

# Increasing the marketability of alfalfa (*Medicago sativa*) through sustainable aquafeeds

APS Thesis Proposal Seminar Abstract

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**Background:** Aquaculture is the fastest growing food sector in the world (FAO, 2016). China is the leading cause for aquaculture growth with 61% of the world's production in 2014 (FAO, 2016). Aquafeeds, a \$99 billion industry in 2016, are expected to rise to the value of \$163 billion by 2021 (Market Data Forecast, 2016). The growth in demand for aquaculture and subsequent need for low cost, abundant terrestrial aqua feed sources provides a unique opportunity for Minnesota grain producers and feed suppliers. For example, Cargill, a Minnesota based company, has been heavily investing in developing aquafeeds since 2015 (Dirdal, 2017).

Government entities and private companies such as Cargill are investigating aquafeeds heavily as the supply of fishmeal, the traditional protein source of aquafeeds, is highly limited (Rust et al., 2011; Love et al., 2017). Due to the limited supply of fishmeal, producers of aquafeeds are adding larger and larger portions of terrestrial agriculture products to aquafeeds each year (Fry et al., 2016). Terrestrial agriculture by-products such as blood meal and bone meal cannot replace fishmeal fully because they are not complete. Soybean derived feed sources are a popular renewable input to use in replacement of animal proteins but not without certain limitations. The amount of soybean meal that a fish can handle is limited by the limiting amino acids, such as methionine, and by the anti-nutrients soybeans contain that negatively affect fish (Sales, 2017). Also, soybeans grown in mass production as they are currently used pose risks for our freshwater systems and soils due to the nature of growing annual crops with fertilizers and barren soils when not in production (Fry et al., 2016). A sustainable and affordable protein source is needed to support the growing aquaculture industry worldwide. The environmental consequences of our annual feed crops, including water, nitrogen, and phosphorus demands and pollution, coupled with the increase demand of these products through the growing aquafeeds business, show that in order for aquaculture to be sustainable, we need to find a new crop to feed our fish.

Alfalfa, *Medicago sativa*, is the crop that produces the most protein per acre and is the 4<sup>th</sup> crop of MN with 1,285,000 acres harvested in 2016 (Akeson and Stahmann, 1966; National Agricultural Statistics Services, 2017). Alfalfa also provides many environmental benefits due to its perennial legume growth and it's popularity with pollinators (Jung and Lamb, 2011). With the increased interest in biofuels and leaf protein concentrates, refining alfalfa into a digestible ingredient for fish feeds is becoming a possibility (Bals et al., 2012).

**Objectives:** This project proposes to study the usage of alfalfa protein concentrate (APC) in aquafeeds with two objectives. The first is to evaluate APC yield and quality from reduced lignin cultivars. The second objective is to establish the growth rates and fillet composition for yellow perch on APC feed rations.

**Methods:** In 2017, six samples of APC were made from each of three cultivars of alfalfa, Hi-Gest, HarvXtra, and Pioneer's 54VR08 harvested from Rosemount, MN on three harvest dates throughout the summer. The APC samples will be analyzed for amino acid content by high-performance liquid chromatography at the Agricultural Utilization and Research Institute and evaluated for yield and amino acid concentration. We expect that the reduced-lignin cultivars will result in higher quality APC than the reference variety and help us address objective one.

In February, 2017 eight tanks with 15 yellow perch (*Perca flavescens*) each were fed diets of either a balanced standard fish feed containing 40% crude protein provided by fishmeal, soybean meal, and poultry meal, or alternately, an experimental feed with the same attributes except there was no fishmeal and 18% APC was added instead. Consumption was measured daily by feeding to satiation and weighing feeds daily. Growth was measured bi-weekly by tank. A second set of perch will be fed this fall to increase sample size. Analysis will be completed on growth, fillet composition, and feed efficiency in order to address objective two.

**Summary and Preliminary Findings:** Alfalfa is a crop that has many environmental benefits and, in the form of APC, can also be used as a protein source for aquafeeds. My research is establishing baseline data for the production and use of APC with MN grown alfalfa. APC products can vary with agronomic management, processing methods, as well as cultivar. My initial findings on yellow perch has shown that APC is a sustainable feed source with no major detriments to fish growth and production.

## References:

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