HSCAS improves pellet throughput

New feed formulas, including phytase and DDGS, may affect pellet mill throughput. A new coarse aluminosilicate product may help scour pellet dies, improving die performance.

By **DANNY M. HOOGE***

SUPPLEMENTING broiler chicken feeds with a phytase enzyme reduces phosphate levels substantially, but these revised formulas provide less abrasive scouring action by phosphate to keep pellet dies clean, so feed mill throughput usually declines.

Furthermore, adding fats and oils at lower inclusion rates due to their high prices provides less lubrication than before, and inclusion of new-generation corn dried distillers grains with solubles (DDGS), which lack the corn starch component, may worsen throughput problems.

To enhance pellet mill throughput when manufacturing these new feed formulas, a slightly coarser version of a hydrated sodium-calcium aluminosilicate (HSCAS; AZOMITE Feed-Grit, Peak Minerals-Azomite Inc.) from a Utah volcanic ash deposit was developed.

Several years ago, a successful preliminary turkey feed pellet mill throughput trial was conducted with a finer (-200 mesh) HSCAS product (AZOMITE Micronized).

The new lower-cost product with a slightly coarser grind (about 70% as -8 mesh particles with about 30% as -50 mesh powder) was hypothesized to improve pelleting throughput and possibly lower electrical amps per ton needed during pelleting. Therefore, three additional trials with the coarse HSCAS product were planned and conducted at two commercial broiler feed mills in Arkansas during March and July 2008. This article summarizes those four pellet mill trials and results.

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Preliminary trial 1

In the preliminary midwestern U.S. turkey feed pelleting trial several years ago that used fine HSCAS, eight formulas with feeds ranging from 15% to 28% crude protein were manufactured with zero or 1.0% fine HSCAS.

The conditioned mash feed temperature increased, on average, from 179.4°F to 185.5°F (+6.1°F; P = 0.006), amps required during pelleting decreased from 246.3 to 236.9 (-9.4 amps; P = 0.011) and percent pellets (six of eight formulas tested) increased from 78.8% to 82.4% (+3.6% more pellets; P = 0.030) with similar pellet durability indexes (PDIs) of 91.8 and 92.2 for the zero and 1.0% fine HSCAS treatments, respectively (+0.4% PDI; P = 0.489).

1. Trial 2: Pellet mills 1 and 2 combined results for conditioner temperature, throughput and electrical amps used during pelleting as affected by dietary coarse HSCAS in broiler grower feed

Dietary HSCAS, %	Number*	Conditioner temperature, °F	Throughput, ton/hour	Electricity/ pellet mill, amps
0	7	168.1	28.86[b]	333.6
0.5	6	170.7	31.83[a]	339.0
1.0	14	173.1	31.68[a]	337.9
P-value	—	0.247	0.000	0.854

[a,b]Means within a column and group with different letter superscripts differ significantly (P ≤ 0.05) by LSD procedure after One-Way ANOVA (three treatments).
*Number of 3.5-ton batches of grower feed used per mean.

2. Trial 2: Laboratory assay results for pellets:fines, PDI and THI assay results by dietary coarse HSCAS treatments for pellet mills 1 and 2 combined

Dietary HSCAS, %	Number	Pellets: fines, %*	PDI, %	THI
0	2	75.8:24.2	97.8	74.2
0.5	2	77.0:23.0	97.2	75.0
1.0	2	80.7:19.3	97.7	79.0
P-value	—	0.934	0.943	0.950

*Sampled at cooler; No. 10 screen.

3. Trial 3: Pellet mill 1 conditioner temperature, throughput and electrical amps used in consecutive 3.5-ton batches of a grower feed as affected by dietary sand or coarse HSCAS at 0% and 0.4% levels each

Dietary supplement	Number*	Throughput, tons/hour	Conditioner temperature, °F	Electricity/ pellet mill, amps	Automatic in-line sampling, screening and weighing for % pellets
None, 0%	221	28.0	171.3[a]	337.1[b]	75.4[b]
HSCAS, 0.4%	27	28.0	172.2[a]	357.5[a]	80.0[a]
Sand, 0.4%	14	28.0	167.6[b]	354.9[a]	78.8[a]
P-value	—	—	0.0	0.0	0.0

[a,b]Means within a column and group with the same letter superscript do not differ significantly (P ≤ 0.05) by LSD procedure after One-Way ANOVA (three treatments).
*Number of 3.5-ton batches of grower feed used per mean.

Trial 2

Consecutive broiler grower feeds made on a morning shift at the mill were supplemented with zero, 0.5% or 1.0% of the coarse HSCAS supplement on top of the regular formula. One operator was in charge of all of the feed manufacturing during this time period. The feed mill had two pellet mills in operation at the time, which were designated as pellet mills 1 and 2. Results have been presented using data from mills 1 and 2 combined (Table 1).

Computerized batching software in the feed mill captured data from the production runs, and one feed sample from each pellet mill and treatment (six total samples) were evaluated for pellet quality. A No. 10 screen was used to separate pellets from fines, and a New Holpen Tester manufactured in the U.K. was utilized to determine PDI at 60 psi (pressurized air tumbler) for 30 seconds based on a 100 g sample of screened (that is, intact whole) pellets.

Conditioner temperatures for combined pellet mills 1 and 2 (Table 1) showed a stepwise linear increase from 168.1°F to 170.7°F to 173.1°F as the level of inclusion of coarse HSCAS increased from zero to 0.5% to 1.0%, although the treatment differences among these overall averages were not statistically significant (P = 0.247).

Similarly, no significant treatment differences were observed for electrical amps used during pelleting.

Throughput as measured in tons of broiler grower feed produced per hour significantly increased due to the addition of either the 0.5% or 1.0% level of coarse HSCAS for both pellet mills combined (P = 0.000) compared to the negative control treatment. This effect was thought to be due to the abrasive qualities of the hydrated alumnosilicate in the HSCAS product keeping the dies clean.

Pellet quality measurements (Table 2) were taken on one feed sample per treatment and pellet mill and analyzed in the feed mill's quality assurance lab. The percent pellets increased in a linear fashion as the level of dietary HSCAS increased for both pellet mills combined, but differences were not statistically significant. PDIs appeared to be unchanged due to HSCAS supplementation in this trial.

However, theoretical handling indexes (THIs; calculated as % pellets x PDI) numerically increased slightly with 0.5% and substantially with 1.0% dietary HSCAS compared to the negative control results for pellet mills 1 and 2 combined. The numerical improvement in THIs may have been due to the 30% fine powder in the dietary HSCAS acting in a similar manner to bentonite clay for pellet binding.

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Trial 3

Trial 3 was conducted at the same feed mill as trial 2, and zero or 0.4% (8 lb. per ton) levels of either sand or coarse HSCAS were used in a broiler grower feed formula.

One operator was in charge of the production runs. Each batch was 3.5 tons of feed. Results for feed manufactured through one pellet mill are reported (except lab assays for percent pellets and PDI report samples from two pellet mills). There were 22 batches without the supplement (0%), 27 batches with HSCAS at 0.4% and 14 batches with sand at 0.4%.

Computerized batching software in the feed mill captured data from the production runs. Results are presented in Table 3.

Throughput was held steady at 28.0 tons per hour through the 63 total batches in trial 3. Conditioner temperatures were significantly higher for the negative control (0%) and 0.4% HSCAS formulas than for the formula with 0.4% of sand. The reason for this is not known; it is speculated that the sand may serve as a heat sink and take heat away from the moist feed being steam conditioned or that it in some other way physically affects the conditioning process.

Electrical amps used during pelleting were significantly higher for the HSCAS and sand treatments, which could possibly be associated with friction drag caused by their abrasiveness (although the exact cause is not known).

The automatic in-line sampling, screening and weighing system (autosampler) at this mill for weighing pellets and fines permitted the calculation of percent pellets as the batches were moving through the system after manufacturing the pelleted feed.

With regard to feed mill laboratory assay results (Table 4), there was a numerical decrease in percent pellets obtained from pellet mills 1 and 2, and for both pellet mills combined, whenever sand was included at 0.4% compared to nothing added (0%) or HSCAS added at 0.4% of the diet.

Pellet durability testing gave variable results, and no trends were readily apparent except that sand, perhaps, may have been slightly detrimental to PDI. THIs — or "pellets to the chickens" — favored the dietary coarser HSCAS treatment. The improvement in THIs may have been due to the 30% fine powder in the coarser HSCAS acting in a similar manner to bentonite clay for pellet binding.

4. Trial 3: Laboratory assay results for pellets:fines, PDI and THI assay results by dietary supplement (sand or coarse HSCAS) for pellet mills 1 and 2 combined

Dietary supplement	Number	Pellets: fines, %	PDI, %	THI
None, 0%	4	81.1	96.7	78.5
HSCAS, 0.4%	2	86.8	96.8	84.1
Sand, 0.4%	4	79.6	95.6	76.5
P-value	—	0.799	0.932	0.838

5. Corn/soy/bakery byproduct formulas

Ingredients (partial list)	---Amount of ingredient in diet, %--- Negative control	HSCAS (0.5%)
Bakery byproduct meal	8.08	8.02
DDGS	5.02	5.03
Meat and bone meal (50% CP)	2.02	3.29
Poultry fat	1.51	1.52
Phytase	+	+
Defluorinated phosphate	0.20	0
AZOMITE Feed-Grit	0	0.50
Cost difference, $ per ton	—	-0.80
Summary of results by feed treatment		
Temperature mid-conditioner, °F	185	185
Tons per hour throughput achieved	30	45
Electrical amps	382	390
Electrical efficiency, amps per ton per hour	12.7	8.7
Hot pellets (after screening), %	94.1 (at 30 tons/hour; 21 tons)	92.3 (at 38 tons/hour)
Hot pellets (after screen, tumbler), % (PDI)	76.6	82.1

Trial 4

A commercial broiler integrator conducted a pelleting throughput trial with 0% or 0.5% coarse HSCAS in a broiler withdrawal 2 (final) feed. The outside temperature was in the upper 90°F range. One of three pellet mills was used for the trial, and one operator on the morning (first) shift controlled the feed manufacturing.

The pellet mill used was a California Pellet Mill with a 500 hp motor. The die was 3 in. thick (T.S. brand high-strength alloy) with a 1.5 in. effective die thickness for pelleting and a 7 mm pellet size. There was a 47-ton-per-hour pellet cooler from which samples were collected for percent pellets (screening) and pellet durability testing (tumbler). One sample was collected per treatment (one-quart sample bag).

The experienced operator made five 5-ton batches of coarse HSCAS (0.5% or 10 lb. per ton) feed and then made five 5-ton batches of negative control feed (no HSCAS). A total of 25 tons of feed were made per formula (treatment). The corn/soy/bakery byproduct formulas varied only slightly, as shown in Table 5.

The coarse HSCAS supplemented at the 0.5% level to a broiler withdrawal feed numerically reduced costs and increased pelleting throughput and electrical efficiency at similar percent pellets and PDI compared to the negative control feed. In this case, coarse HSCAS (0.50%) and meat and bone meal (1.27%) replaced defluorinated phosphate (0.20%) to accomplish these results.

Conclusion

These trials were based on a successful preliminary turkey feed pelleting trial with a fine HSCAS product and some of the current broiler chicken feed formulations requiring throughput aides.

The new coarse HSCAS product improved pellet mill throughput in the two trials where it was evaluated. In another trial where throughput was kept constant (28 tons per hour), other benefits were observed.

Electrical amps were used more efficiently for pelleting (that is, lower amps per pelleted ton) when coarse HSCAS was added to the feeds. The percent pellets and PDIs were generally equal to or better than negative control feeds despite higher throughputs. This was possibly due to the 30% fine powder in the coarser product acting as a pellet binder.

Based on research shown here, the coarse HSCAS can be used as a pelleting throughput aid in commercial poultry mills and additionally results in improved electrical efficiency during pelleting.

Phytase considerations discussed

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PONTOPPIDAN, K., D. Pettersson and A.-S. Sandberg. 2007a. *Peniophora lycii* phytase is stabile and degrades phytate and solubilizes minerals *in vitro* during simulation of gastrointestinal digestion in the pig. J. Sci. Food Agric. 87:2700-2708.

Pontoppidan, K., D. Pettersson and A.-S. Sandberg. 2007b. Interaction of phytate with protein and minerals in a soybean-maize meal blend depends on pH and calcium addition. J. Sci. Food Agric. 87:1886-1892.

Rynsburger, M., and H.L. Classen. 2007. Effect of age on intestinal pH of broiler chickens. International Poultry Sci. Forum, Atlanta, Ga. Abstr. M5.

Scott, N., and D. Steven. 2000. Engineering a disulfide bond in recombinant manganese peroxidase results in increased thermostability. Biotechnol. Prog. 16:326-333.

Simon, O., and F. Igbasan. 2002. *In vitro* properties of phytases from various microbial origins. Inter. J. Food Sci. Tech. 37:813-822.

Sorbara, J.O., J.L. Lecznieski, C. Arakaki and F.J. Piraces. 2007. Phytase recovery test after pelleting process in different commercial feed mills in Brazil. Poultry Sci. meetings, San Antonio, Texas. Abstr. 963.

Suzuki, U., K. Yoshimura and M. Yamazaki. 1907. Ube rein enzyme "phytase" das anhydro-oxy-methylen-diphosphosaure spaltet. Coll. Agric. Bull. Tokyo Imp. Univ. 7:503-505.

Takemasa, M., H. Murakami and M. Yamazaki. 1996. Reduction of phosphorus of chicks by addition of yeast phytase. Japan. Poult. Sci. 33:104-111.

Vats, P., and U.C. Banerjee. 2004. Production studies and catalytic properties of phytases (myo-inositolhexakisphosphate phosphohydrolases): An overview. Enz. Microbiol. Tech. 35:3-14.

Ward, N.E. 1993. Phytase in nutrition and waste management. Poultry Digest (August), p. 10-15.

Ward, N.E., and D.R. Campbell. 2007. Phytase assessment requires understanding. Feedstuffs, Vol. 79, No. 22, May 28.

Ward, N.E., and J.W. Wilson. 2002. Pelleting stability of Ronozyme P (CT) phytase in commercial feedmills: An update. Southern Poultry Sci. Soc. meetings, Atlanta, Ga. Abstr. 137.

Ward, N.E., D. Campbell and A. Korsbak. 2006. Comparative stability of phytase products in pelleted feeds. Poultry Sci. meetings, Univ. of Alberta, Edmonton. Abstr. T21.

Watanabe, K., and Y. Suzuki. 1998. Protein thermostabilization by proline substitutions. J. Mol. Cat. B. Enz. 4:167-180.

Weaver, J.D., and X.G. Lei. 2007. Comparison and accounting for differences of three phytase activity assay methods. Poultry Sci. meetings, San Antonio, Texas. Abstr. W137.

Wyss, M., R. Brugger, A. Kronenberger, R. Remy, R. Fimbel, G. Oesterhelt, M. Lehman and A. van Loon. 1999a. Biophysical characterization of fungal phytases (myo-inositol hexakisphosphate phosphohydrolases): Catalytic properties. Appl. Environ. Micro. 65:359-366.

Wyss, M., L. Pasamontes, A. Friedlein, R. Remy, J. Kohler, M. Tessier, A. Kronenberger, A. Middendorf, M. Lehman, L. Schoebelen, U. Rothlisberger, E. Kusznir, G. Wahl, F. Muller, H. Lahm, K. Vogel and A. van Loon. 1999b. Biophysical characterization of fungal phytases (myo-inositol hexakisphosphate phosphohydrolases): Molecular size, glycosylation pattern and engineering of proteolytic resistance. Appl. Environ. Micro. 65:359-366.

Wyss, M., L. Pasamontes, R. Remy, J. Kohler, E. Kusznir, M. Gadiet, F. Muller and A. van Loon. 1998. Comparison of the thermostability properties of three acid phosphatases from molds: *A. fumigatus* phytase, *A. niger* phytase and *A. niger* pH 2.5 acid phosphatase. Appl. Environ. Micro. 64:4446-4451.

Xiong, A., Q. Yao, R. Peng, Z. Zhang, F. Xu, J. Liu, P. Han and J. Chen. 2006. High level expression of a synthetic gene encoding *Peniophora lycii* phytase in methylotrophic yeast *Pichia pastoris*. Appl. Micro. Biotech. 72:1039-1047.

Yin, Q.Q., G.H. Zheng and X.T. Kang. 2007. Biochemical characteristics of phytases from fungi and the transformed microorganism. Anim. Feed Sci. Technol. 132:341-350.