WP

NUTRITION

Yeast improves resistance to environmental challenges

Following the disappearance of antibiotic growth promoters, a wide variety of new products have been analysed in order to know more about their capability to replace antibiotics. Research has shown that dietary yeast extract has an effect on resistance to cold stress, transport stress, and E. coli respiratory challenge.

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Regulatory pressures to limit antibiotic usage in livestock and recent international marketing agreements that prohibit treating poultry with antibiotics have limited the disease-fighting tools available to poultry and livestock producers, particularly in Europe. There is a need to evaluate potential antibiotic alternatives to both increase production and improve disease resistance in high intensity food animal agriculture. Nutritional approaches to counteract the debilitating effects of stress and infection may provide producers with such alternatives. Improving the disease resistance of animals grown without antibiotics can benefit the animals' health, potentially increasing production efficiency and food safety.

Stress and infection

Growth promoting and therapeutic antibiotics have been used to compensate for the high levels of stress that can be present in intensive animal production, because stress can lower resistance to many of the microorganisms always present in the environment. The broiler chicken has been bred to become an animal that is well adapted to intensive agriculture and has been shown to grow productively under commercial conditions without antibiotic growth promoters. However, the food animals that may be more difficult to produce without antibiotics are those that are more reactive under modern production conditions and have the highest response to production stressors, such as turkeys, veal calves, and weanling pigs.

While growth promoting antibiotics are thought to function mainly by changing the intestinal bacterial flora and affecting gut development, another mechanism by which they may improve production values is through their ability to decrease subclinical disease with the opportunistic pathogens that are present in the environment, such as *E. coli*. The stresses of intensive poultry production can lead to changes in the immune response that make animals susceptible to these pathogens and thus lead to disease. Our research programme, using an *E. coli* respiratory disease challenge model, has allowed us to study the effects of different kinds of stress on diseases and develop nutritional strategies for increasing both disease resistance and production values in turkeys and broilers.

Table 1 - Intermittent cold stress schedule

Age of bird (Days)	Duration of cold stress (hours)	Temperature °C
6	1	15.1±2.2
7	2	13.3±2.0
9	3	13.0±1.6
11	7	13.1±1.7
19	8	13.2±1.0

Figure 1 - Effect of Alphamune™ (Y) on week 1 body weight of poults subjected to cold stress and *E. coli* challenge

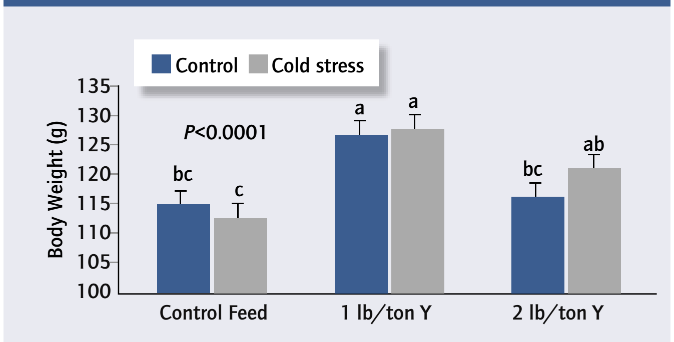


Figure 2 - Effect of Alphamune™ (Y) on week 2 body weights of poults subjected to cold stress and *E. coli* challenge

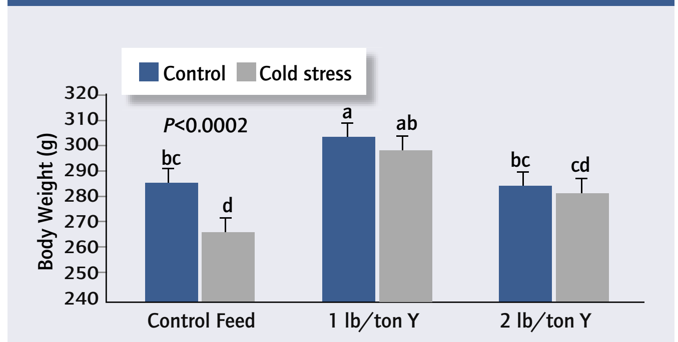


Figure 3 - Effect of Alphamune™ (Y) on week 3 body weights of poults subjected to cold stress and *E. coli* challenge

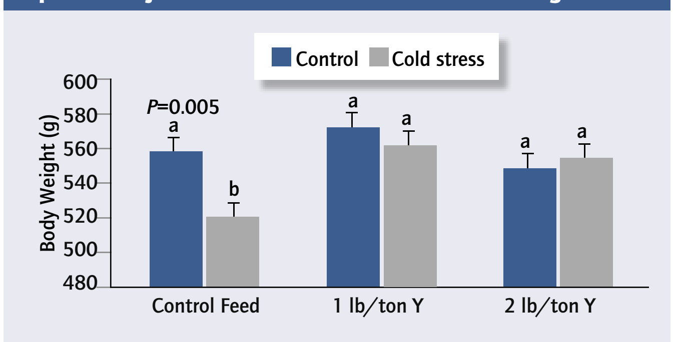


Figure 4 - Effect of Alphamune™ (Y) on feed conversion of poults subjected to cold stress and *E. coli* challenge

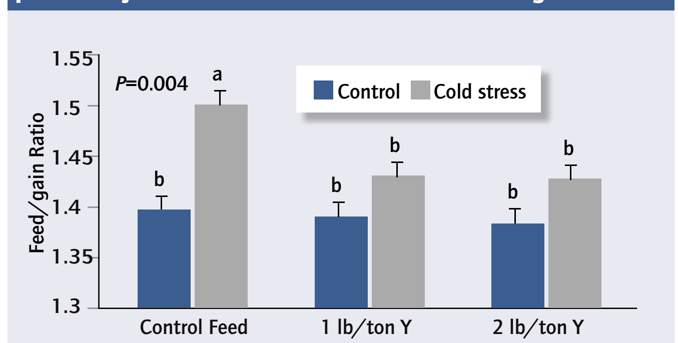


Figure 5 - Effects of Alphamune™ supplementation on week 2 body weights (a) week 2 main effect mean body weights (b) 7 days post *E. coli* challenge

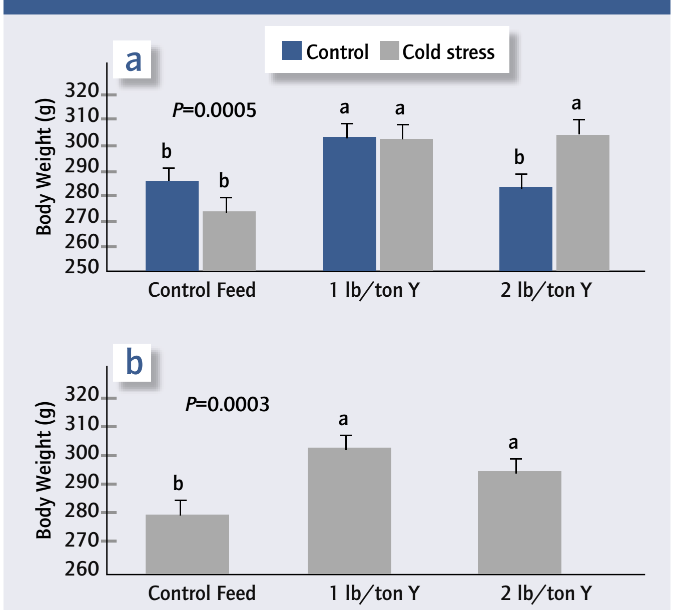
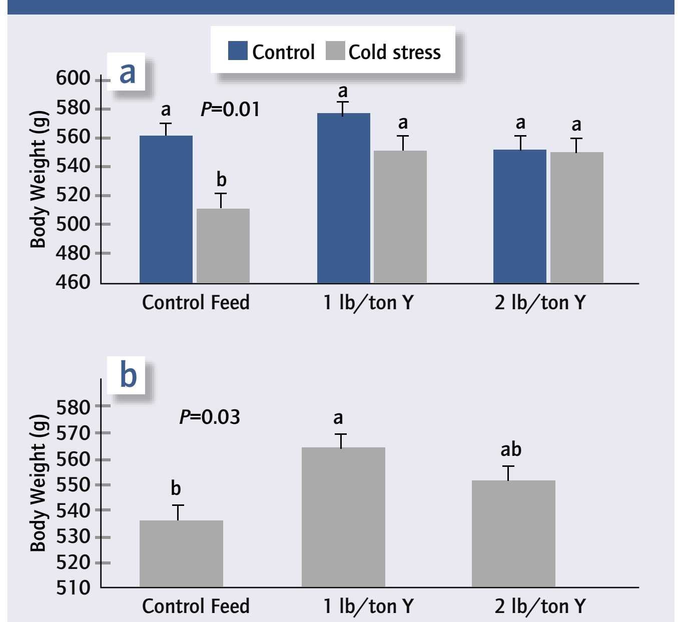


Figure 6 - Effects of Alphamune™ supplementation on week 3 body weights (a) week 3 main effect mean body weights (b) 14 days post *E. coli* challenge and 1 day post transport stress



Yeast extracts

Yeast cell walls are potential immunomodulators that may serve as alternatives to antibiotics for both growth promotion and disease resistance in poultry production. Brewer's yeast (*Saccharomyces cerevisiae*) extracts, which are by-products of beer manufacturing, have been added to animal feeds for many years for their nutritional content. Brewers dried yeast has been used as a source of both mannan-oligosaccharides (MOS) and ß-1,3/1,6-glucan by a number of companies providing antibiotic-replacement products for animal production. Whole yeast or yeast cell wall components have been shown to improve growth of turkeys and broilers. Both ß-1,3/1,6-glucan and MOS are generally recognised as safe (GRAS) by the FDA for use as food and feed additives. Alphamune™, made by Alpharma Animal Health, is a yeast extract feed additive that combines both the immunomodulatory properties of a standardised level of (1,3)/(1/6)

Figure 7 - Feed conversion efficiency (total feed consumed/ total weight gained as affected by *E. coli* challenge and transport stress.

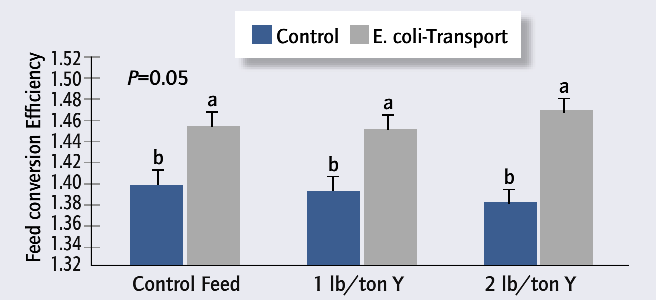
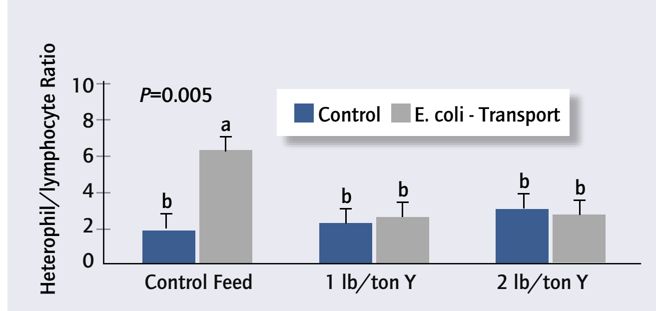


Figure 8 - Heterophil/lymphocyte ratio the morning after transport stress.



ß-glucans with the performance enhancement of MOS. To prove this the following study was conducted to determine if it can protect turkey poults from the effects of cold stress, transport stress, and *E. coli* infection.

Cold stress and E. coli challenge

One hundred and eighty day-of-hatch poults were obtained from a commercial hatchery and placed in battery brooders. They were fed an unmedicated turkey starter diet or the same diet supplemented with 1lb/ton (at 500 g/ton) or 2 lb/ton (at 1000 g/ton) of Alphamune™. There were three random pens with 10 birds/pen in each treatment. Poults were challenged by exposure to intermittent cold stress (12-16°C) during wk 1-3 (*Table 1*), and inoculation of eye and nose by coarse spray of a 108 cfu culture of a non-motile, serotype O2 strain of *E. coli* at 1 wk of age. Controls were neither stressed nor inoculated. Birds were bled and necropsied at 3 wk of age.

Results showed that one lb/ton of the additive significantly increased week 1 body weight of both control and cold stressed birds, while 2 lb/ton increased week 1 body weight of cold stressed birds only *(Figure 1)*. Week 2 body weights of both control and cold stressed/challenged birds were increased by 1 lb/ton of the yeast products *(Figure 2)*. Week 3 body weights of cold stressed and challenged birds were protected by both 1 lb/ton and 2 lb/ton Alphamune™ *(Figure 3)*. The reduction seen in feed conversion efficiency due to cold stress and challenge was prevented by both levels of Alphamune™ supplementation *(Figure 4)*.

E. coli and transport stress

During a second trial poults were challenged by air sac injection of 60 cfu of *E. coli* at 1 week of age. At 3 weeks of age these challenged birds were also subjected to transport stress. Birds were placed in coops and driven for 3 hours, then held in the same coops for 9 hours, giving a total of 12 hours of containment without feed or water. Treatment controls were neither stressed nor inoculated. Birds were returned to their original pens and provided with feed and water. The next morning nine birds from each experimental group were bled and all birds were necropsied.

Results showed that both levels of Alphamune™ supplementation increased the week 2 *(Figure 5a)* and week 3 *(Figure 6a)* body weight of challenged birds relative to control fed challenged birds. The *E. coli* challenge alone did not significantly affect week 2 body weight; however, following transport stress body weight was decreased in the control challenged birds and this decrease was prevented by both levels of the additive *(Figure 6a)*. Main effect mean body weights were improved by both levels of supplementation at week 2 *(Figure 5b)* and by 1 lb/ton of the product at week 3 *(Figure 6b)*. Feed conversion efficiency was reduced by *E. coli* challenge and transport; however, there was no effect of Alphamune™ supplementation *(Figure 7)*. The heterophil/lymphocyte (H/L) ratio was increased by *E. coli* challenge and transport stress. The increase in H/L ratio, which is an indicator of stress, was prevented by both levels of Alphamune™ supplementation *(Figure 8)*.

A valuable addition

These results illustrate the dramatic effects that stress and subclinical disease challenges can have on production values, and suggest that feed supplementation with yeast extracts may be effective in preventing the production losses due to subclinical *E. coli* infection in turkey poults. The primary method of controlling *E. coli* infections in poultry is through the use of therapeutic antibiotics. Since the 1950s, sub-therapeutic levels of antibiotics have been used to improve production values, particularly feed conversion efficiency, presumably by modifying gut bacterial ecology and development. However, sub-therapeutic antibiotics are also credited with decreasing morbidity and mortality from both clinical and subclinical infections with opportunistic pathogens, such as *E. coli*, and have allowed the development of increasingly intensive confinement of animal production.

Alphamune™ improved body weight in both cold stress and transport stress challenges and poults that were exposed to cold stress had improved feed conversion efficiency compared to non-stressed controls. The stress response, as determined by the H/L ratio, was lowered in supplemented poults that were subjected to transport stress. These studies suggest that supplementation of turkey diets with dietary yeast extracts may be valuable for preventing the production losses due to stress. ■

(Reference available on request)

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