



## West Central News

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# Figuring Out the Digestibility of Bypass Proteins

**C**areful heating of soy proteins causes a reversible chemical reaction between reducing sugars and free amino groups of soy proteins rendering them resistant to bacterial attack. Continued heating can accelerate this reaction and will further increase the amount of protein that escapes rumen degradation – but it also starts to cause irreversible reactions between the sugars and amino groups. These reactions render the protein indigestible and useless to the rumen bacteria and the cow.

Most methods to determine digestibility of the rumen undegradable protein (RUP) start by placing a ground sample of the protein source in a nylon mesh bag. This goes in the rumen of a cow, typically for 16 hours. After washing to remove bacteria, the protein remaining in the bag is considered RUP. The classic means of determining digestibility of the RUP involves placing the contents of the bag into the crop of precision fed cecectomized roosters. Total excreta are recovered to determine digestibility. Alternatively, the nylon bag can be incubated in a pepsin-HCl solution (to simulate passage thru the abomasum). The bag is then placed into the duodenum of a cow via a cannula and recovered from the feces. The protein remaining in the bag is considered “indigestible RUP”. The above techniques are long, laborious and plagued by lab to lab variability. Literature values for SoyPLUS® RUP digestibility by in vivo and in situ techniques range from 76% to 98.4%. The three-step procedure of Calsamiglia and Stern (1995) involves incubation of the pepsin-HCl residue with the intestinal enzyme pancreatin. Protein that is not digested after this treatment is considered indigestible. This test is less laborious and more repeatable than in situ techniques. While it predicts protein digestibility fairly well, it does not determine digestibility of individual amino acids. Using the three-step procedure, literature values for SoyPLUS RUP digestibility range from 76% to 99%, with lab to lab variation accounting for much of the variability. The 2001 NRC uses 93% as the average RUP digestibility

for expeller soy – based largely on review of the SoyPLUS literature.

Soy proteins are highly valued in animal nutrition because they are rich in lysine. Unfortunately, the exposed amino group of lysine makes this amino acid among the most likely to form bonds with the reducing sugars. Heating the protein to increase bypass is most likely to affect digestible lysine content when done incorrectly. One can measure lysine in the residue protein following in situ intestinal digestion of the RUP. Using this method, Borucki et al. (2007) determined 98% of lysine in SoyPLUS RUP was digested. Boucher et al (2007) have been looking at in vivo and in vitro methods to determine how digestible the lysine is that is found in the RUP. Rooster growth assays suggest SoyPLUS RUP lysine is 87% digestible (solvent extracted soymeal was 90% digestible). Lysine that is digestible has a free epsilon amino group which is capable of reacting with O-methylisourea to form homoarginine. Measuring homoarginine produced by this reaction within the RUP is indicative of the digestibility of the lysine in the RUP. Boucher et al. found SoyPLUS RUP lysine digestibility was 76% in a chick growth assay, 79% based on homoarginine formation. Using an immobilized digestive enzyme assay SoyPLUS RUP lysine was 87.4% digestible.

Bottom line: just as with RUP determination, the method used and the lab performing the assay to evaluate intestinal digestibility of a bypass protein source has a tremendous effect on the value obtained. When you want to compare RUP and digestibility of various protein sources, make sure the RUP and digestibility assays used were the same in each product. SoyPLUS may not be the highest bypass soy protein or the most digestible RUP on the market, but we do think we have a consistent product you can rely on to perform as intended every time.

Calsamiglia & Stern. *J Anim Sci.* 1995 May;73(5):1459-65.

Borucki Castro, et al; *J Dairy Sci.* 2007 Feb;90(2):810-22.

Boucher, et al., 2007 *J Dairy Sci* suppl 1: 682. Abstract

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