Improving the Determination of Fiber Digestion Kinetics In Situ

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Introduction

The in situ (meaning "in original place" in Latin) technique provides a way to conduct nutrition experiments in the actual location of digestion. In the case of ruminants, a cannulated animal allows feed samples to be placed directly in the rumen to get the most accurate digestion kinetics and data. The feed samples are sealed within nylon bags that have tiny pores small enough to keep the feedstuff in, while still allowing the vast population of ruminal bacteria and protozoa in.

The standard technique for in situ research includes soaking/rinsing the bags in water to remove the soluble fraction of the feed to avoid it affecting the calculation of the insoluble portion.

However, fibrous parts of plant cells (lignin, hemicellulose, cellulose) can *only* be broken down into volatile fatty acids by microbes in the rumen.

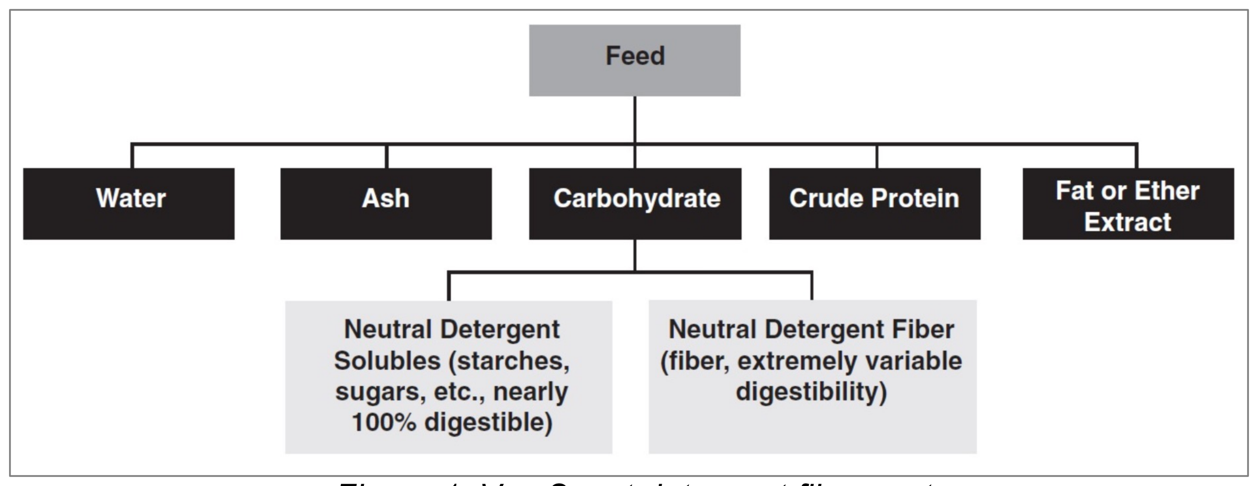

Figure 1. Van Soest detergent fiber system

Therefore, in theory, there should be no fiber loss in water at T_0, not requiring a rinse or soaking prior to entering the rumen for in situ fiber digestion experiments.

Materials and Methods

Three different washing protocols were compared in a 10-day in situ fiber digestion experiment.

Duplicate in situ bags (Ankom F57 fiber filter bags) per time point (0, 2, 4, 6, 12, 24, 48, 96, 240 hr) were weighed and filled with 0.25g of ground feedstuff for each washing protocol (protocol A, B, C). A duplicate blank bag containing no feed was also included for each time point and protocol. The preparation was repeated with four different forages (alfalfa hay, corn silage, grass hay, rye).

Protocol A bags were rinsed in a bucket of warm water for 30 seconds prior to entering the rumen. Protocol B bags were put directly into the rumen. Only the T_0 bags were rinsed in water for Protocol C, while the rest went directly in the rumen.

Retrieval of the T_4 in situ bags

A cannulated Holstein dairy cow housed at the Kentland Dairy Science Complex in Blacksburg, VA was used. At the time of the experiment, she was approximately 7 years old, 1760 lbs, and producing 62 pounds of milk per day at 665 DIM (days in milk).

At each time point the bags retrieved were washed three times for five minute cycles in a portable washing machine to rinse remaining ruminal fluid and halt microbial degradation. They were then dried for at least 24 hours in an oven at 55-60°C and weighed.

Next, the samples were processed in a fiber analyzer (Ankom 200) with neutral detergent solution and soaked in acetone to leave only the undigested neutral detergent fiber (NDF) behind. After a final round of oven drying at 100°C, final weights were taken.

Results

The NDF digestibility values were found using known initial NDF proportions of the different feed types and the data obtained in the experiment in the formula below.

$$NDFD = 100 - \frac{fNDF}{iNDF}$$

Equation 1. NDF digestibility formula

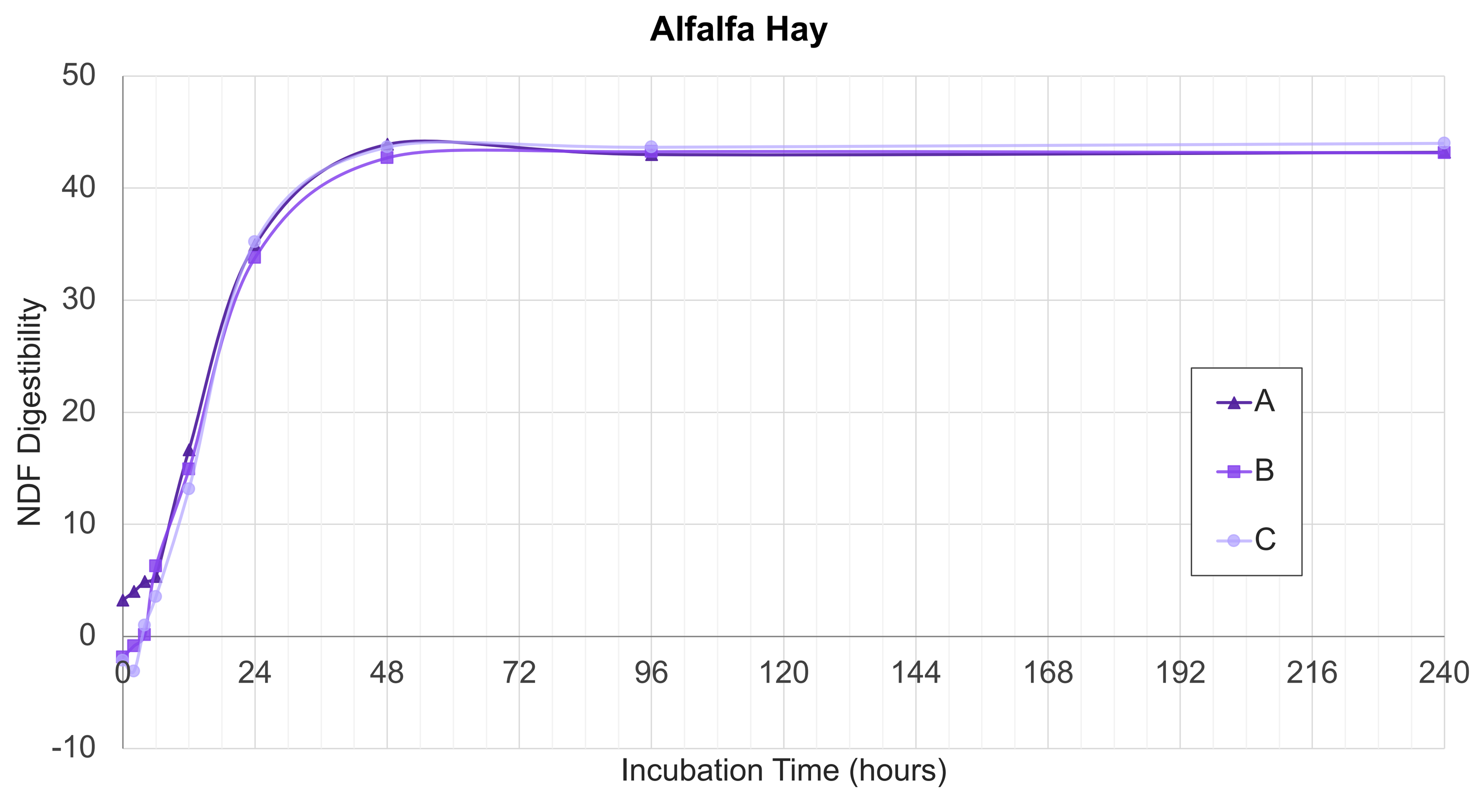

Figure 2. Determination of alfalfa hay NDF digestibility using different washing protocols

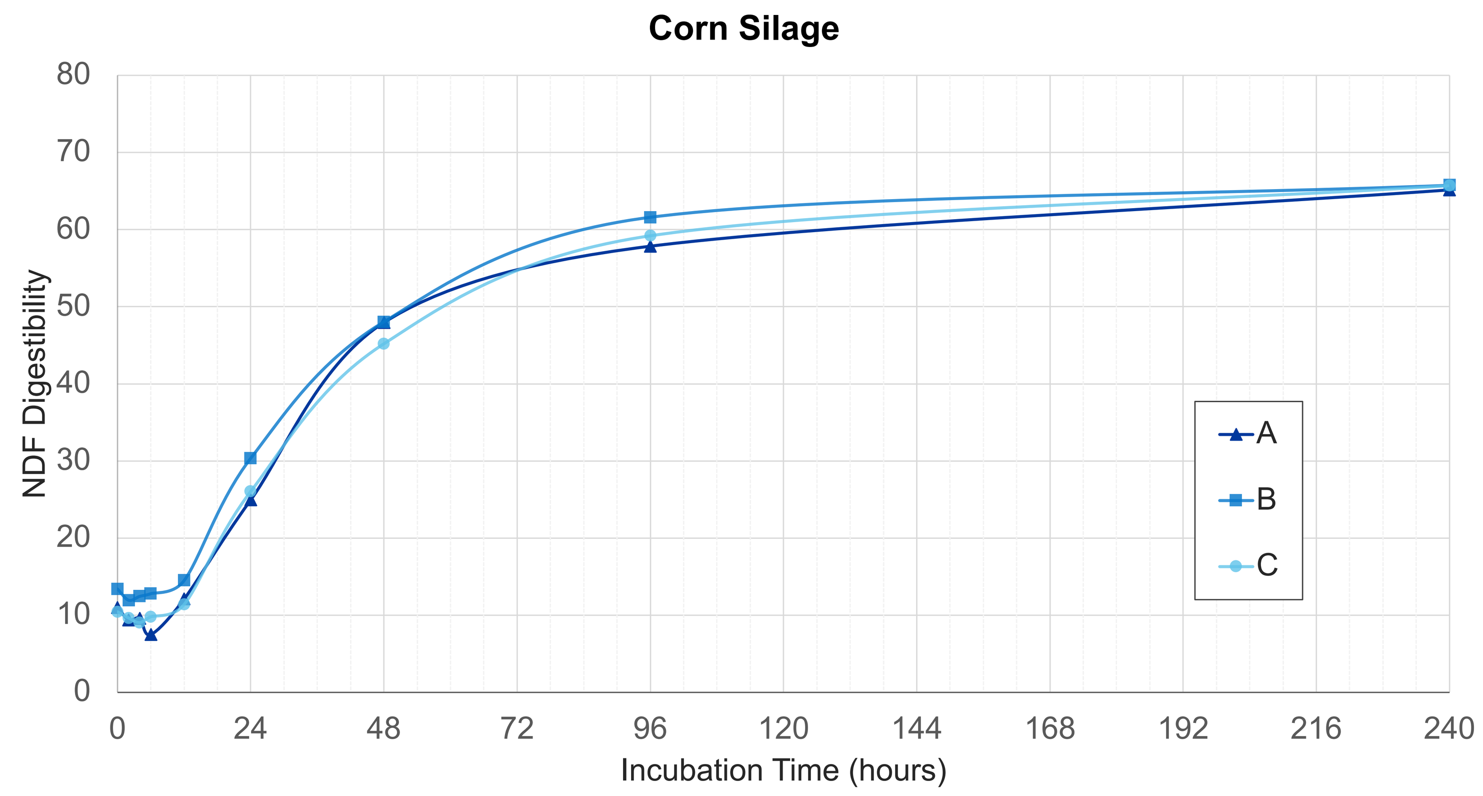

Figure 3. Determination of corn silage NDF digestibility using different washing protocols

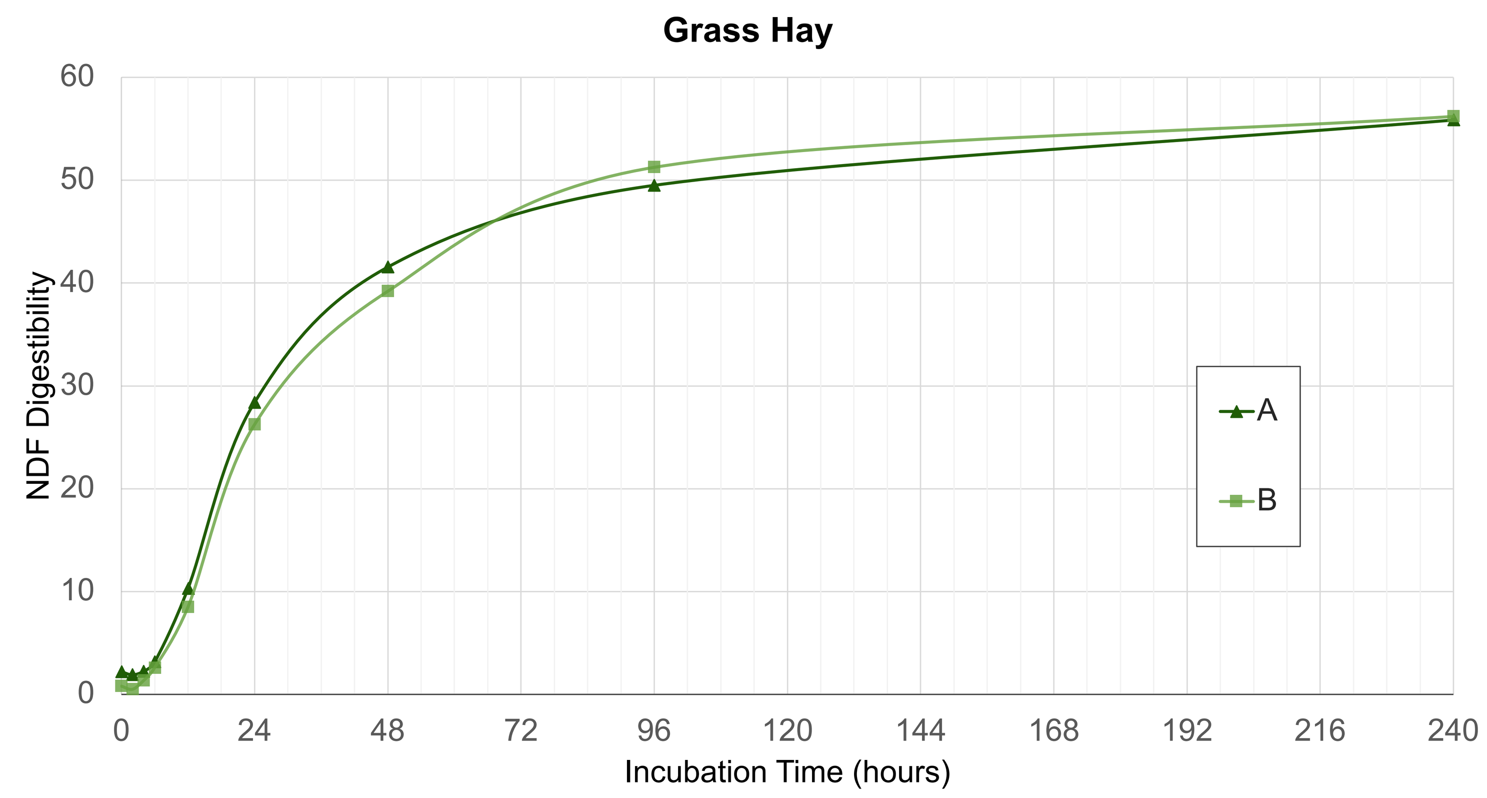

Figure 4. Determination of grass hay NDF digestibility using different washing protocols

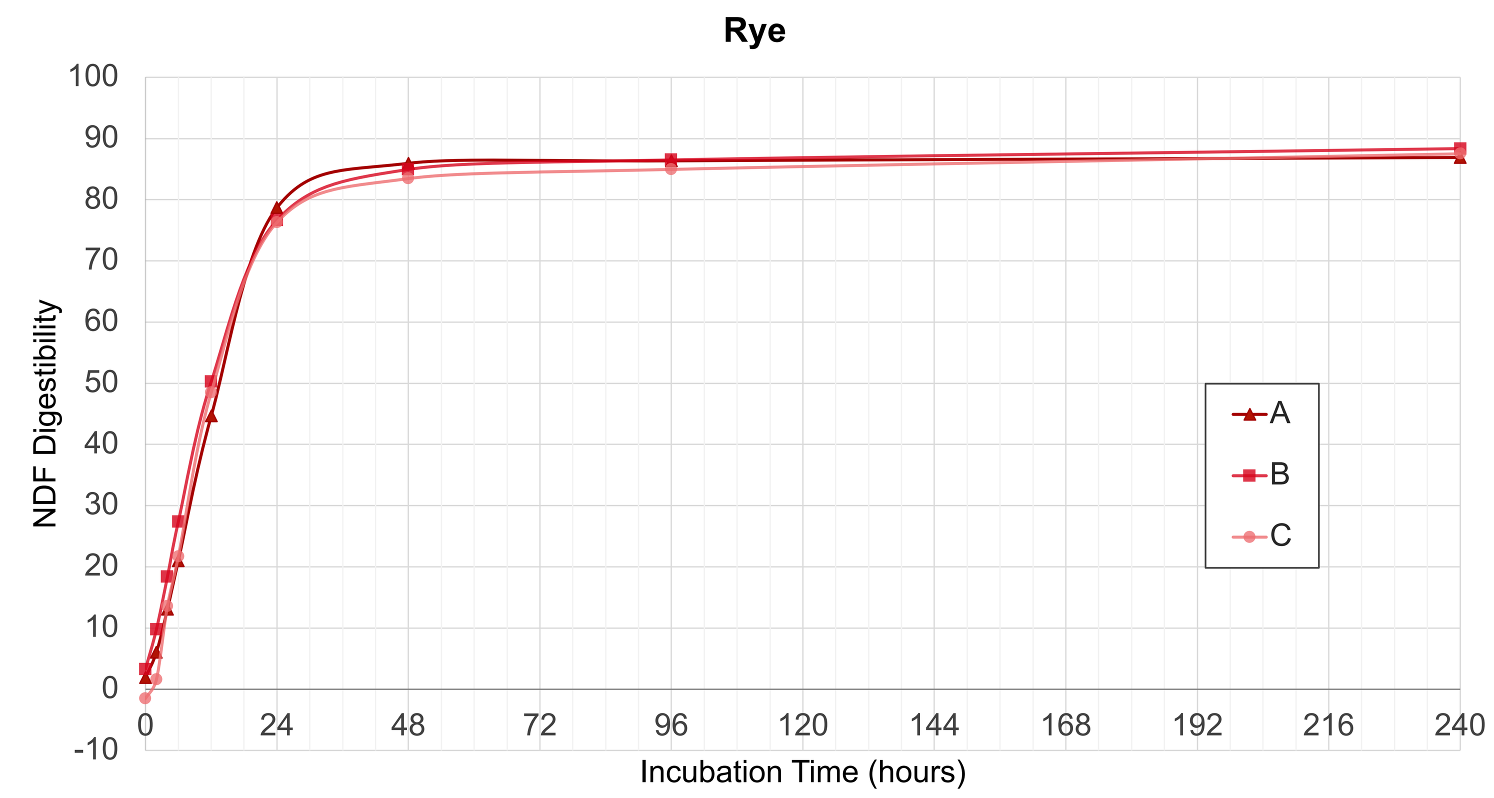

Figure 5. Determination of rye NDF digestibility using different washing protocols

Conclusion

The data suggests the necessity of rinsing samples prior to incubation for in situ fiber research varies by forage type. The results for alfalfa at T_0 were significantly different between the various washing methods.

This experiment also revealed some unexpected information about rate of digestion. Notably, corn silage had significant NDF digestion at T_0, regardless of washing protocol.

Further research into these newfound topics and the variability of NDF fiber digestion determination among more forages should be explored.

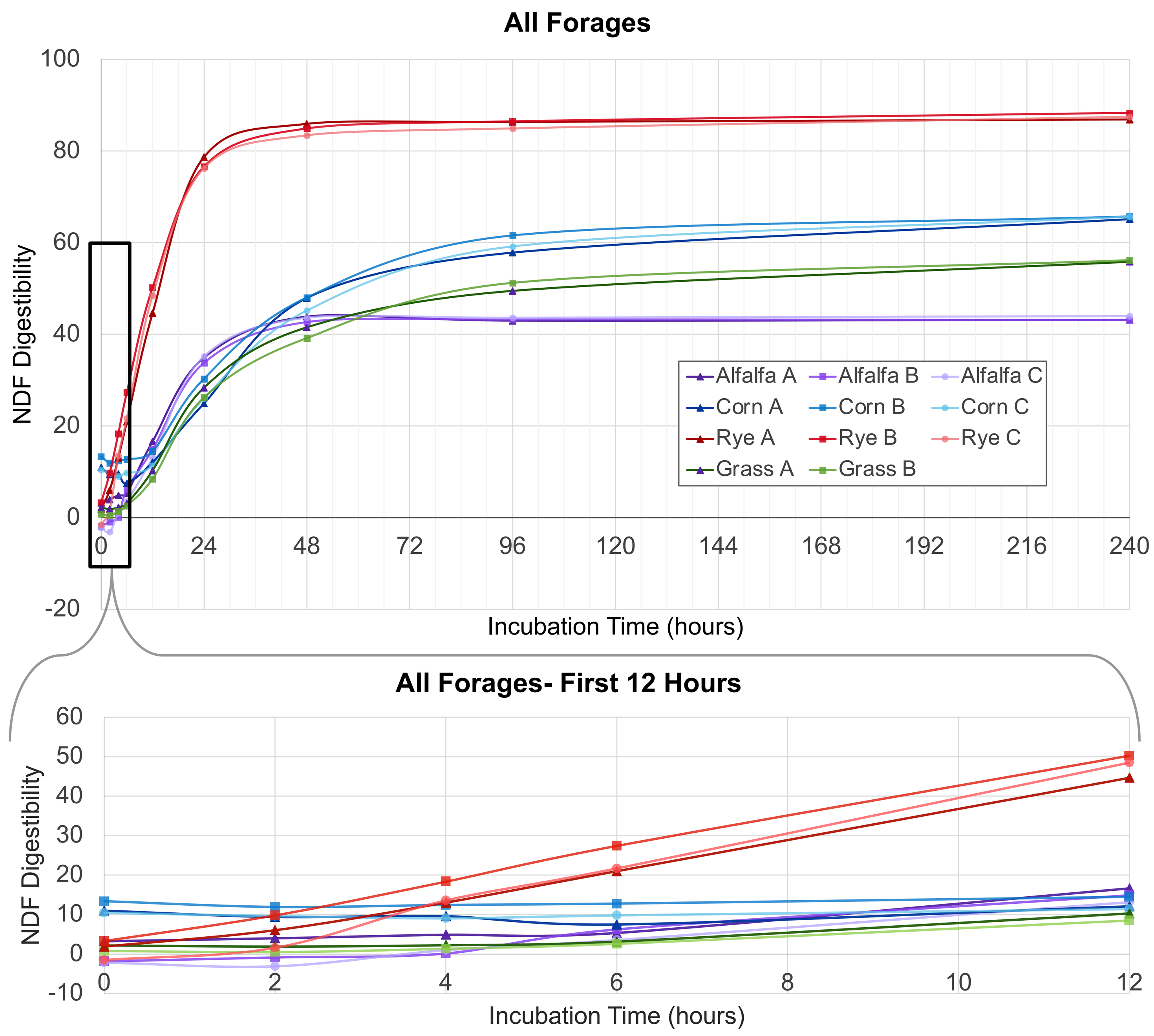

Figure 6. Summary comparison of all forage NDF digestibility curves using different washing protocols with an in-depth view of the first 12 hours

Literature Cited

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