ceca.

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

1 Effect of refined functional carbohydrates from enzymatically hydrolyzed yeast on the presence of *Salmonella* spp. in the ceca of broiler breeder females. *Poultry Science,* 2017;96:2684-2690.

2 Effect of refined functional carbohydrates from enzymatically hydrolyzed yeast on the transmission of environmental *Salmonella Senftenberg* among broilers and proliferation in broiler housing. *Poultry Science*, 2018;97:1412–1419.

3 The effect of refined functional carbohydrates (RFCs) on cecal *Salmonella* prevalence in commercial turkeys and broilers. Abstract 204, *Poultry Science Association*, 2019.

4 The effects of yeast feed supplementation on turkey performance and pathogen colonization in a transport stress/*Escherichia coli* challenge. *Poultry Science*, 2013;92:655–662.

5 Refined functional carbohydrates reduce cecal *Salmonella* reading load in a challenge trial compared to turkey hens fed a control diet. Abstract P289, International Poultry Scientific Forum 2020.

6 Effect of a yeast cell wall preparation on cecal ovarian colonization with *Salmonella enteritidis* in commercial layers. *Journal of Applied Poultry Research* 2018;27:453–460.

7 The effects of refined functional carbohydrates (RFCs) supplemented to laying hens on egg production and mortality under commercial conditions. Abstract P304, International Poultry Scientific Forum, 2020.

8 *Adapted from a study done at a private Poultry Research Center.* Data on file, 2020.

9 *Adapted from a study done at a private Poultry Research Center.* Data on file, 2020.