Fertility and hatchability – the role of MOS

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Restrictions on the use of antibiotics in poultry production are increasing the interest in natural replacements. As an alternative to antibiotics, MOS (Bio-Mos from Alltech) appears to offer additional benefits.

Although the routine use of antibiotics is less prevalent in breeders than in broiler production, the concerns regarding development of resistant strains of pathogenic bacteria remain the same.

In addition to the potential impact on bird health and performance (either within the breeding flock or in the progeny), much of the driving force for change comes from fears relating to the transfer of such resistance problems from poultry to humans.

From a global poultry production perspective, the greatest threat comes from any reduction in the effectiveness of antibiotic growth promotants (AGPs) in broilers.

The potential for resistance to be passed on to broiler poults from parent stock, that is the breeders, is sufficient for the industry to be actively seeking alternatives.

Gut microflora

The modes of action of most of these alternatives centre on their ability to alter the microfloral profile within the gut, limiting the colonisation of harmful bacteria and promoting growth and activity of beneficial microbes.

As a result, the bird is more able to withstand stressors such as heat, transportation, vaccination, handling and certain bacterial infections, which would ordinarily predispose the gut to pathogenic colonisation.

Prebiotics from plant sources, for example fructo-oligosaccharides, act by providing an additional substrate for beneficial bacteria in the intestine.

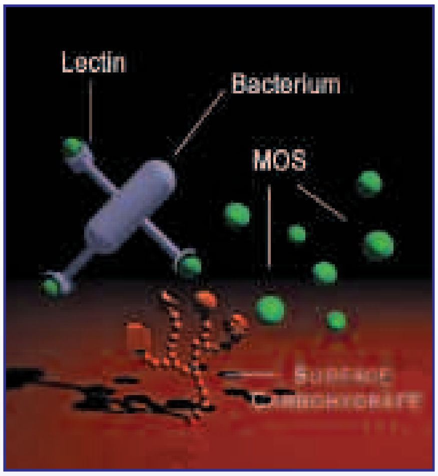

Fig. 1. MOS pre-empts adhesion of pathogens to mannose receptors on intestinal cell (adapted from Sharon and Lis, 1993).

Where pathogens lack the necessary enzymes to utilise these oligosaccharides, the result is competitive exclusion of pathogens from the gut.

In contrast, mannan oligosaccharide (MOS) is derived from the outer cell wall of the yeast Saccharomyces cerevisiae, and prevents colonisation of Gram negative pathogens with type I fimbriae (such as salmonella and E. coli) by the mechanism shown in Fig.1.

What is particularly interesting, however, is the apparent ability of MOS to also influence fertility and hatchability in breeders.

Breeder benefits

Sefton (1991) reported that the use of a yeast culture in breeder diets improved both egg specific gravity and hatchability (the latter by 4%) in hens between the age of 60-65 weeks, whilst McDaniel and Sefton (1991) noted a similar increase in hatchability (3.5%).

Such results have also been supported by commercial scale trials. Cragoe and Olsen (1994) reported a field trial in Minnesota using 44,000 breeders from 29-41 weeks of age, comparing a positive (bacitracin) control diet with a MOS supplemented diet (0.1% for two weeks, followed by 0.05% thereafter).

One house of 10,000 breeders and two houses of 6,000 breeders were allocated to each treatment (22,000 birds per treatment) and the results are shown below in Table 1.

A more detailed study into the effects of MOS on hatchability was carried out by Shashidhara and Devegowda (2003) at the University of Agricultural Sciences, Bangalore, India, using a total of 390 broiler breeders (360 hens and 30 males) from 60-68 weeks of age.

The birds were assigned to eight replicate pens and received a control diet containing no MOS or the same diet supplemented with 0.05% MOS (Figs 2, 3 and 4).

Table 1. Effects of dietary MOS on commercial broiler breeders (Cragoe and Olsen, 1994).

	Control (bacitracin)	MOS*
Hen day egg production (%)	83.75	85.59
Feed consumption (kg/100 birds/day)	12.27	11.54
Mortality (%)	2.4	3.5

**MOS supplied in the form of Bio-Mos.*

Egg production improvements

Although the data for hen day egg production demonstrated no statistical difference, there was a significant ($p<0.05$) improvement seen in hatchability and corresponding reductions ($p<0.05$) in infertile and dead-in-shell eggs. The net result is an overall improvement in productivity per hen, with subsequent improvement in financial performance for the flock.

There are several factors capable of influencing hatchability, although the majority are related to environmental changes. As hens used for this particular trial were kept under identical conditions, environment was clearly not a factor.

It has been reported, however, that hatchability problems in females over 50 weeks of age are often associated with poor shell quality.

Although not measured in this trial, an improvement in eggshell quality is one possible explanation for differences in hatchability and dead-in-shells seen between treatments. Such a theory is supported by the results of Sefton (1991), where an improvement in hatchability corresponded with an increase in egg

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specific gravity, a potential indicator of eggshell quality.

It is also possible that the nutrient sparing action of MOS, resulting from the reduction in pathogen loading within the gut , may enable the breeder to deposit a greater quantity of vital nutrients in the developing egg.

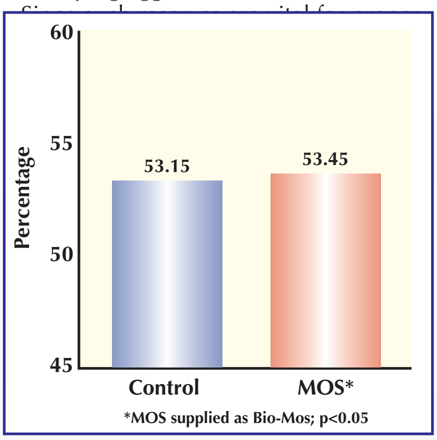


Fig. 2. Effects of dietary MOS on hen day production (Shashidhara and Devegowda, 2003).

Improved hatchability and fertility in females may also be due to the influence of MOS on semen quality in males. In this trial, significant increases in spermatozoa density (2,540 million/ml compared to 2,156 million/ml, p<0.05) were noticed in males fed MOS after six weeks of supplementation (Fig. 5).

Similarly, McDaniel (1991) demonstrated that the addition of yeast culture to diets of Ross males at 20 weeks of age increased both the percentage of roosters in semen production and semen concentration.

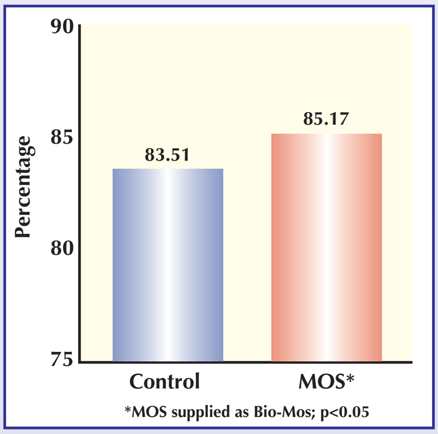
The total sperm number present in the oviduct does appear to be an important factor influencing fertility and early embryonic mortality in poultry. Behtina showed that while only one sperm penetrates the ovum to form a zygote, many spermatozoa enter the vitelline membrane. Eslick and McDaniel (1992) also reported that when inseminating breeders with increasing sperm concentrations, the number of sperm present in the oviduct had a considerable influence on fertility and hatchability.

Correspondingly, fertility reduced and early embryonic death increased as the number of inseminated sperms decreased.

What is most apparent is that the addition of MOS to the diets of breeders can have a significant impact on overall productive performance. In addition to the benefits attributed to improved gut health and immune status, which have been well documented, there appear to be significant benefits to be gained in fertility and hatchability.

That both male and female broilers can benefit from these gains adds to the financial potential these improvements represent. ■

Fig. 3. Effects of dietary MOS on hatchability (Shashidhara and Devegowda, 2003).



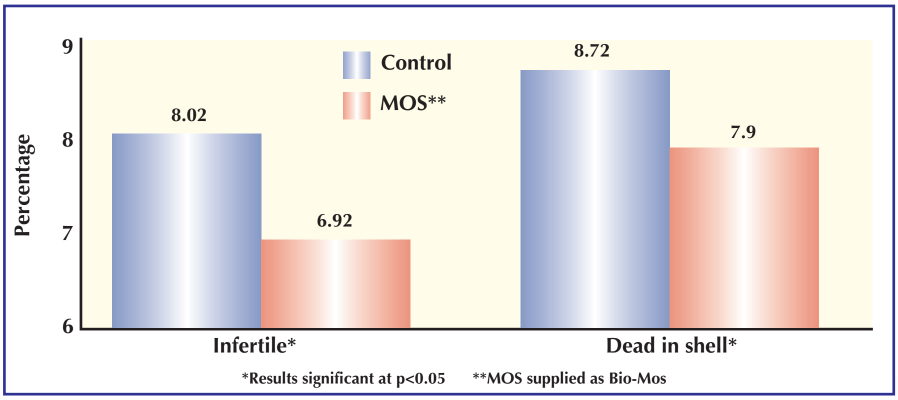
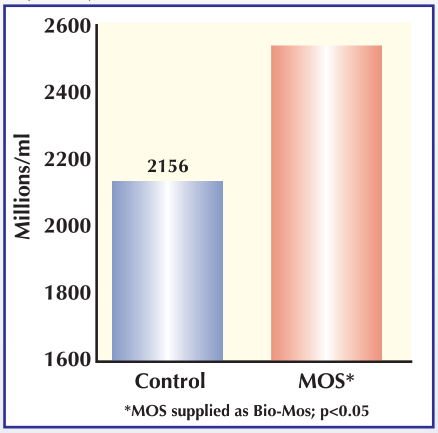


Fig. 4. Effects of dietary MOS on fertility (Shashidhara and Devegowda, 2003).

Fig. 5. Effects of dietary MOS on spermatozoa density (Shashidhara and Devegowda, 2003).



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