

Novimet® Rumen By-Pass Methionine

Targeted-Release Methionine for use in Ruminant Nutrition

Background

The need for alternative sources of rumen by-pass methionine became most apparent in 2013-2014 - severe supply shortages and drastic price increases created opportunities for dairy consultants to independently test and source alternatives.

Innovad has a long history and experience in by-pass technologies. Different techniques are utilized depending on the active ingredient, the species and target release site. **Innovad** lead Europe in the development of products designed to release butyric at different points along the gastro-intestinal tract of monogastrics, helping to maintain gut health and reduce the use of antibiotics in these livestock sectors.

Novimet® - Product Summary

Building on this experience, Innovad have been able to develop **Novimet®**, a micro-encapsulated form of DL-Methionine. Initial screening tests used different concentration combinations of the amino acid and a fat matrix (a degummed and refined mixture of palmitic, stearic, myristic and lauric acids) to define the optimum, economical ratio for the delivery of digestible methionine into the intestines of the ruminant.

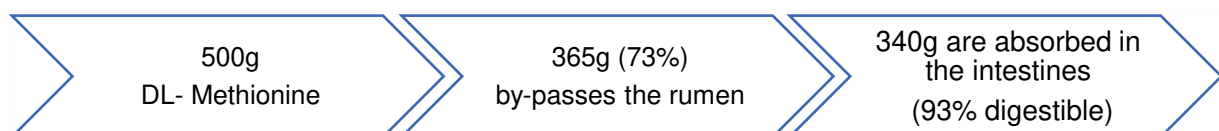


Novimet® is produced using spray-chilling micro-encapsulation. This process is designed to allow a fat matrix to form a protective shell around of DL-Methionine to produce very small particles that are 0.3 – 2.0mm in diameter that have good dispersion characteristics.

Novimet® contains 50% DL-Methionine. The results obtained from various research institutes have been reviewed by independent dairy nutritionists Dr Essi Evans & Charlie Sniffen to review the Cornell findings, Dairyland labs results and consideration of the feedback from consultants now using Novimet.

On average 73% of this DL-methionine by-passes degradation in the rumen, and that the digestibility of the by-pass methionine in the small intestine is 93%.

1 kg of Novimet provides:



Stability of Novimet® in Aqueous Solution and Feed

A. Aqueous Solution

To ensure consistent stability and protection, in-house tests are run on batches of Novimet® as part of the quality control protocols. Novimet® is added to five replicates of water at 40°C. The contents are agitated and incubated for periods of 6, 12, 24 and 48 hours. At each time point a replicate is filtered and the residue tested. This allows the calculation of methionine release (Novimet® degradation).

Table 1 below gives an example of three tests, and shows a 10% mean degradation of . Novimet® over 48 hours in aqueous solution.

Table 1: Novimet® Degradation in Aqueous Solution (%)

Time (hours)	Novimet 2123924-03	Novimet 2124509-04	Novimet 2131724-08
0	0	0	0
6	3.6	2.9	0.8
12	4.6	4.9	2.4
24	5.4	6.3	4.8
48	7.6	11.3	10.8
Mean Degradation at 48hrs	9.9%		

B. Temperature and Steam

It is important that Novimet® remains stable under typical manufacturing conditions i.e. the use of steam in conditioning, and the pressure and temperature of pelleting.

A dairy feed supplement containing Novimet® was analyzed for Rumen Undegraded protein (RUP) fraction and with no steam and in a meal form, the RUP%CP was 42.20%.

The effect of steam and pelleting on RUP and the stability of Novimet® was then examined. Since the analytical variation of the laboratory was 2.5%, it can be concluded that the non-degradable protein fraction which by-passes the rumen remained unchanged. Novimet® was therefore unchanged by the steam and pelleting pressures used in this trial (Figure 1).

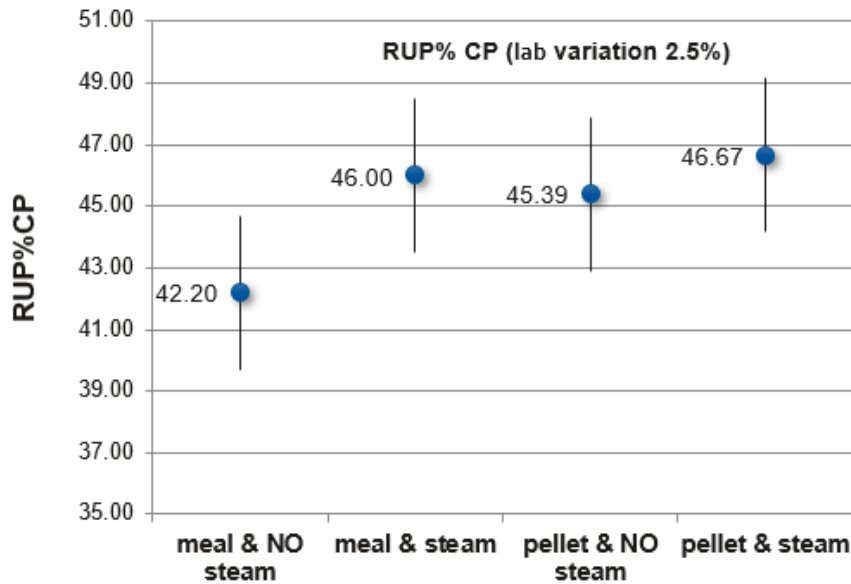


Figure 1: The effect of steam and pelleting on the RUP%CP when dairy diets are supplemented with **Novimet®**

Rumen By-Pass

The ability of **Novimet®** to withstand degradation by the rumen microflora was tested at the University of Padova in Italy in 2012. The trials measured the *in vitro* disappearance of three different sources of methionine – Novimet®, Smartamine® and DL-Methionine. The products were incubated in rumen fluid for up to 48 hours. A total of six replicates were set up to allow a time course for the disappearance of dry matter and nitrogen to be established. Samples were removed after 0, 2, 6, 12, 24, 48 hours. The results are shown in Figures 1 and 2 below.

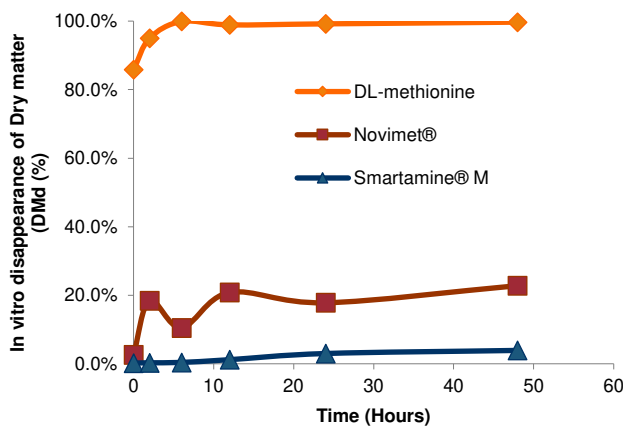


Figure 2: *In vitro* disappearance of dry matter (DMd%)

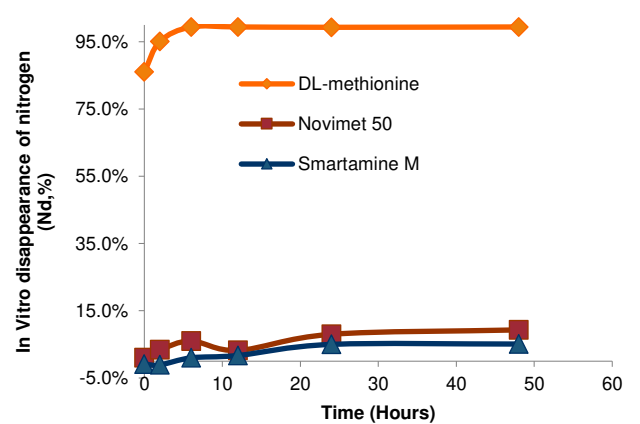


Figure 3: *In vitro* disappearance of nitrogen (Nd%)

Table 2: In vitro disappearance of dry matter and nitrogen from different sources of methionine

	DL-Methionine	Smartamine®	Novimet®
Rumen disappearance of DM (%)	98.3	1.9	5.1
Rumen disappearance of Nitrogen (%)	98.2	1.2	16.9

These results confirm that DL-methionine is degraded rapidly in artificial rumen, but both Smartamine®M & Novimet® remain stable in an artificial rumen and indicate a by-pass of >80%

The most recent study was conducted in 2017 at ILVO in Belgium. Fistulated animals and the nylon bag technique were used to determine rumen degradability, and intestinal digestibility using the same animal to eliminate between animal variation

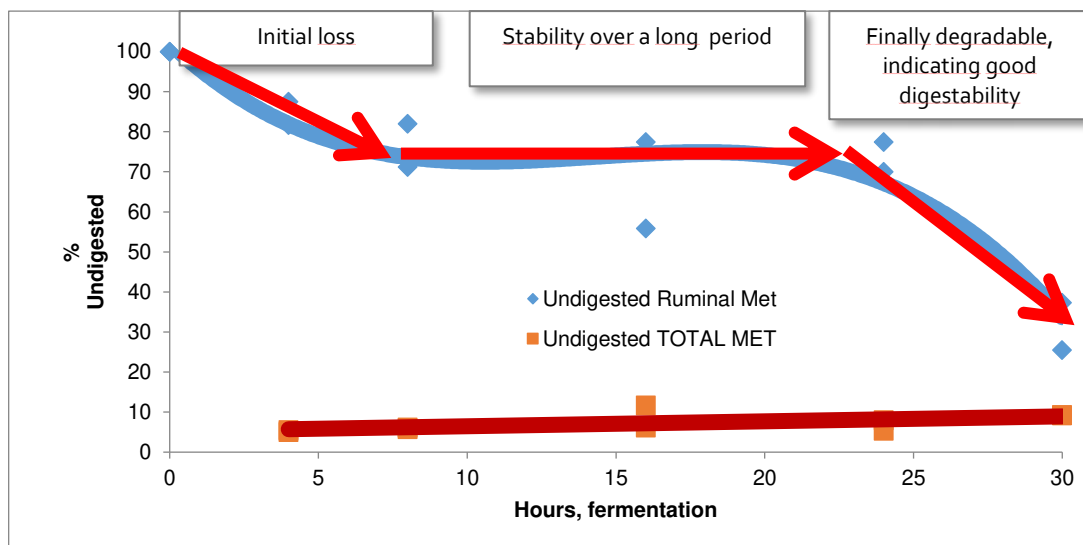
Digestible Methionine was calculated using the following formula:

$$MetDi = RUP - undCP$$

Where RUP = crude protein remaining after ruminal incubation and undCP: crude protein remaining in manure

The results of the nylon bag digestibility trial indicate a strong ability of Novimet to resist rumen degradation, and hence rumen by-pass. Intestinal digestibility was very good at 70%, and the digestible methionine content of Novimet® was estimated to be 322g/kg

Trial work was also been conducted at Dairyland Laboratories, Cornell University using an *in situ* rumen fermentation, followed by the *in vitro* intestinal digestibility assay for ruminant feeds. A Novimet® degradability time line is shown below in Figure 4:


Figure 4 : Cornell Degradability Profile for Novimet®

A further trial with a research institute designed to look at the rumen stability of Novimet under different feeding regimes and hence rumen conditions.

Cows fitted with rumen cannulae were offered diets with differing forage to concentrate ratios, and in situ degradability was calculated for low, medium and high producing dairy cows:

Table 3: In situ degradability of Novimet in cows offered diets varying in forage:concentrate ratio

Forage to Concentrate Ratio	Dry Matter Intake (kg/day)	Kp Rate of passage of solids from rumen (% hour)	Rumen Degradability (%)	Rumen Undegradability (%)
63:35	12	5	23.9	76.1
	20	8	20.8	79.2
	26	10	19.1	80.9
50:50	12	5	24.2	75.8
	20	8	21.4	78.6
	26	10	19.9	80.1
35:65	12	5	24.9	75.1
	20	8	21.8	78.2
	26	10	20.2	79.8

The mean rumen degradability was 21.8% giving a rumen by-pass rate of **76.2%**. Forage to concentrate ratio had very little effect (SD 0.4%) on the by-pass, and at higher feed intakes and hence outflow rates the degradability was found to be slightly lower (SD 1.9%).

Table 4: Summary of Rumen Degradability Data

Novimet®	%	ILVO, 2017	%	Cornell, 2014	%	Institute Trial
		Methionine g/kg Novimet®		Methionine g/kg Novimet®		Methionine g/kg Novimet®
		500		500		500
Rumen degradation (%)	8.4	42	24.6	123	21.8	109
Rumen Protection (%)	91.6	458	75.4	377	78.2	391
Intestinal digestibility (%)	70.2	322	93.1	351	-	-
Indigestible (%)	27.3	136	5.2	26	-	-

Summarising the results of the four trials, the by-pass methionine delivered by 1kg of Novimet® is

Trial	Method	By-Pass Methionine (g)	Mean By-Pass Methionine
University of Poldova, 2012	<i>In vitro</i>	416	411 (83%)
Dairyland Labs, Cornell University, 2014	<i>In vitro</i>	377	
Institute	<i>In vivo</i>	391	
ILVO, Belgium 2017	<i>In vivo</i>	458	

Intestinal Bio-Availability

Combining the data from Cornell (2014) and ILVO (2017) the bio-availability of the methionine delivered to the intestines is estimated to be 337g/kg **Novimet®**

Trial	Method	Bio-availability of methionine (%)	Methionine (g) delivered to small intestine
Dairyland Labs, Cornell University, 2014	<i>In vitro</i>	93.1	322
ILVO, Belgium 2017	<i>In vivo</i>	70.2	351
Mean		82	337

Cornell Formulation Data

Cornell University assigned the data shown below to **Novimet®** for use when formulating dairy diets:

Nutrient	% Crude Protein
Soluble Protein A	4.7
Slowly Degradable Protein B	60.8
Undegradable Protein C	34.5
RUP	76.3
RDP	23.7
Total Tract Undigestible Protein	6.7
dRUP = mMet/MetDi	69.6

HRS February 2021