Hemp as organic protein source for pigs and poultry

Eco Amino Conference November 4, 2010
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Agenda
- Status for hemp in the EU and globally
  - Cultivation, yield, and harvesting of hemp seed
  - Previous trials and experiences
  - Danish trials 2010 with hemp for protein/oil and quality
  - Barriers for producing hemp seed for oil and protein products
  - Will hemp growing be economically for the farmers?
  - Discussion 10 minutes

Focus on Industrial Hemp as a protein source
- The goal is to find alternatives to protein sources in organic pig and poultry production
- Can we grow hemp seed in DK?
- Is the quality OK?
- Which barriers do we have to overcome?
- Is it economically for the farmers?

Production
- Production of hemp seed in EU (6,500 t) and Canada is app. 15,000 tons
- Canada, app. 5,600 ha i 2009
- Export from Canada to EU
- App. 50% Organic hemp in Canada

Utilization of hemp seed
- Seed for animal feed
- Protein cake and Hemp protein powder
- Oil – High value products
- Hemp nuts, hemp tea
- Cosmetics
- Hemp milk, hemp beer etc.

Growth area for industrial hemp in EU (ha)
Source: NovaInstitute

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**Hemp in North America**
- Short seed varieties (Finola, Crap) and dual purposes (USO-14) account for >95% of acreage.
- Seed yields have increased - average now ~670 kg/ha clean (600 lbs/acre). Typical yields with Finola on irrigated land: 1800 kg/ha, clean.
- Seed production currently required to supply market demand: ~ 8000 MT/year (produced in Canada)

**Essential Amino Acids in Canadian Hemp Varieties**

**Content of fatty acids in Canadian hemp**
- **ALA (Omega-3)**  **GLA (Omega-6)**  **ILSA (Omega-9)**
  
- Finola: 3.5, 5.4, 1.8, 3.8
- USO-14: 3.5, 5.4, 1.8, 3.8
- USO-31: 3.5, 5.4, 1.8, 3.8
- Crap: 3.5, 5.4, 1.8, 3.8
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Why hemp?

- Hemp has a large yield potential for biomass, but how about seed?
- Valuable properties: High quality protein and valuable fatty acids
- Besides this: high strength, isolating, absorbing properties in the fiber
- The essence of a “green product”, can easily be grown organic
- Innumerable applications: protein, oil, human nutrients, cosmetics etc.
- The byproduct from the stem can be high valuable as well (insulation composites, bedding, etc.)

Development steps for Industrial Hemp

<table>
<thead>
<tr>
<th>Maj</th>
<th>Juni</th>
<th>Juli</th>
<th>August</th>
<th>Sept.</th>
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Harvest for fiber production: Laying in swaths from medium August
Separation of fibers and core DMC% ca. 82-85

Development steps for Industrial Hemp II

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Harvest for seed production: Laying in swaths from medium Sept. or harvest directly end September to mid October in DK.

Growing of hemp - Conventional as well as organic

- Approval as a hemp grower
- A good seedbed
- Adding of organic manure
- No plant protection
- Eventually laying in swaths
- Harvesting seeds
- Cutting the retted stems and pressed in big bales
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Guidance to grow organic hemp

Previously trials with hemp for seed production in DK

Danish and foreign trials 2010 with organic hemp for protein (amino-acids) and fat (fatty acids)

- Two trials carried out under Nordic Field Trials
  - www.nfts.dk
- 1. Trial with varieties of organic hemp
- 2. Trial with organic hemp with varying N-supply and varying levels of seed
  - 1. trial
    - Felina 32, Uso 31 and Finola
  - 2. Trial (Finola)
    - 50 kg N, 80 kg N and 120 kg N
    - 10 kg/hectare and 30 kg/hectare

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Harvesting hemp trial for seed in DK 2010

Raw material from the seeds: Seed, Protein and Oil from hemp trials 2010
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### Results from Trials 2010. Organic Hemp Varieties

#### Yield of Seed per Hectare

- **Finola**: 329 kg
- **Uso**: 311 kg
- **Felina**: 268 kg

#### Protein and Fat Content of Raw Material

<table>
<thead>
<tr>
<th>Variety</th>
<th>Protein (%)</th>
<th>Fat (%)</th>
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<tbody>
<tr>
<td>Finola</td>
<td>30.3</td>
<td>17.3</td>
</tr>
<tr>
<td>Uso</td>
<td>29.2</td>
<td>15.5</td>
</tr>
<tr>
<td>Felina</td>
<td>28.9</td>
<td>15.2</td>
</tr>
</tbody>
</table>

#### Content of Amino Acids as % Protein Content

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Felina 32</th>
<th>Uso 31</th>
<th>Finola</th>
</tr>
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<tbody>
<tr>
<td>Lysine</td>
<td>0.85</td>
<td>0.89</td>
<td>0.85</td>
</tr>
<tr>
<td>Methionin</td>
<td>0.54</td>
<td>0.53</td>
<td>0.58</td>
</tr>
<tr>
<td>Cystine</td>
<td>0.41</td>
<td>0.45</td>
<td>0.41</td>
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### Conclusions from the Hemp Seed Trials 2010 (2)

- Low yields. The season has been far more cold and wet than normal.
- Too few plants germinated and weed was a big problem.
- Harvested (30th of Sept.) at app. 30% water.
- Maturity of the seeds were delayed, but Finola matured best.
- In the combined trial (with Finola): 30 kg sown per hectare was better than 10 kg/ha, and 50 kg N gave the highest yield 329 kg.
Conclusions from the hemp seed trials 2010 (II)

- Seed yield was best in Felina (280 kg/ha) at 9% water (Std. quality)
- The oil content was lower (25%) than normal (33%) due to early harvest.
- Protein content: Finola had the highest (24%)
- Amino acid content was best in Uso: Methionin 2.8% and Lysine 4.7%, Methionin and Cystine 4.7% of the protein content.

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Barriers or challenges for producing hemp for protein purposes

- We need to address the whole plant: seed purposes and utilization of the stem
- The seed market need to be build up for:
  - Protein for fodder
  - Oil for consumption or?
- The prices need to be competitive to other protein sources (between 1 – 2 US dollars pr. kg?)
- We need to build up capacity to process the seeds – if the demands for seed increase!

Processing of seeds for oil and hemp protein cake

- Drying and cleaning the seeds
- Pressing the seeds
- Storage of the protein cake
- Packaging of the oil-products
- Certificates and approval for producing organic products
- Certificates and approval for producing organic products for human purposes etc.

Harvesting the stem of hemp after seed harvest

- We need to build up capacity to harvest seeds as well as collecting the stem.
- Is this economically?
- The hemp stem need to be retted, and then cut, depending on the utilization
- Expecting from 3 tons – 8 tons per hectare
Harvesting fibre in Denmark – we have capacity for app. 500 - 700 hectares.

Utilization of hemp stem (fibre and shive/core) is part of achieving an economically production

Is hemp growing economical???
That depends on the yield and quality, demands for seed and straw and the prices!

<table>
<thead>
<tr>
<th>Organic hemp</th>
<th>2010</th>
<th>2012</th>
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<tbody>
<tr>
<td>Income</td>
<td>DKK</td>
<td>Euro</td>
</tr>
<tr>
<td>Seed, 500 kg</td>
<td>5000</td>
<td>667</td>
</tr>
<tr>
<td>Hemp Straw, 6 tons</td>
<td>-9000</td>
<td>1200</td>
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<tr>
<td>Income total</td>
<td>14000</td>
<td>1867</td>
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<tr>
<td>Costs</td>
<td></td>
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<tr>
<td>Seed and fertilizer app.</td>
<td>-2181</td>
<td>-291</td>
</tr>
<tr>
<td>Cultivation and harvest</td>
<td>-6000</td>
<td>-800</td>
</tr>
<tr>
<td>Gross margin after machinery and labor costs</td>
<td>5819</td>
<td>776</td>
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Organic Hemp, Felina, 2010, Sealand

Maybe hemp for seed will be the future??
Thank you for your attention

The European Community and the Danish Ministry of Food, Agriculture and Fisheries support the project.