

FROM GRAIN TO FEED



**DANISH
TECHNOLOGICAL
INSTITUTE**

PROCESS DEVELOPMENT CONCERNING PRODUCTION OF HIGH PROTEIN FRACTIONS FROM GRAIN AND LEGUME PRODUCTS TO BE USED IN EXTRUDED FISH FEED PELLETS



Blue Lupine



Fish feed



NEW ORGANIC FISH FEED

- The Danish project "Organic Aquaculture" - the link between sustainable production and superior products" is examining relevant organically produced crops to be used as raw materials for fish feed where fish meal is the main source of protein.
- Due to restrictive quotes the global fish catch will not increase. Consequently, the production of fishmeal for the aquaculture industry will not increase.
- Protein from crops and legumes is an obvious solution; however, it needs to be processed into fractions with a higher protein content in order to compete with fishmeal.
- The process development was carried out at Danish Technological Institute's Pilot Plant in Denmark.
- Sweet lupine seeds were dehulled, ground and processed by air classification. A protein fraction with 62% protein on dry matter basis was obtained.
- The lupine protein was used as a substitution for fish meal in fish feed. The feed was extruded into pellets on a Werner Pfleider extruder.
- The feed was tested in the following feeding trials.



PROJECT FOCUS: ALTERNATIVE CROPS FOR FISH FEED

- The project focused on investigating the availability of relevant organically produced vegetable crops with a high protein content.
- The effect that organic vegetable proteins have on trout concerning growth, digestion and health was investigated
- The effect of organic vegetable protein on the eating quality was investigated
- The Institute has carried out a trial production which indicates that a combination of pea, rape and lupine protein can replace up to three quarters of the fish meal in the feed without deteriorating the pellet quality.
- The techniques used for the lupine protein optimization process were grinding, sifting, air classification and extrusion.
- The lupine raw material used was "blue lupine" from the sort "Prima". The lupine contained 4.7 % crude fat, 8.6 % water and 29.4 % crude protein.
- The unit operations at the Pilot Plant can be combined and converted so that the optimal process and the best products are achieved.

DEVELOPMENT STAGES: DEHULLING, GRINDING, SIFTING AND EXTRUSION

- Dehulling - the hull and a large part of the fibrous part of the seed are removed by knife milling and sifting.
- Grinding - the protein and starch particles are broken apart by grinding - on a hammer mill and on a pin mill
- Air classification - protein particles are separated from the carbohydrates and other components in an MP 400 Alpine air classifier. The air classifier can separate in the interval ~ 10 - 45 µm.
- The raw material mixes are extruded into 5 mm pellets on a "Werner Pfleider Continua 37" twin screwed extruder with two die holes, each with a diameter of 4.2 mm.
- The fish meal content was 53 % in the control feed, 35 % in "Mix 1" and 25 % in "Mix 2".

COMPONENT	CONTROL	MIX 1	MIX 2
FISH MEAL %	53	35	25
WHEAT %	7	7	7
PEA PROTEIN %	0	12	20
RAPESEED %	0	8	10
LUPIN PROTEIN %	0	4	6
PROTEIN/FAT RATIO	48/25	45/28	45/28

Composition of fish feed recipes containing lupine protein and other vegetable protein sources.

LUPINE PROTEIN IN FISH FEED

- By air classification the dehulled and ground lupine fraction was separated into two fractions - coarse and fine.
- A fine fraction yield of 35 % w/w with a protein content of 62 % on a dry matter basis was obtained. The protein shift was calculated to 52 %.
- An increased plant protein quantity in the recipes did not show any indication of a decreasing pellet quality.

PROTEIN % DW	FRACTION
32	RAW MATERIAL
42	DEHULLED
62	AIR CLASSIFIED PRODUCT

Overview of the protein content after each of the steps in the optimization process

BY

HANNE TOLDERLUND RASMUSSEN, M.SC. (CHEM.ENG.)
DANISH TECHNOLOGICAL INSTITUTE
KONGSVANG ALLÉ 29, DK-8000 AARHUS C
TEL.: +45 7220 1936, E-MAIL: HANNE.TOLDERLUND@TEKNOLOGISK.DK