Lysine Availability in AminoMax Pro

Chick Trial

Background

Vegetable protein meals are heated during processing to remove antinutritional factors. For example, soybean meal contains protease inhibitors that reduce protein digestibility, lectins that cause lesions in the gut wall and goitrogens that influence the function of thyroxin. Canola meal can contain glucosinolates, which along with the enzyme myrosinase can produce compounds that irritate the gut and other compounds emanating from glucosinolates that can cause lesions in vital organs such as the liver and kidneys. Fortunately, heating during processing effectively reduces the effects of these anti-nutritional factors.

Excessive heating reduces the availability of amino acids, and in particular lysine. During heating, amino acids react with sugars in what is known as the Maillard reaction. However, the extent of damage to amino acids varies from negligible to severe depending on the method of treatment for the meal. Recent research conducted in the laboratory of Dr. Hans Stein (Gonzalez-Vega et al., 2011) demonstrated that time was an important factor: autoclaving for 30 minutes reduced digestibility to a greater extent than autoclaving for 15 minutes. As well, oven drying produced less damage than autoclaving at the same times and temperatures due to less moisture involved.

Heat processing is used to increase Rumen Undigested Protein (RUP). Expelling oilseeds, adding browning reagents and heating and along with a number of other heat treatments have all been imposed to reduce rumen degradation.

As table 1 illustrates, control of the process is critical to maximizing the amount of protein that becomes available to the cow. Heating will increase RUP, but after a point, heating no longer effectively improves the availability of the RUP.

Table 1. Effects of autoclaving duration on the RUP and Intestinally available protein content of cottonseed meal (Broderick and Craig, 1980)

Time, Minutes	Meal RUP,	Intestinally available RUP
	---% of Protein---	
0	21.2	19.2
15	26.1	23.3
30	41.6	26.5
60	69.6	58.0
90	73.2	56.2
120	74.9	53.0

AminoMax Pro is produced by a very rapid heat treatment with reducing sugars to yield Maillard intermediates that increase the RUP value of the meal. Research conducted at Cornell University demonstrated that the protein digestibility of the canola component of the meal was enhanced by this tightly controlled process. There was no change in the digestibility of the soybean meal. As a result, the total protein digestibility in AminoMax Pro increased from 84 to 87 % with processing. The digestibility of the RUP fraction increased from approximately 75% to 84%.

Although the digestibility of the protein increased with treatment, questions remained about the digestibility of the amino acid lysine. The following study was conducted to determine the effects of the patented AminoMax process on the availability of lysine.

Broiler chickens are highly sensitive to amino acid imbalances, and large numbers of chickens can be used in feeding studies to improve the extent of accuracy. For those reasons, this study was conducted at the Penn State Poultry Unit by Dr. R.M. Hulet and student Macie Whitsel. The treatments imposed were as follows:

TREATMENTS:
1. Negative Control (0.90% dietary lysine)
2. As 1 + 0.15% Lysine Sulfate (0.98% dietary lysine)
3. As 1 + 5.0% AminoMax (0.98% dietary lysine)
4. Positive Control (1.02% dietary lysine)

ANIMALS:
Total Number: 1,728 one-day old straight-run broiler chicks
- Number of Pens: 48
- Birds/Pen: 36
- Replications: 12
- Birds/Treatment: 432

The birds were supplied their respective diets for the duration of the 42 day study. Birds were individually weighed at days 1, 18, 28 and 42 of the trial.

Lysine sulfate has been shown to have a lysine bioavailability that is equal to lysine hydrochloride for both poultry (Ahmad et al., 2007) and swine (Smiricky-Tjardes et al., 2004). Lysine in lysine hydrochloride is assumed to be 100% bioavailable.

The results show that the birds with the Negative Control diet (0.90% dietary lysine) weighed numerically less at the end of the trial then birds on all other treatments. Differences in weight gain between the positive control (1.02% lysine) and the lysine sulfate diet (0.98% lysine) clearly illustrate the sensitivity of this assay method.

Body weight gains from 0-18 days of age and from 18-28 days of age were lower for the negative control, than for the positive control. There were statistically no differences (P>0.05) between the AminoMax and the lysine sulfate treatments, although there were small numerical differences favoring the lysine sulfate. This means that AminoMax was on par with lysine sulfate in its ability to support weight gain in the birds.

Table 2. Body Weight (BW) and Body Weight Gain (BWG) Data Per Bird (Kg)

Diet	Initial BW (kg)	BW 18d (kg)	BW 28d (kg)	BW 42d (kg)	BWG 0-18d (kg)	BWG 18-28d (kg)	BWG 28-42d (kg)	BWG Overal l (kg)
0.90% Lysine	0.0411	0.644^{b}	1.492^{c}	2.658	0.602^{b}	0.835^{b}	1.114	2.551
0.98% Lysine (Lysine Sulfate)	0.0412	0.672^{a}	1.543^{ab}	2.714	0.630^{a}	0.850^{ab}	1.122	2.602
0.98% Lysine (AminoMax)	0.0410	0.661^{a}	1.520^{bc}	2.747	0.620^{a}	0.842^{ab}	1.148	2.610
1.02% Lysine	0.0414	0.670^{a}	1.567^{a}	2.747	0.627^{a}	0.881^{a}	1.121	2.629
P-value	0.5759	0.0052	0.0055	0.2064	0.0078	0.0940	0.8471	0.3158

$^{a-b}$ Means within a column with no common superscripts differ significantly ($P \leq 0.05$).

Table 3. Feed Intake (kg/Bird)

Diet	Starter 1-18d	Grower 18-28d	Finisher 28-42d	Overall Mean
0.90% Lysine	0.897	1.385	2.374[c]	4.656[b]
0.98% Lysine (Lysine Sulfate)	0.925	1.421	2.460[bc]	4.806[a]
0.98% Lysine (AminoMax)	0.920	1.406	2.552[ab]	4.878[a]
1.02% Lysine	0.901	1.381	2.580[a]	4.861[a]
P-value	0.0695	0.0667	0.0005	0.0037

[a-c] Means within a column with no common superscripts differ significantly ($P \leq 0.05$).

Table 3 provides feed consumption data for the duration of the feeding trial. There were slight differences in the final feeding period and intakes paralleled the levels of lysine in the diet. There were treatment differences in feed efficiency within feeding periods, but none overall (Table 4).

The P values show the high degree of sensitivity that can be obtained in feeding experiments when there are large numbers of animals per treatment. Throughout, there were no statistical differences between the AminoMax treatment and the Lysine Sulfate treatment. These results would suggest that the availability of lysine in AminoMax is very high. As noted, Lysine Sulfate is assumed to be 100% bioavailable. While it is not likely that the lysine in AminoMax is 100% available, the value is very high, and should be equal to the digestibility of the protein overall. The results show that lysine is not unduly damaged through processing, and like the protein in the meals, may actually be enhanced with treatment.

Table 4. Feed To Gain Ratio

Diet	Starter 1-18d	Grower 18-28d	Finisher 28-42d	Overall Mean
0.90% Lysine	1.490[a]	1.664[a]	2.142[b]	1.827
0.98% Lysine (Lysine Sulfate)	1.468[ab]	1.673[a]	2.199[ab]	1.848
0.98% Lysine (AminoMax)	1.484[a]	1.671[a]	2.233[ab]	1.870
1.02% Lysine	1.437[b]	1.574[b]	2.313[a]	1.850
P-value	0.0095	0.0117	0.0389	0.2463

[a-c] Means within a column with no common superscripts differ significantly ($P \leq 0.05$).

References

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