Development of New Alfalfa Products in Combination with Almond Hulls for Emerging Domestic & International Markets

Katherine Swanson[1], Maia Zack[1], Ed DePeters[1], Daniel Putnam[1]

Due to the expansion of California almond industry, there are over 2.5 million tons/year of almond hulls (AH) available to be fed to cattle as a cheap, carbohydrate-rich feed. However, they are low in protein and digestible fiber, unlike alfalfa. Different combinations of alfalfa and AH could utilize the strengths of each product, potentially producing a 'synergy' in combination for animal production that open new markets for alfalfa. This project aimed to analyze combinations of different qualities of alfalfa combined with AH for forage quality characteristics and digestibility to assess the potential for a new mixed product that would capitalize on the strengths of both feeds. Samples of AH and four qualities of alfalfa (low, low/medium, medium, and high) were obtained and combined with 0, 25, 50, or 75% AH in the mix. There was also one pure AH sample, which resulted in 17 total samples. The sample mixes were analyzed for wet chemistry composition analysis. In addition, they were analyzed for *in vitro* digestibility using both the gas production (over 72hours) with syringes and Daisy methods. Gas production using the syringes at 24 hours was used to calculate metabolizable energy (ME). *In vivo* digestibility was determined using eight sheep with fecal collection harnesses in a feeding study using a 4 x 4 Latin Square design The diets for the *in vivo* study consisted of a low to medium quality alfalfa cubed with 0, 10, 20, or 40% AH in cubes. Each sheep consumed each diet for a two-week period, with feces being collected during the second week of each period. Fecal and feed samples were sent out for wet chemistry composition analysis and used to calculate digestibility. All data was analyzed in R. Averages and standard deviations were calculated for all *in vitro* data and a linear mixed effects model was used to analyze the *in vivo* data. The alfalfa samples used had calculated total digestible nutrients (TDN) ranging from 45 to 58 TDN. For all mixes, as the amount of AH increased, the calculated TDN and non-fiber carbohydrates increased while percent crude fiber and neutral detergent fiber (NDF) decreased. *In vitro* results showed that the Low/Medium quality alfalfa mixed with 25 or 75% AH had improved dry matter and NDF digestibility, and had calculated ME similar to that of High-quality alfalfa. In sheep, a diet consisting of Low/Medium quality alfalfa cubed with 10% AH was found to have the highest dry matter, organic matter, and crude protein digestibilities (62.9, 64.1 and 72.1% respectively) with only small decreases in ADF and NDF digestibilities compared to the 100% alfalfa diet. The ADF and NDF digestibilities for the 100% alfalfa diet were 45.8% and 44.7% while the 10% AH diet had ADF and NDF digestibilities of 43% and 42.8%, respectively. Both the 20% and 40% AH diets had significantly lower ADF and NDF digestibilities compared with the 100% alfalfa diet. The *in vivo* study suggests that the fiber in AH is not very digestible in ruminants since we observed decreased fiber digestibility of alfalfa when mixed with higher amounts of almond hulls. Overall, we found that mixing low amounts of almond hulls with low to medium quality alfalfa hay could be beneficial by increasing the overall dry matter and crude protein digestibility with only slight decreases in fiber digestibility.

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[1]K. Swanson, Post-Doctoral Scholar, Dept. of Plant Sciences; M. Zack, Junior Specialist, Dept. of Animal Science; E. DePeters, Professor, Department of Animal Science, and D. Putnam, Extension Specialist, Dept. of Plant Sciences, University of California, Davis.