Mannan oligosaccharides for laying hens

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Dietary Saccharomyces cerevisiae yeast outer cell wall extract known as mannan oligosaccharide (MOS) has been shown to adsorb (agglutinate) pathogenic bacteria having Type 1 fimbrae and mannose-seeking lectins, to serve as a general immunomodulator reducing intestinal microbial populations, and to improve the integrity and morphology of the intestinal mucosa.

Advantages in productive performance have previously been demonstrated in 22 comparisons of control versus MOS diets in pigs, 34 in broiler chickens, 27 in turkeys, and 20 comparisons in rabbits.

Benefits in performance

Results of initial recent feeding trials using dietary mannan oligosaccharide (MOS) for laying hens in cages or on a slatted floor indicate benefits in productive performance.

The results of four laying hen trials with dietary MOS in Greece, Hungary, Spain, and Turkey are presented in this article.

Additional studies presently underway at other locations will add to this database, allowing the type of improvements and their magnitude to be better estimated in the future.

Greek trial

In each of two simultaneous studies, a total of 2,600 Lohmann Brown laying hens on a slatted floor were fed diets with 0 or 1.0g MOS/kg from housing to 300 days (approximately 43 weeks) of age.

In each trial there were two replicate groups of 650 hens each per treatment.

As pullets, these birds were started on deep litter and given feeds containing MOS at 1.5g/kg from 0 to 42 days and 1.0g/kg thereafter, grown on slatted floor from 60 days of age to end of lay.

Primary ingredients in the diets were maize, soyabean meal, herring meal, and wheat bran.

Item	Negative control	+MOS 1.0g/kg	P-value
Final body weight (g at 300 days)	2,254	2,294	0.201
Total mortality (%)	2.08	1.46	0.127
Hen day egg production (%)[1]	86.42[b]	88.61[a]	0.005
Feed consumption (g/hen/d)	150.6	150.7	0.804
Egg weight (g)[1]	66.54[b]	68.36[a]	0.023
Eggs with blood spots (%)	0.35	0.15	0.146
Egg shell thickness (mm)	0.408[b]	0.453[a]	0.037
Roche yolk colour	11.38[b]	12.13[a]	0.002

[a-b] Means in a row with different letter superscripts differ significantly ($P < 0.05$).

[1] Daily egg mass production calculated from egg production and egg weight means are: negative control = 57.50 and +MOS (1.0g/kg) = 60.57g/hen/d (5.34% increase). Calculated feed conversion values are 2.091 and 2.041kg feed/dozen eggs and 2.619 and 2.488kg feed/kg egg, respectively.

Table 1. Productive performance of Lohmann Brown laying hens on a slatted floor to 300 days (approximately 43 weeks) of age and fed diets containing 0 or 1.0g MOS/kg (Demovelis et al., 2004).

For purposes of this article, the means from the two experiments have been combined for analysis.

Live performance results during the laying period (initial age not stated) are shown in Table 1.

Hungarian trial

Caged Bovans Brown Goldline hens, 279 in total, were used in a feeding trial from 17 to 70 weeks of age to compare three dietary treatments – negative control (0g MOS/kg), +MOS (1.0g/kg, 20-26 weeks, and 0.5g/kg, 26-70 weeks), or + MOS (1.0g/kg).

At 17 weeks of age, birds were first sorted into three body weight groups of equal number (1450-1500, 1501-1550, and 1551-1600g) and distributed equally among the three feeding groups.

The stocking density was at 450cm^2 cage floor space per bird.

The primary ingredients in the diet were maize, wheat, soyabean meal, sunflower meal, limestone, fish meal, and alfalfa meal (calculated crude protein 17.0%; 11.50MJ/kg or 2,747kcal ME/kg).

Results analysed using 12 monthly means per treatment are presented in Table 2.

Because egg production and shell quality has typically been equal or better for MOS-fed birds compared to negative control birds, perhaps some unknown confounding factor such as nutritional deficiency due to feed mixing error may have been involved in this trial.

Spanish trial

A total of 1,200 ISA Brown caged laying hen were allocated to two dietary treatments (0 or 1.0g MOS /kg) from 38 to 66 weeks of age.

There were three hens per cage (750cm^2 cage floor space per bird), 15 hens per replicate, and 40 replicates per treatment.

Maize, barley, wheat, soyabean meal, limestone and lard were the main ingredients (calculated 16.7% crude protein; 2,750 kcal AMEn/kg). The results are shown in Table 3.

Continued on page 27

Table 2. Effects of dietary MOS at 0, 1 (17-25 weeks) then 0.5 (25-70 weeks), or 1.0g/kg on productive performance of caged Bovans Brown Goldline laying hens from 17 to 70 weeks of age (Molnar Korosine, 2004).

	Negative Control	+MOS 1.0, 0.5g/kg	+MOS 1.0g/kg	P-value
Total mortality (%)	15.05	5.38	12.90	0.554
Number eggs/month	26.08	25.29	25.39	0.803
Feed consumption (g/hen/d)	145.5[a]	133.8[b]	139.0[ab]	0.042
Feed conversion (kg feed/kg egg)	2.72	2.59	2.66	0.530
Egg weight (g)	64.54	64.60	64.81	0.983
Total egg mass (kg/hen)	20.20	19.60	19.75	0.846
Total deformed eggs[1]	151	211	199	0.112
Total blood and meat spot eggs	65	64	65	0.994
Efficacy index egg production (EIEP)[2]	13.26	14.97	13.88	

[a-b] Means in a row with different letter superscripts differ significantly ($P < 0.05$).

[1] Egg deformities characterised as either soft eggshell, broken egg, greater than 70g, or deformed eggshell. Only broken (first problem) or soft eggshells (second problem) were found.

[2] $EIEP = \frac{\text{Livability (\%) x egg mass (kg/hen) x 100}}{\text{50 week laying period x feed (kg/kg eggs)}}$ EIEP not analysed statistically.

	Negative control	+MOS 1.0g/kg	P-value
Hen day egg production (%)	85.1^{b}	86.9^{a}	0.008
Feed consumption (g/hen/d)	114.3^{b}	115.7^{a}	0.008
Feed conversion (kg feed/dozen eggs)	1.61	1.60	0.297
Feed conversion (g feed/g egg)	2.09^{a}	2.06^{b}	0.037
Egg weight (g)	64.3	64.7	0.171
Normal eggs (%)	96.2	96.3	0.902
Dirty eggs (%)	1.7	1.6	0.551
Broken eggs (%)	2.0	2.1	0.664
Shell thickness (µm)	360	361	0.502
Haugh units	81.5^{a}	79.9^{b}	0.045
Roche yolk colour	12.5^{b}	12.8^{a}	0.001

[a-b]Means in a row with different letter superscripts differ significantly ($P < 0.05$).

[1]Daily egg mass production calculated from egg production and egg weight means are: negative control = 54.72g/hen/day and +MOS (1.0g/kg) = 56.22g/hen/day (2.74% increase).

Table 3. Productive performance of ISA Brown caged laying hens, 38 to 66 weeks of age, when fed diets containing 0 or 1.0g MOS/kg (Medel and Mendez, 2004).

Continued from page 25

Hen day egg production, feed consumption, and yolk colour score (Roche) were increased and feed conversion per g eggs and Haugh units were decreased by MOS addition ($P < 0.05$).

Turkish trial

Caged Nick Brown laying hens, 360 in total, were placed in 120 cages (four replicates of 10 cages each per treatment, with three hens per cage) to evaluate diets containing either no additive, avilamycin at 10g/tonne, or MOS at 1.0g/kg from 54 to 74 weeks of age.

The major ingredients were maize, soyabean cake, sunflower cake, limestone, meat and bone meal, and fish oil (calculated 17.39% crude protein; 2,763kcal ME/kg).

The results are detailed in Table 4 below. Adding MOS (1.0g/kg) gave similar results except for lower egg weight compared to avilamycin (10ppm) in laying hen diets.

Benefits of MOS

Final body weight of hens was increased with MOS (1.0g/kg) in the Turkish trial.

Egg production was increased in the trials in Greece, Spain, and Turkey with MOS (1.0g/kg) diets.

Feed consumption was increased in the Spanish trial (MOS 1.0g/kg), decreased in the Hungarian trial (MOS 1.0 then 0.05g/kg), and approximately equal for control and MOS (1.0g/kg) diets in the Greek trial.

Egg weight was increased in one trial (Greece) and decreased in another trial (Turkey) using MOS (1.0g/kg) supplementation.

Feed conversion ratio expressed as g feed/g egg was reduced in the trials in Spain and Turkey using MOS (1.0g/kg) supplementation.

Internal egg Haugh units were decreased in the Spanish trial with MOS (1.0g/kg).

Shell thickness was improved in the Greek trial, and the cracked-broken egg percentage was decreased in the Turkish trial, each using MOS at 1.0g/kg of diet.

Yolk colour measured by Roche colour fan was greater in two trials (Greece and Spain) when MOS (1.0g/kg) was added to feed.

The typical level of MOS inclusion was 1.0g/kg (0.1%) in laying hen diets.

Table 4. Comparison of live performance of caged Nick Brown laying hens fed diets containing either no additive, avilamycin (10g/tonne), or MOS (1.0g/kg) from 54 to 74 weeks of age (Bozkurt et al., 2003).

	Negative control	+Avilamycin (10ppm)	+MOS 1.0g/kg	P-value
Final body weight (kg)	1.601^{b}	1.650^{a}	1.670^{a}	< 0.001
Total mortality (%)	7.49	5.83	0.83	0.269
Hen day egg production (%)	75.51^{b}	77.05^{a}	78.92^{a}	< 0.001
Feed consumption (g/hen/d)	103.9	103.9	102.9	0.338
Feed conversion (g feed/g egg)	2.093^{a}	2.045^{ab}	2.001^{b}	0.002
Egg weight (g)	65.57^{a}	65.66^{a}	65.01^{b}	< 0.001
Cracked/broken eggs (%)	3.59^{a}	2.25^{b}	2.64^{b}	< 0.001

[a-b]Means in a row with different letter superscripts differ significantly ($P < 0.05$).

[1]Daily egg mass productions calculated from egg production and egg weight means are: negative control = 49.51, +avilamycin (10g/tonne) = 50.59, and +MOS (1.0g/kg) = 51.31g/hen/d (3.64% increase). Feed conversion values calculated from egg production and feed consumption are: 1.652, 1.618, and 1.565kg feed/dozen eggs, respectively.

Conclusions

Research results to date with caged laying hens support the inclusion of MOS in feed to improve performance, especially in the categories of egg production, feed conversion ratio (per unit of egg weight), egg shell quality, and egg yolk colour.

Potential application in breeder hen diets is suggested as well. For growing replacement pullets or cockerels on litter or for production of table eggs or fertile eggs, the typical inclusion rates are about 1.0 to 1.5g MOS/kg of feed. ■

References are available from the author on request