Ruminal degradation of protein commences extracellularly and results in the production of small peptides. The peptides are absorbed into the bacteria where they are broken down to amino acids. Some of the amino acids are utilized for synthesis of microbial proteins by the bacteria themselves, or by other bacteria, or by protozoa. However, most of the amino acids are deaminated, resulting in formation of ammonia and VFA (Fig. 15.27). The bacteria then use the ammonia and VFA to manufacture endogenous proteins as they grow. The microbial metabolism of straight-chain amino acids leads to formation of acetate, propionate, and butyrate, degradation of branched-chain amino acids results in formation of branched-chain VFA. The branched-chain VFA are used to synthesize the amino acids from which they originated, and are important growth factors for some species of rumen bacteria.

The rapid multiplication of rumen bacteria means that they are dependent on rapid protein synthesis. Cellulolytic bacteria and some of the amylolytic bacteria use ammonia as their main nitrogen source, but other types of rumen bacteria require pre-formed amino acids. Usually, 50-70 % of the nitrogen content in the ruminal microorganisms is derived from ammonia. Non-protein nitrogen (NPN) in feed and in additives, such as urea, also contributes to the rumen NH_4^+ pool (see below).

Dietary proteins are degraded to small peptides outside the microorganisms

A major portion of amino acids produced by degradation of dietary protein is metabolized to ammonia and VFA

Non-protein nitrogen (NPN). Nitrogen from amides, amines, peptides, free amino acids, N-containing building blocks in nucleic acids, urea, nitrates, and ammonium ions are collectively known as *non-protein nitrogen, NPN*. A unique quality of ruminants is that they, in contrast to simple-stomached animals, can utilize NPN for protein synthesis, since the rumen microorganisms convert NPN-compounds to ammonia, and subsequently to amino acids and proteins. NPN-compounds are essential for maintenance of bacterial growth, fermentation, and, conse-

Some rumen bacteria require pre-formed amino acids to synthesize proteins, while others use ammonia as nitrogen source

Non-protein nitrogen (NPN) can be used for protein synthesis by rumen bacteria

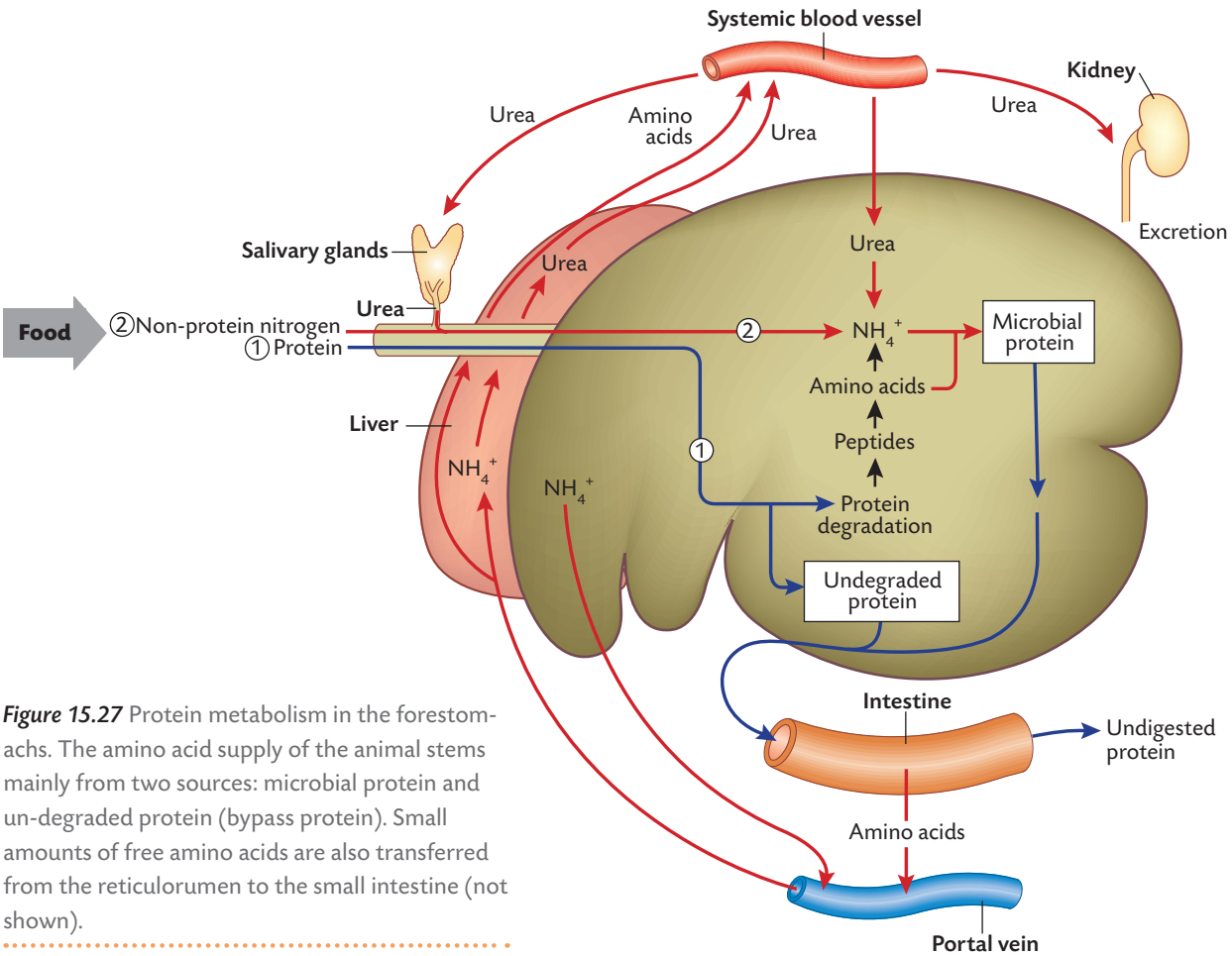

Figure 15.27 Protein metabolism in the forestomachs. The amino acid supply of the animal stems mainly from two sources: microbial protein and un-degraded protein (bypass protein). Small amounts of free amino acids are also transferred from the reticulorumen to the small intestine (not shown).