Klinofeed®

An Effective Ammonia Remover

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Theoretically two important considerations can affect the productivity of the monogastric animals over ammonia:

- 1. The influence of ammonia on the microbiological, ecological system in the lumen and the Intestinal wall.
- 2. The effect of ammonia on the metabolism of the nutrients in the liver.







Source of Ammonia in the Digestive Tract

Only 35 to 45% of proteins consumed by the poultry or pigs will be transformed into animal products, (i.e., meat, milk, eggs)

Penz (2000)





Source of Ammonia in the Digestive Tract

- Unabsorbed amino acids in the intestines continue being degraded to produce ammonia gas.
- The epithelial tissue is also a source of protein for producing ammonia.
- Microorganisms in the intestines utilize those unabsorbed nutrients to grow and multiply and produce ammonia gas through metabolism.





Effect of Ammonia on the Intestines

- High ammonia concentration in the Intestines causes faster turnover (more frequent renewal) of the epithelial cells.
- Nutrient absorption is affected by frequent epithelial cell renewal in the Intestines resulting in slower growth rate and reduction of production performance.

Ziggers (2003)





Ammonia in the Intestines

 The reduction of ammonia produced during digestion can support (favour) more healthy intestinal development for more efficient nutrient absorption.

Ziggers (2003)

Klinofeed® in Feed Improves Air Quality in Swine Barn



Av. NH₃ Conc. In Air (ppm) Control 12.3 w. Klinofeed® 8.6

Improvement = 30.08%

Black=Control Yellow=Klinofeed®





Ammonia overloading in liver and kidneys







Ammonia in the plasma

Ammonia is continuously released in the lumen by the Intestinal bacteria and absorbed into the blood as ammonium ions.

Guyton (1996)





The influence of Ammonium lons on the metabolism of nutrients in the liver







Effect of Ammonium Ion on Blood Calcium

- Liver has extra work load to detoxify ammonia in addition to regular metabolism
- Uric acid is produced after ammonium is metabolized
- Calcium-Uric acid complex is formed
- Available calcium in the blood is reduced
- Bone health is adversely affected

Leach, Hendricks et al (1990)





Heulandite-Clinoptilolite can help controlling diseases

The use of Heulandite-Clinoptilolite can work as therapeutic means for controlling diseases.

Mumpton und Fishman (1977)

Milene und Froseth (1982)

Kovac et al (1988)







The Effect of Ammonium Ion on Bone Development in Broilers

- Heulandite decreases the absorption of ammonium ions and reduces uric acid concentration in the blood
- Klinofeed[®] helps broilers in healthy bone development

LEACH RM, HEINRICHS BS et al - Broiler chicks fed low calcium diets. 1. Influence of zeolite on growth rate and parameters of bone metabolism. *Poultry Science*, 1990, 69 (9), 1539-1543.





The influence of Klinofeed[®] on the metabolism of nutrients in the liver









Reduced Ammonia Improves Immunity

- Liver work load lightened without the task of ammonia detoxification.
- Immunity is improved when the liver works normally.
- Klinofeed[®] reduces the level of absorbed ammonia thus improves immunity.

Conversion of Ammonia to Urea Needs Energy



Energy Requirement for Production of Urea from Ammonia

Requirement of 3 moles of ATP for conversion of 1 mole of ammonia to urea:

 $NH_3 + NH_3$ (from Glu-acid)+ $CO_2 + 3ATP$ ---> $(NH_2)_2CO + H_2O + 3 ADP + 3P_i$

Amm + Amm (fr Glu-acid) + carbon dioxide + 3ATP ---> urea + water + 3 ADP + 3P_i

Energy Requirement for Ammonia Removal

- One mole of ATP represents 30.5J (7.3cal)
- To eliminate one mole of ammonia requires 3 moles of ATP, or 91.5J (~22cal)

Klinofeed[®] decreases energy wastage

 Klinofeed reduces the level of absorbed ammonia thus saves wastage of valuable energy for growth and production.