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Effect of pelleting on nutrients for broilers

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The combination of improved genetics and increased feed prices is creating pressure to deliver a higher percentage of pellets to the broiler chicken. Feed producers may respond by pushing harder with mechanical solutions. Such methods of improving pellet quality may include: fine grinding, increasing die thickness, high-temperature conditioning, use of expanders, and even double pelleting. The resulting improvement often leads to better feed efficiency but it is becoming clear that mechanical solutions can also have a negative impact on nutrients.

Fine grinding

For example, broilers fed a medium grind corn (1042 µm) had better performance than those fed finely ground corn (781 µm) (Parsons, 2006). The reason for this is simply that the bird develops a better gizzard when it has something to grind and the gizzard is a critical digestive organ. Improving pellet quality with fine grind may actually hurt nutrition and also add cost by slowing production and increasing energy requirement.

Table 1 - *Effect of Corn Particle Size on 3 - 6 week Broiler Performance*

Corn	Weight,		Nutrient retention, %		TMEn
Particle size	kg	F:G	Nitrogen	Lysine	kcal/kg
Fine - 781 µm	1.568	1.923	4.75	2.62	3546
Small - 950 µm	1.590	1.946	4.29	2.23	3625
Medium - 1042 µm	1.619	1.934	5.29	3.90	3853
Large - 1109 µm	1.566	1.972	5.12	3.48	3689
Coarse - 2242 µm	1.610	2.079	5.72	3.90	3476

Parsons, A.S., et. al., 2006 J. Appl. Poult. Res. 15:245-255.

High-temperature conditioning

Pellet quality usually increases when more steam is added into the conditioning chamber. This is especially true for diets that contain high levels of corn. However, performance has been observed to decline when pellets that were conditioned to >80^{o}C were reground and fed to broilers (Creswell, 2006; Loar, 2013). This was due in part to reduced effectiveness of supplemental enzymes. In wheat rations levels of both natural and supplemental xylanase were observed to decline when conditioning temperature was >80^{o}C (Silversides, 1999).

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Similarly, benefits of supplementing mixed enzymes into a corn/soya diet were lost when conditioning temperature exceeded 80°C (Beaman, 2012).

Table 2 - *Effect of Conditioning for 55 Seconds at Varied Temperature.*

Conditioning	In-feed xylanase, U/g		Intestinal viscosity, cps		Feed:gain	
Temp., °C	Control	+ Xylanase	Control	+ Xylanase	Control	+ Xylanase
70	0.20	1.85	4.12	3.55	1.530	1.497
75	0.20	1.60	5.63	4.06	1.426	1.443
80	0.53	1.35	5.93	4.30	1.496	1.417
85	0.08	0.77	8.58	4.02	1.478	1.404
90	0.09	0.60	9.14	5.96	1.545	1.455
95	0.05	0.44	11.14	4.90	1.474	1.509
Mean:	0.19	1.10	7.42	4.47	1.493	1.454

Silver sides, F.G., 1999 Poultry Sci. 78:1184-1190.

More mechanical energy

Another way to improve pellet quality is simply to input more mechanical energy, either by use of a thicker die, an expander, or double pelleting. All of these techniques increase the electrical energy needed to make a ton of pellets. That cost is easily understood but the nutritional cost is less obvious. Nir (1994) fed mash, normal pellets, and double-pellets to broilers and observed poorer performance with the double pelleted diets. Shipe (2012) tested a variety of pelleting conditions including double-pelleting. When these pellets were reground and fed to broilers the unpelleted mash diet had the most efficient feed conversion (1.94), followed by normal pelleting (2.02), with the double-pelleted diets having the worst feed efficiency (2.12).

Table 3 - *Effect of various process conditions*

Factors:			Responses:		
Through-put, TPH	Die Thick-ness, mm	Mixer fat, %	Power, kWh/T	Durabilty, PDI	Feed per gain
0.8	44.5	0.5	8.8	93.1	2.01
0.8	44.5	3.0	7.0	91.3	2.01
0.8	38.1	0.5	8.3	93.0	2.02
0.8	38.1	3.0	7.5	91.4	2.04
0.5	44.5	0.5	8.8	94.8	1.99
0.5	44.5	3.0	7.1	89.5	2.02
80% Lysine			--	--	2.12
Unprocessed Mash			--	--	1.94
Double Pelleted			24.4	97.7	2.09

Shipe, K.J., et. al., 2013 Poultry Sci. 91(Suppl. 1, Abstr. 132).

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Addition of fat post-pelleting

Shipe's results also show that shifting the addition of fat from the mixer to post-pelleting will improve pellet quality. However, post-pelleting application of fat increases the chances of the diet becoming unmixed if less than perfect pellet quality allows segregation or selective eating. In addition, shifting fat out of the mixer has been shown to reduce the digestibility of some amino acids (Gehring, 2011).

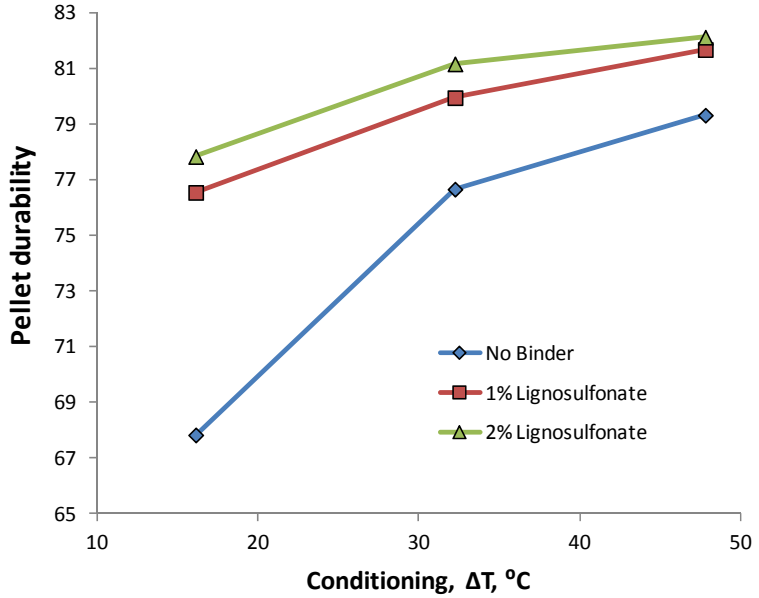
Use of a lignosulfonate pellet binder

When fat is added prior to pelleting its negative impact on pellet quality can be corrected by addition of lignosulfonate (Lemons, 2013). In addition, lignosulfonate often provides extra lubrication (Pfost, 1976; Corey; 2013). Furthermore, lignosulfonate does not require high conditioning temperature to activate its binding capacity (Figure 1). These properties allow pellet quality to be achieved with less stress on nutrients.

Lignosulfonate is a bio-polymer that is completely soluble in water. It often has a sugar component and in fact 'lignin sulfonate' is recognized by AAFCO as source of metabolizable energy (AAFCO, 2013; Morrison, 1962). The ability of lignosulfonate to dissolve readily is critical for its performance as a binder. When it encounters moisture in the conditioned meal it immediately becomes tacky and is able to stick particles together.

Another unique feature of lignosulfonates is that they can act as a soluble fiber and collect in the broiler's ceca. Once there they can be fermented and lower cecal pH, providing a prebiotic effect similar to FOS (Moran, 1992a). In a separate feeding experiment lignosulfonate independently reduced the incidence and concentration of *Salmonella* in the ceca (Moran, 1992b).

Figure 1 – The effect of conditioning and lignosulfonate on pellet quality.



From - Pfost, H.B., Pelleting Research Results, 1976 AFIA Feed Manufacturing Technology, pp. 334.

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Conclusion:

Pellet quality is important for optimized performance of broiler chickens. However, mechanical stress that is applied to achieve pellet durability can be detrimental to nutrients. Lignosulfonate provides a way of improving pellet durability without stressing nutrients. As a water soluble bio-polymer it may also provide positive contributions to broiler nutrition.

Figure 2 – Summary of factors that affect pelleting

	Pellet durability	Process energy	Nutrition
Fine Grind	⇔	↑	↓
High Temp. Conditioning	↑	↓	↓
Double pelleting	↑	↑	↓
Thicker Die	↑	↑	↓
Fat Added to Mixer	↓	↓	↑
Add Ligno-sulfonate	↑	↓	↑

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