## Discussion and conclusion

In agreement with numerous authors, the urinary losses are largely explained by the level of N intake. This work points out the specific positive influence of the DPDI, which constitutes an index of excess of degradable N (positive values) or of a dominant recycling of N (negative values). This means that the excess of fermentescible N over energy which first increases the plasma urea (Brun-Bellut et al., 1987) is then partly voided through the urine (43 % of N intake in this study). The regression equation also shows the influence of the level of carbohydrates which are not correlated together and act roughly in the same extent.

The N fecal losses are better explained by the N and SC intakes than by the classical approach from DMI, or fecal dry matter (NRC, 1985) or the association of intakes of N, DOM and FOM (Jarrige et al., 1978). The specific influence of DPDI may be explained by the fact that the amount of N leaving the rumen is determined mainly by the diet N input and the relative importance of absorbed $N\text{-}NH_3$ and recycled urea in the rumen (Leng and Nolan, 1984). The positive influence of SC is likely related to their partial utilisation as substrates of fermentation in the distal part of the digestive tract (Ulyatt et al., 1975). If we consider that metabolic fecal N (MFN) is related to undigestible SC and lignin, we obtain for MFN a value of 0.094 g/kg MW, smaller than 0.15 g/kg MW proposed by Brun-Bellut et al.(1987).

The DPDI coefficients are opposite (0.00592 vs -0.00460) in the best equations explaining urinary or fecal N losses. Moreover, it has no significant influence on the cumulated N losses through urine and feces. That means that one way of excretion is balanced by the other. For the SC, the compensation is not total, and lignin intake increases both N urinary and fecal excretions.

This work emphasizes the interest of taking into account the respective influence of diet characteristics in supplement of N intake or dry matter intake to explain and predict the urinary and fecal nitrogen losses for a high-producing ruminant.

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# VALIDATION OF A MODEL OF UREA METABOLISM CONNECTED WITH THE PDI SYSTEM

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## Summary

A simple mechanistic model of ammonia and urea metabolism was developped to be compatible with the ruminant PDI system. This model allows to noticeabily predict urea recycling ammonia absorption and urinary losses of a given diet . Model validation was performed through various experimental conditions (animal species, diets...).

## Introduction

The new protein unit system have permitted a significant progress in applied ruminant nutrition. However some important aspects such as N-urea recycling into the reticulo-rumen or N-urinary losses are not yet satisfactory taken into account. It seemed consequently worthwhile to consider the numerous experimental data published on ruminant ammonia and, urea metabolism to model it in connexion with the PDI system (VERITE et PEYRAUD 1989).

## Material and methods

The model includes five state variates (figure 1) : two N-$NH_3$ pools (one for the reticulo-rumen NHRU, and another for the body metabolic space, NH) and, three urea pools, (one for the reticulo-rumen URRU,and two, for body metabolic pools, $UR_1$ and $UR_2$, as it was demonstrated by urea challenges (BAS et al 1988). In an aim simplification it was assumed that N-urea entering the hindgut is reabsorbed as N-$NH_3$ and constituted thus only a reciprocal N flow from body urea to body $NH_3$ pool. The connexion with the PDI system is mainly realised at the level of the ruminal N-$NH_3$ pool : the calculated dietary degraded N enters this pool, while its outflows are N-$NH_3$ ruminal absorption and N-$NH_3$ microbial utilisation as calculated from the flow of fermentescible organic matter (figure 1). This last parameter can be reduced by low values of NHRU.

The model is described by a set of five differential equations which are numerically integrated with the method of RUNGE-KUTTA (4th order). The dry matter intake can be considered as a constant value, or variable according to a meal describing fonction, or another differential equation, to explore short term variations of urea metabolism.

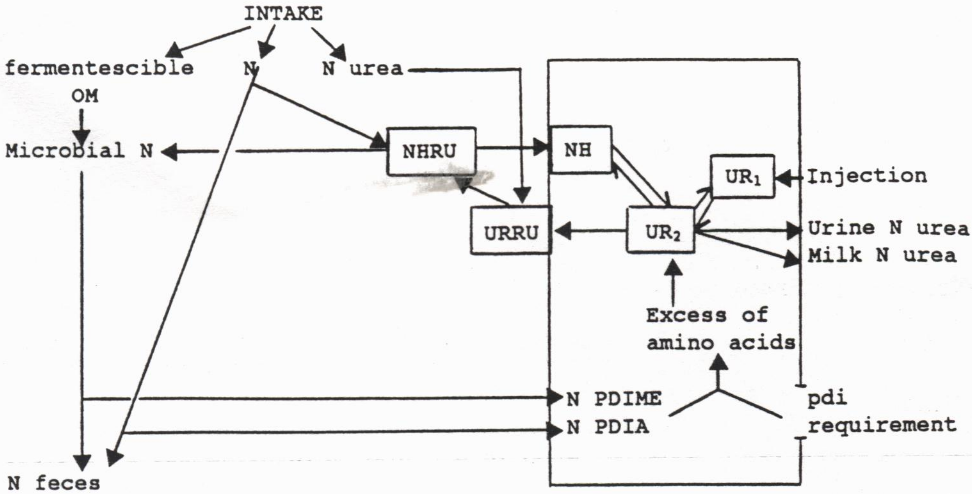


Fig 1. Diagram of ammonia-urea metabolism system
(see text for abbreviations)

## Model validation

The model was validated through various sets of experimental data :

- data concerning the influence of variations of levels of N intake on urea metabolism parameters with sheep (Mc INTYRE, 1970 ; SCOTT and MASON, 1970), goat (IDE et al 1975) and dairy cow (JARRIGE et al 1978)

- data of more sophisticated models of N metabolism of sheep (NOLAN and LENG 1972) and dairy cow (DANFAER 1990)

- data base adjustments of urea pool, urea entry and degradation rates digestive renal clearance variations gathered by HARMEYER and MARTENS (1980)

- data of relationship between of N urinary excretion and plasma or milk urea contents in dairy goats (GIGER et al 1986) and cows (REMOND et al.)

- data of plasma N urea content after urea challenges performed to predict body water space (BAS et al 1988).

The data of these validations were rather satisfactory and, although all the known nutritional situations (fasting...) were not systematically tested, this model constitutes a useful subroutine which can be quickly adapted to any of the new protein unit systems to obtain the most probable values of N flows, particularly urea recycling, and nitrogen urinary losses.

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