THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER EIGHT

# PROTEIN METABOLISM OF WILD RUMINANTS

by

Aaron N. Moen

Professor of Wildlife Ecology

Department of Natural Resources

College of Agriculture and Life Sciences

Cornell University

Ithaca, N.Y. 14853

and

Certified Wildlife Biologist

(The Wildlife Society)

Published by

CornerBrook Press
Box 106
Lansing, N.Y. 14882

Library of Congress Catalog Card Number 80-70984

CONTENTS OF CHAPTER EIGHT

PROTEIN METABOLISM OF WILD RUMINANTS

# CHAPTER 8. PROTEIN METABOLISM

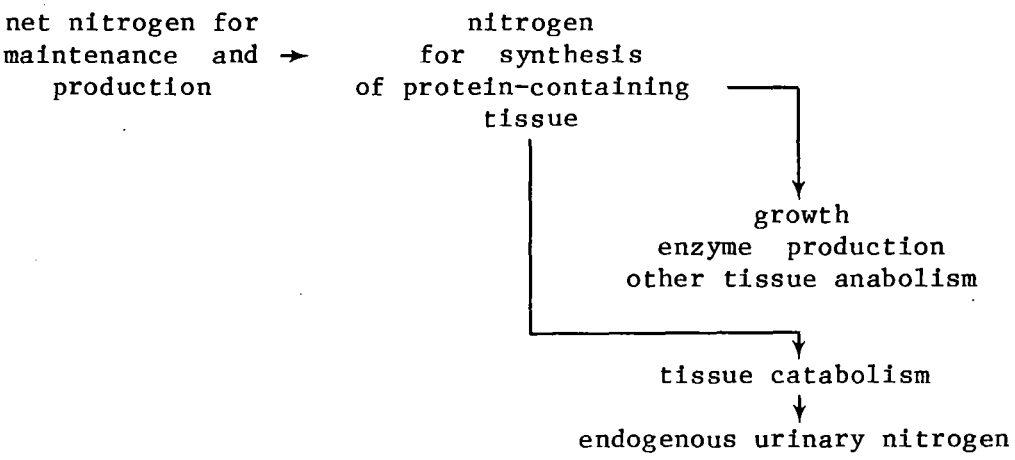
Protein metabolism involves the breakdown of the protein in food ingested into amino acids to be synthesized into new proteins that become part of different animal tissues. Muscle tissue is the main protein depot in the body as it is primarily protein and water.

The pathways and terms used to describe protein metabolism from ingestion to net use are listed below. The word nitrogen is used rather than protein because nitrogenous compounds are used by ruminants to synthesize protein-containing tissue.

Total nitrogen intake − fecal nitrogen = apparent digestible nitrogen

apparent digestible nitrogen − metabolic fecal nitrogen = true digestible nitrogen

true digestible nitrogen − urinary nitrogen = net nitrogen for maintenance and production




The fundamental unit or building block of a protein molecule is the amino acid. Amino acids contain amino groups ($-NH_2$) and carboxyl groups (-COOH) which link together to form peptides. Many amino acids linked together form a polypeptide, and very long polypeptides are proteins.

The breakdown of or hydrolosis of natural proteins has yielded 26 different amino acids (McCauley 1971:190). Many of these are present in animal tissue, and can be produced by the process of transamination, or the interconversion from one to another. Some cannot be produced from other amino acids, so they must be present in the diet. These are called essential amino acids.

Amino acids not synthesized into protein are deaminated in the kidneys and liver and ammonia is produced (Pantelouris 1967). Ruminants convert ammonia to urea, which may then be used by rumen microflora in their own protein metabolism.

The ruminant animal has an advantage over the monogastric animal when meeting its protein needs because the intestinal microflora synthesize proteins which are, in turn, available to the ruminant host. Thus the ruminant does not need to have all of the essential amino acids supplied directly in the diet because the microflora synthesize these for the host. The total protein in the diet must be adequate in order to provide the necessary nourishment for the microflora (Crampton and Harris 1969:171). Ruminants also have a metabolic adaptation for the conservation of protein resources. The recycling of urea is a nitrogen conservation adaptation when protein intake goes down. This is characteristic of winter range conditions when many species of wild ruminants are on browse or highly lignified diets.

This chapter deals with the applied aspects rather than the biochemical aspects of protein metabolism. The TOPICS that follow include material on the factors affecting protein metabolism (TOPIC 1), measurements of protein metabolism (TOPIC 2), and estimates of protein costs for production (TOPIC 3). The equations presented will be used when evaluating range and diet characterics in PART IV.

## LITERATURE CITED

Crampton, E. W. and L. E. Harris. 1969. Applied animal nutrition. W. H. Freeman and Co., San Francisco. 753 pp.

McCauley, W. J. 1971. Vertebrate physiology. W. B. Saunders Company, Philadelphia. 422 pp.

Pantelouris, E. M. 1967. Introduction to animal physiology and physiological genetics. Pengamon Press, Oxford. 497 pp.

REFERENCES, CHAPTER 8

PROTEIN METABOLISM

BOOKS

| TYPE | PUBL | CITY | PGES | ANIM | KEY WORDS---------- | AUTHORS/EDITORS-- | YEAR |
|---|---|---|---|---|---|---|---|
| edbo | butt | loen | 297 | rumi | dig phys & nutr, proc symp | lewis,d ed | 1961 |
| aubo | cfmo | code | 154 | rumi | gastro-intestinl prot loss | nielsen,k | 1966 |
| aubo | dcch | coor | 400 | rumi | dig physiol & nutri, vol 1 | church,dc | 1969 |
| aubo | dcch | coor | 400 | rumi | dig physiol & nutri, vol 2 | church,dc; smith/ | 1971 |

| TYPE | PUBL | CITY | PGES | ANIM | KEY WORDS---------- | AUTHORS/EDITORS-- | YEAR |
|---|---|---|---|---|---|---|---|
| aubo | clpr | oxen | 272 | | metab of prot, mammal body | bach,sj | 1952 |
| edbo | rupr | nbnj | 80 | | prot met, hormones & grwth | bur biol research | 1953 |
| aubo | meth | loen | 198 | | protein metabolism | fisher,rb | 1954 |
| aubo | ccth | spil | 68 | | dynan equili body proteins | whipple,gh | 1956 |
| edbo | rupr | nbnj | 119 | | serology, biochem, protein | cole,wh,ed | 1958 |
| edbo | blsp | oxen | 402 | | role of g-i trct, prot met | munro,hn,ed | 1964 |
| edbo | acpr | nyny | 566 | | mammal protein meta, vol 1 | munro,hn,ed; alli | 1964 |
| edbo | acpr | nyny | 642 | | mammal protein meta, vol 2 | munro,hn,ed; alli | 1964 |
| edbo | acpr | nyny | ... | | mammal protein meta, vol 3 | munro,hn,ed | 1964 |
| edbo | acpr | nyny | 763 | | mammal protein meta, vol 4 | munro,hn,ed; alli | 1970 |
| aubo | hein | loen | 82 | | protein: basis of all life | mcdonagh,jer | 1966 |
| edbo | rupr | nbnj | 303 | | protn met & biol functions | bianchi,cp,ed; hi | 1970 |
| edbo | acpr | nyny | 560 | | plasma protn metab; regula | rothschild,ma,ed/ | 1970 |
| edbo | butt | loen | 515 | | prot met & nutr, proc symp | cole,dja,ed | 1974 |
| edbo | else | nyny | 398 | | biochem evol & orig of lif | schoffenfiels,e,e | 1977 |
| aubo | nhpc | nyyn | 804 | | prot trnovr in mamm body & | waterlow,jc; gar/ | 1978 |
| edbo | base | nyny | 260 | | N, elctroly, wat, ener met | rechcigl,m,jr,ed | 1979 |