UNDERSTANDING THE MECHANISMS BEHIND

XTRACT™

Code 6965

Effects on the reduction of ruminal ammonia and milk urea nitrogen

Protein is the source of amino acids and nitrogen in feeds. It is needed by livestock for growth and milk production. Protein is also needed by rumen bacteria, which digest much of the feed for ruminant animals like cattle, sheep and goats.

The feed crude protein (CP) can be divided into classes based on how fast it is degraded in the rumen. These classes are termed the soluble, rumen degradable and rumen undegradable protein fractions. Soluble protein (SP or Soluble Intake Protein, SIP) is protein which is rapidly degraded to ammonia in the rumen. Some of this rapidly available protein is needed by the rumen bacteria when their growth rate is high. Rumen degradable protein (RDP or Degradable Intake Protein, DIP) is all the protein that is degraded to ammonia in the rumen and includes the soluble fraction.

For ruminants, urinary urea nitrogen is formed when the products of the microbial degradation of dietary crude protein in the rumen are not incorporated into microbial protein but absorbed, ultimately causing an elevation in blood or milk urea nitrogen. These elevated levels may have detrimental knock-off effects on animal performance and health.

However, ruminant protein nutrition is complicated and high ammonia levels is not simply solved by lowering the dietary crude protein level. Balancing protein, protein fractions and carbohydrates is integral to controlling protein utilisation as well as maintaining animal performance. An intensive technical program has shown the benefits of **XTRACT™** in this regard.

***In vivo* studies validating the benefits of XTRACT™ on slowing deamination and reducing ruminal ammonia**

Previous studies (Busquet *et al.,* 2004) in a dual flow continuous culture system simulating the dairy cow have shown the benefits of cinnamaldehyde from *Cinnamomum spp.* on protein degradation. **XTRACT™**, which contains cinnamaldehyde as one of its two main ingredients was confirmed to exhibit the same mode of action *in vitro.* These results are shown in Table 2.

Table 2. Average effects on the level of small peptides and amino acids nitrogen (a consequence of the inhibition of deamination) and ammonia nitrogen measured over 12 hours in vitro comparing a diet with and without the addition of XTRACT™.

Parameter (mg/100mL)	Negative control	Negative control + XTRACT™	SEM
Small peptides and amino acids nitrogen	17.9a	21.0b	0.89
Ammonia nitrogen	16.5a	13.9b	0.70

a,b: p<0.05
Source: Autonomous University of Barcelona, Spain, 2004.

***In vivo* studies validating the benefits of XTRACT™ on slowing deamination and reducing ruminal ammonia**

Results found *in vitro* are often difficult to reproduce in the animal. Four Holstein dairy cows in early lactation were allocated to two treatment groups (negative control and negative control + **XTRACT™**) in a switchback design experiment over three periods of 4 weeks each. The first three weeks served as an adaptation period, and two samplings from the fourth week were recovered for analysis of peptide, amino acid and ammonia nitrogen which are shown in Table 3.

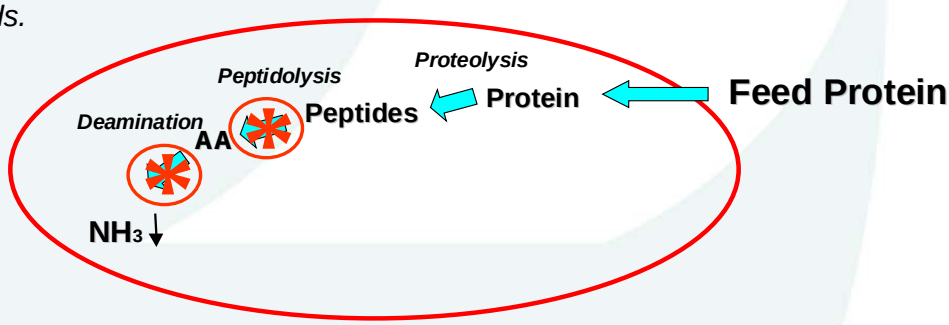
Table 3. Average effects on the level of amino acids nitrogen and ammonia nitrogen measured in switchback design over 100 days with cannulated animals comparing a diet with and without the addition of XTRACT™.

Parameter (mg/100mL)	Negative control	Negative control + XTRACT™	SEM
Amino acid nitrogen	15.4A	18.5B	0.97
Ammonia nitrogen	16.8a	15.0b	0.91

A,B: p<0.10; a,b: p<0.05
Source: Bach *et al*,, 2005.

Conclusions: The results of this trial confirm the effects of **XTRACT™** on reducing ammonia nitrogen by slowing deamination activity (Figure 1). The proposed mechanism is shown schematically in Figure 1.

Figure 1. Schematic diagram of the protein degradation pathway. Steps marked by an asterisk (*) indicate those where XTRACT™ intervenes leading to a reduction of ammonia nitrogen and an increase in available small peptides and amino acids.



The inhibition of peptidolysis and deamination leads to an increased availability of small peptides and amino acids which may be readily used by the microbial populations to produce microbial protein, as illustrated from the in vitro studies shown in Table 2. It has been confirmed that this is through a reduction of *Prevotella spp*. which play a major role in protein degradation (Ferme *et al.,* 2004).

This reduction in ammonia not only has implications on reducing blood and milk urea, but the corresponding accumulation of small peptides and amino acids also has its own benefits on protein and energy metabolism. *Griswold et al (1996)* has shown that small peptides and amino acids are used more efficiently by rumen bacteria for growth and metabolism. Also, they are a source for rumen energy.

Animal trials showing the benefits of XTRACT™ on milk urea nitrogen

The benefits of **XTRACT™** on reducing milk urea nitrogen has been shown repeated in trials around the globe. Two such examples are shown below in Figure 3 and Table 4. Figure 3 shows the effects with and without **XTRACT™** in a grass diet using a switchback (off-on-off-on) design while Table 4 shows results over a continuous 100-day period. **XTRACT™** dramatically reduced the incidence of milk urea nitrogen over short and long term when included in the diet.

Figure 3. Off-on-off switchback design using 32 Red Simmentaler cows fed a protein concentrate and forage-based diet with or without the supplementation of XTRACT™. Diets were fed over the first three weeks and morning and afternoon samples were taken on two identical days in the fourth week for milk urea nitrogen.

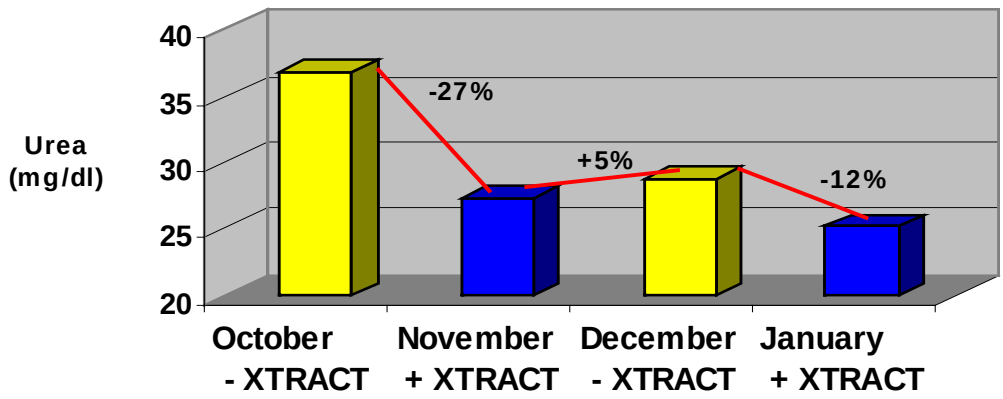


Table 4. Head-to-head trial design using 32 Holstein-Freisan cows fed a protein concentrate and forage-based diet with or without the supplementation of XTRACT™ over the first 14 weeks of lactation. Diets were fed over the first three weeks and morning and afternoon samples were taken on two identical days in the fourth week for milk urea nitrogen.

Parameter (mg/100mL)	Negative control	Negative control + XTRACT™	SEM
Milk urea nitrogen	30.7a	25.7b	0.92

a,b: $p<0.05$
Source: Private farm, Switzerland, 2004.

References are available upon request.

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