

## NR 26. ENHANCING PROTEIN UTILIZATION FROM FEATHER MEAL

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### Resumen

#### Aumentando la utilización de la proteína de la harina de plumas

Se evaluó un proceso de presurización y despresurización amoniaco (PDA) para verificar la eficacia en aumentar la solubilidad y digestibilidad de la proteína de la harina de plumas. La harina de plumas se procesó por 5 min con diferentes cargas de amoníaco, humedades y temperaturas. La solubilidad y digestibilidad *in situ* de la proteína se determinaron con la técnica de bolsas de dacrón y el método Kjeldahl. La solubilidad de la proteína de la harina sin tratar fue baja (7 %), y aumentó hasta 23 % (SE = 1.103) en la harina tratada con amoníaco en condiciones óptimas. La digestibilidad ruminal aumentó significativamente ( $P < .05$ ) con la carga de amoníaco, temperatura y humedad de las plumas. La proteína digerida a las 48 h aumentó de 24 % (harina no tratada) hasta 48 % en la tratada. El incremento observado en la solubilidad y digestibilidad ruminal de la proteína mejoraría la disponibilidad de la harina de plumas y aumentaría su valor como fuente proteínica.

**Palabras claves:** Plumaz, proteína, amoníaco, solubilidad, digestibilidad.

**Key words:** Feathers, protein, ammonia, solubility, digestibility.

### Introduction

The poultry industry currently generates a considerable amount of feathers each year. Feathers represent a substantial (5-7 %) fraction of the mature weight of birds, but are a keratinous source of protein low in nutritional value, with an amino acid imbalance, mainly a lysine limitation (Latshaw, 1990). Processing methods such as steam and pressure and strong alkali or acid are currently used in processing feathers with the disadvantage of destroying nutritionally important amino acids and causing a substantial fraction to escape digestion in the whole animal. As a result, other animal proteins such as blood have to be added to enhance the value of this important industry byproduct. Even with this processing, it is priced similar to other feedstuffs, i.e., soybean meal, that have half the protein level. The potential exists to make the protein in feathers more useful to animals, but the treatments investigated to date have been extensive and uneconomical. A novel and relatively inexpensive process was investigated in our laboratories. The Ammonia Pressurization and Depressurization (PDA) process alters fiber and starch and may increase the availability of protein in feather meal. Preliminary results showed that solubility of the protein in 0.1 M NaCl was slightly increased (24 %) with an ammonia treatment (Ferrer *et al.*, 1996). Enhancing solubility of protein should increase its digestibility allowing this protein source a wider range of applications and enhancing its potential as a protein source for both ruminants and non ruminants. The objective of this work was to develop novel ammonia reactor processing conditions to treat feather meal which will extend the use of feather meal protein products for animal feeding.

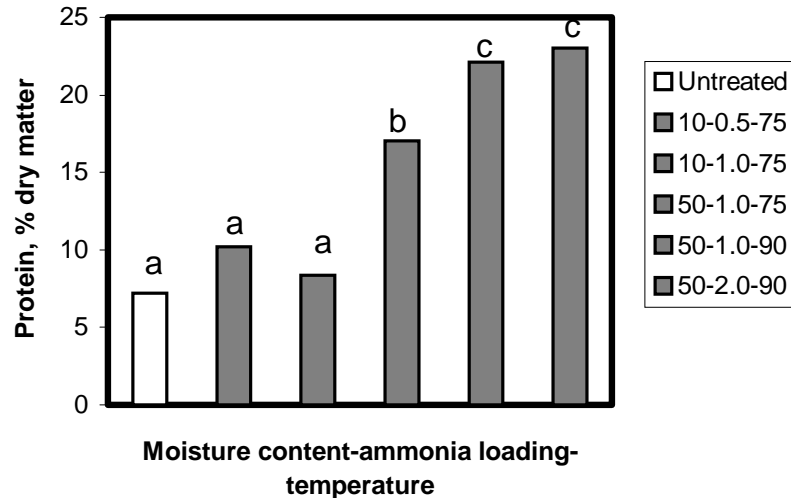
### Materials and methods

A laboratory-scale ammonia reactor unit consisting of a 4-L reactor with appropriate support equipment was used for the treatment of feather meal. A batch hydrolyzed FM obtained from a local processor in Texas was used in these studies. Liquid anhydrous ammonia was added to 60 g-samples and temperature was rapidly elevated to the desired temperature. After desired treatment time, pressure was suddenly released and samples allowed to air-dry overnight. *In situ* ruminal solubility (one minute in the rumen) and digestibility (3, 6, 12, 24 and 48 h in the rumen) were determined by the dacron satchel method (Zinn *et al.*, 1981) using a cannulated steer. Kjeldahl was used for crude protein determination. All assays were carried out in triplicate.

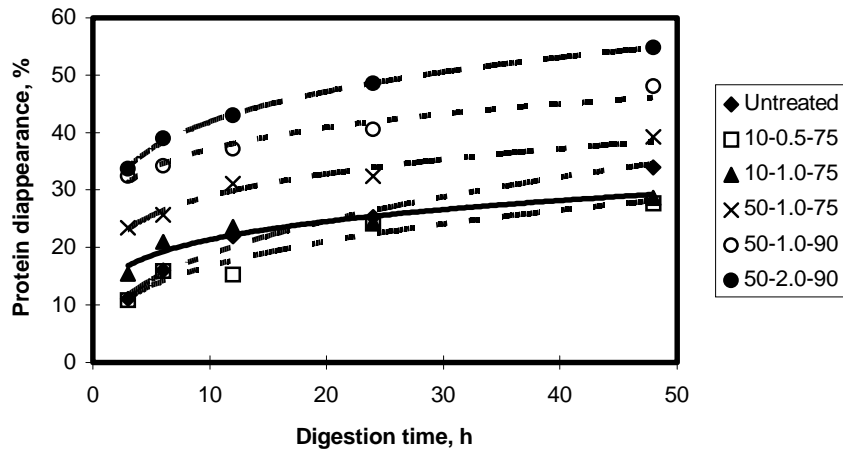
### Results and discussion

Feather meal had 10 % moisture content (w.b.), 88 % crude protein, 1.4 % crude fat and 6.2 % ash. Figure 1 shows that protein solubility greatly increased (7 to 23 %) with PDA for 50% moisture-samples compared to

the control ( $P < .05$ ). There were also significant differences in protein solubility ( $P < .05$ ) with PDA at 75 and 90 °C for the 50 % moisture-samples. Since limited solubility has been inferred as major cause for nutrient limitation of feather meal (Dalev, 1994), PDA processing greatly enhances the potential use of feather meal as a protein source. Figure 1 also shows that if treated feather meal is fed to a ruminant, more than 20 % of the protein will be immediately soluble and thus available to the rumen microorganisms, providing ammonia for microbial function. Limited digestibility has also been noted in feather meal (Crawshaw, 1992). Figure 2 shows that the disappearance of protein was rapid during the first hours, after which it increased at a much lower rate. This is critical since microbes must have a steady supply of ammonia. Digestibility of protein for 10% moisture-samples was not significantly different ( $P > .05$ ) from the control (untreated feather meal). However, protein digestibility greatly increased for PDA-treated 50 % moisture FM. Protein digested at 48 h was increased from 24% (control) to 48 % with selected treatments. Significant effects were also found for temperature and ammonia loading ( $P < .05$ ). These results show that PDA can be used to increase the utility of feather meal protein.



**Figure 1.** *In situ* ruminal protein solubility of untreated and ammonia treated FM at variable moisture content (10 and 50 % w.b.), ammonia loading (0.5, 1.0 and 2.0 g ammonia/g dry FM) and temperature (75 and 90 °C) (SEM = 1.103,  $P < .05$ ).



**Figure 2.** *In situ* ruminal protein disappearance of untreated and ammonia-treated FM at variable moisture content (10 and 50 % w.b.), ammonia loading (0.5, 1.0 and 2.0 g ammonia/g dry FM) and temperature (75 and 90 °C) (SEM = 0.695,  $P < .05$ ).

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