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# Fiberfriläggning, kvalitetssäkring och fiberanvändning

Workshop svensk Agrofiber 26 June 2018 Bodil Engberg  
Pallesen, DTI

# Will a Nordic production of sustainable hemp textiles be a reality???



Lots of challenges to overcome.

- **Introduction**
- **Project: Sustainable Hemp Textiles**
- **The raw material – harvesting and mechanical processing**
- **Enzyme retting**
- **Outputs**
- **Challenges to overcome**
- **Food, feed and Pharma**







## Biomaterialer - Produktudvikling ud fra plantefibre og restmaterialer



Foto: Martin Håkan / Coverganda.dk

Udslip af drivhusgasser, mangel på råvarer samt affalds- og forureningsproblematikker udgør en stigende trussel for vores klima. Forbrugere og virksomheder efterspørger derfor også innovative biomaterialer som aldrig før, og der er stor fokus på cirkulær økonomi, bioøkonomi og bæredygtighed.

Biobaserede produkter er bionedbrydelige og mindre forurenende, fordi de giver mindre affald, kan recirkuleres og udleder mindre CO<sub>2</sub> ved fremstilling. Foruden miljømæssige fordele kan produkterne endda have bedre tekniske egenskaber med hensyn til styrke, lethed og isoleringsevne. Plantefibre fx er velegnede til brug i



Jeg er din kontaktperson

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Skriv til mig

- <http://www.teknologisk.dk/ydelser/biomaterialer/produktudvikling-ud-fra-plantefibre-og-restmaterialer/37309>



# It started with hemp - a multi functional plant





# Experience

- More than 20 years of experience in the sector, worked with development and testing of new products made from plant fibers
- Development work started at the former “Danish Agricultural Advisory Service, National Center, Department of Crop Production” – now SEGES and continued at AgroTech (from 2007) and now Technological Institute, AgroTech division (from 2016)
- Developed fibermats from hemp for insulation, growth mats, composites etc.





# Development work in cooperation with Advance Nonwoven a.o.



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Various natural fibers

Hamp/Hør  
Lagner/Duge  
Aviser/Magasiner  
Gulvtæpper  
MDF Plader  
Jeans  
Søgræs  
Savsmuld  
Glasuld/Rockuld  
Kapok  
Træspåner



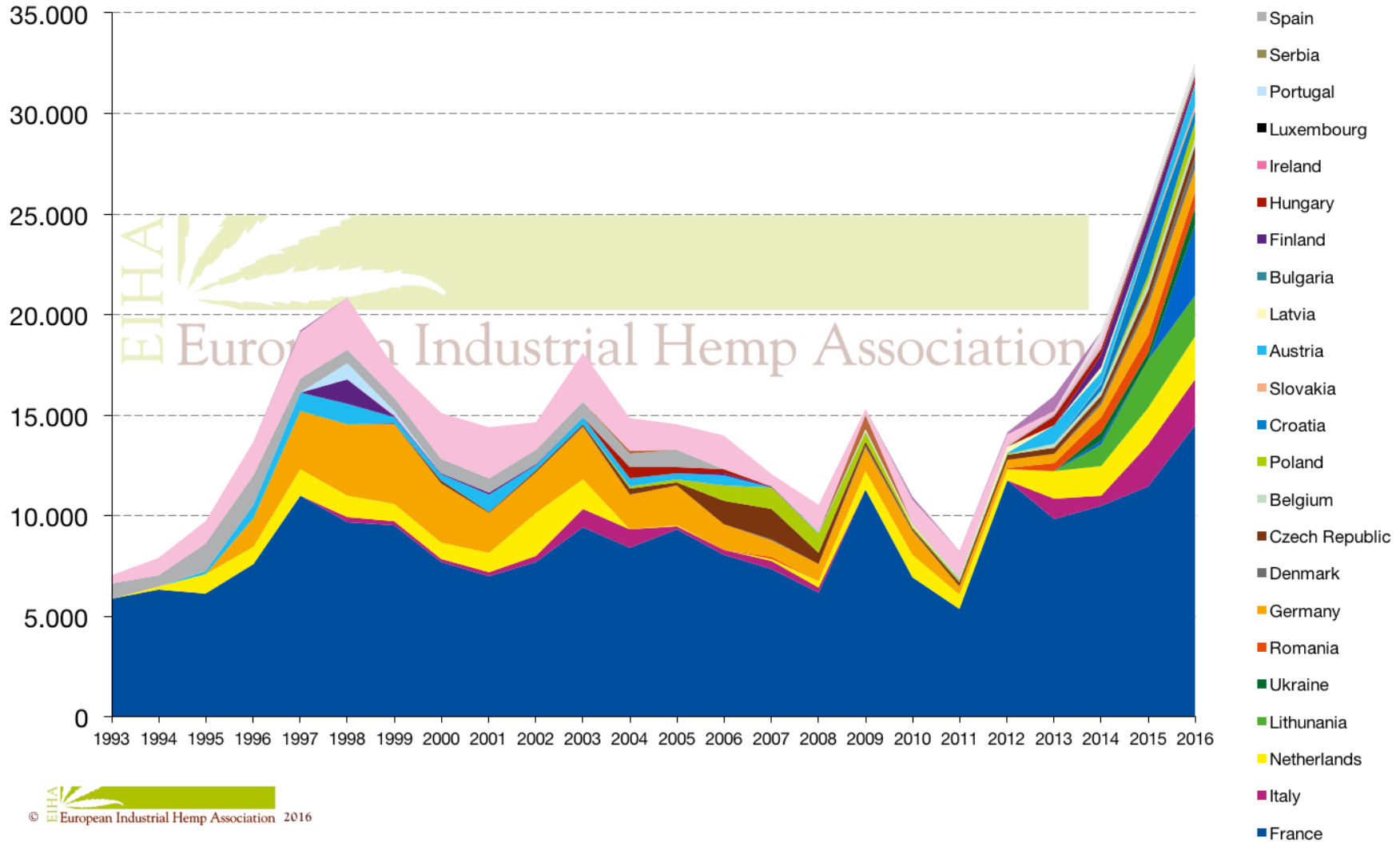
Applications:

Isolering  
Akustikplader  
Vækstmåtter  
Luftfiltre  
Vandfiltre  
Løftplader  
Absorberings måtter  
Membraner



# Hemp Cultivation Area in the EU (ha)

## 2016: ca. 32,500 ha







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600 ha i DK i 2016  
516 ha 2017  
421 ha 2018  
(som har søgt  
EU-støtte)



# Hampeplanten har både han- og hunplanter



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# Erfagrupperen ud i hamp på Djursland





# Danske hampeavler og -pioner: Jørgen Heggelund, Bjæverskov



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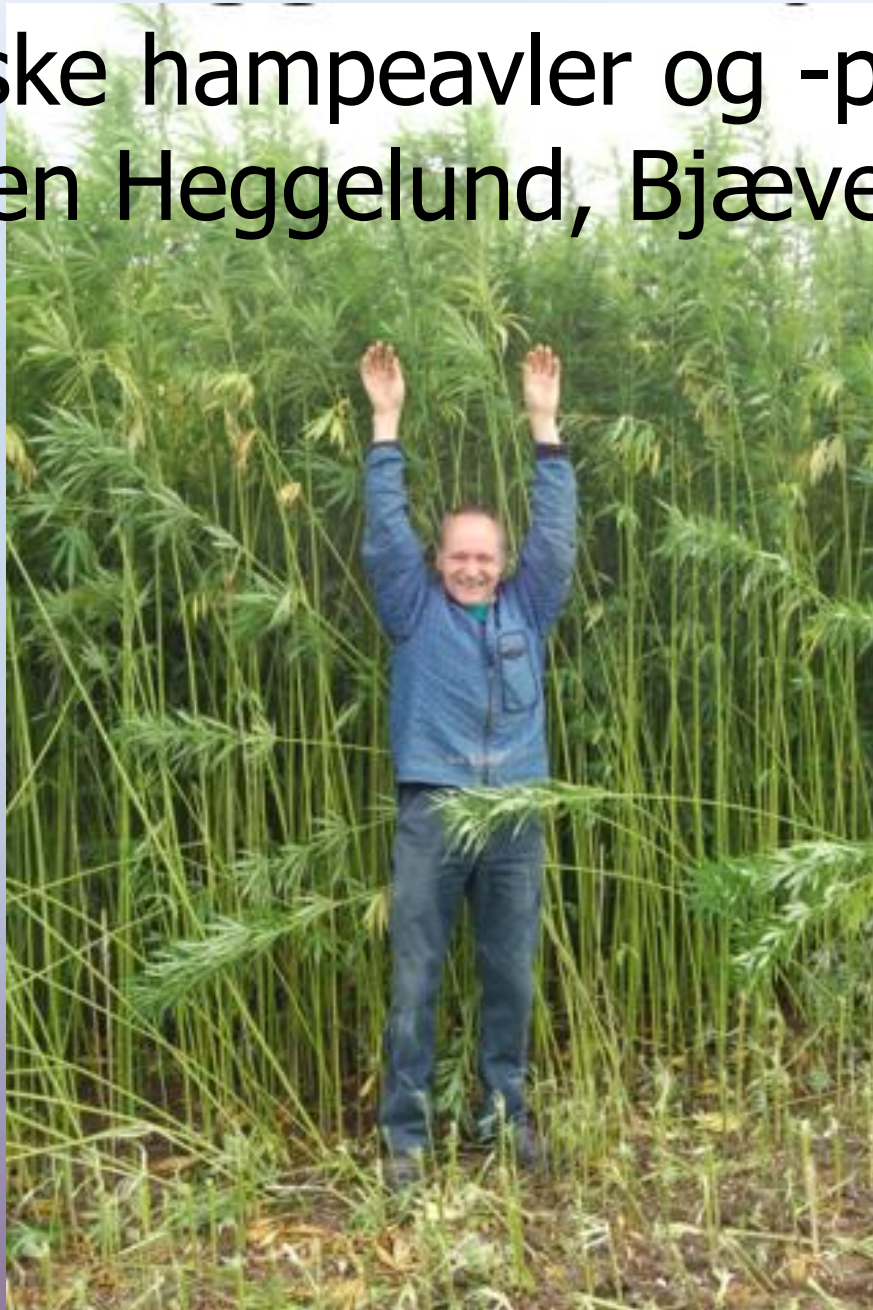


Photo: Bodil Pallesen, AgroTech





Man skal godkendes som  
hampeavler HVERT år, se  
NaturErhvervsstyrelsen



# Høst af hampetop med ribbebord, samtidig skårlægning



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# Project: Concept for production of sustainable hemp textiles



Supported by Danish Agency of Environment ([www.mudp.dk](http://www.mudp.dk) )

Project period: Autumn 2017 – ultimo 2020

Consortium/Partners:

- Advance Nonwoven [www.advancenonwoven.dk](http://www.advancenonwoven.dk)
- Jørgen Heggelund, Vittenbjerggård [www.vittenbjerg.dk](http://www.vittenbjerg.dk)
- Danish Technological Institute (DTI) [www.dti.dk](http://www.dti.dk)
- Kvadrat [www.kvadrat.dk](http://www.kvadrat.dk)
- Rachel Kollerup [www.rachelkollerup.com](http://www.rachelkollerup.com)

**kvadrat**



rachel kollerup

# Focus from Fashion Industry etc.: Textile production is not sustainable - especially not cotton



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Cotton grown in the 3 world are sprayed up 70 times each season due to severe problems with pests and weed. Cotton production is only around 2.5 per cent of the total agricultural area worldwide, but accounts for 25 percent of total consumption of insecticides and 10 percent of total pesticide consumption!

[http://wwf.panda.org/about\\_our\\_earth/about\\_freshwater/freshwater\\_problems/thirsty\\_crops/cotton/](http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_problems/thirsty_crops/cotton/)



# Not sustainable hemp processing

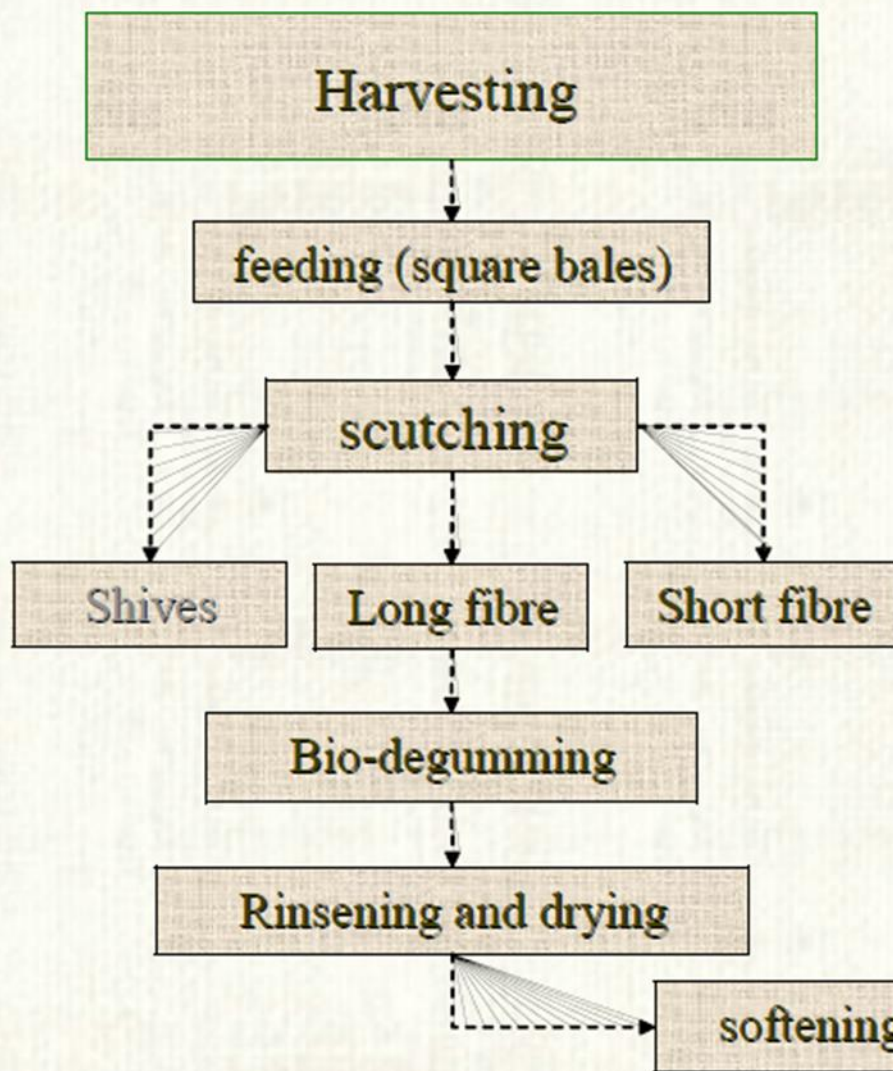


# Many attempts to solve the challenges with hemp for textiles

- The textile and fashion industry demands trackability and transparency in the hemp production
- The old hemp industry have been phased out in most countries of Europe
- The hemp industry have been renewed and are strong in processing hemp for insulation, composites and other nonwoven products
- But the hemp alternative for textile is not yet there???
- Lots of projects targeting the textile track – but are still not scaled up and on the market, the prices are very high, the quality .... differs and is very limited
- The of stream industries such as carding and spinning are limited
- Only very little hemp for textiles produced in Europe is available



# Udviklingsprojekt – bæredygtige hampetekstiler



**Dry spinning**

**Wet spinning**

**Carding**

**Hackling**

# Goals of the Danish Hemp Textile project (DTI)

- The goal of the project is to pave the way for a real Nordic production of sustainable hemp textiles of durable, sustainable high quality fabric based on hemp fiber.
- A scalable process combined with enzyme-treatments
- Controlling the retting process and achieve high textile fiber quality
- The project will at the same time demonstrate that with the new technologies there is a high resource utilization throughout the value chain and the possibility of using the entire raw material, avoiding waste and upcycle after use.



# Approach: The whole value chain



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- The approach addresses the entire value chain from commodity production and processing using new innovative technologies and solutions to end users, ie. ranging from the field of raw materials production, processing of raw materials into long textile fibers, spinning for yarns and transformed to fabrics and sample designs for the fashion and furniture industry.

# Experiments with cultivation, harvesting and handling of the hemp stalks including innovative scalable scutching methods





# Rødningsgrad essentiel til tekstile formål??



Hør- og hampestrå ruskes for at bestemme rødningsgrad. Foto: Bodil E. Pallesen, Teknologisk Institut, AgroTech.



# Green hemp – harvest 2017





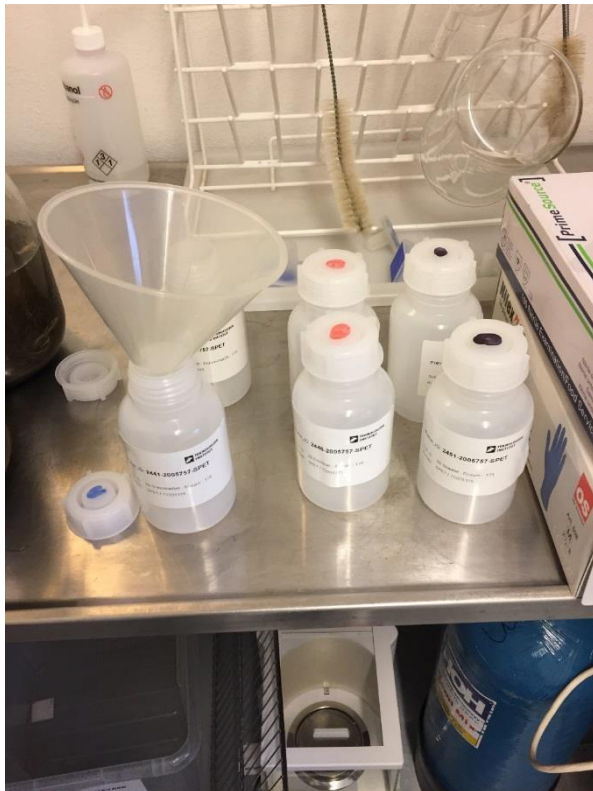
# Handling the raw material – vinter-retted hemp



# Alternative retting with enzymes -

## Screenings of enzyme-treatments

- Enzymes from Novozymes for screening tests.
- Upscaling in Mini-scale
- Upscaling in Pilot scale
- Various raw materials of Danish grown hemp tested





# Test setup in tank with temperature control



# Green hemp enzyme retted

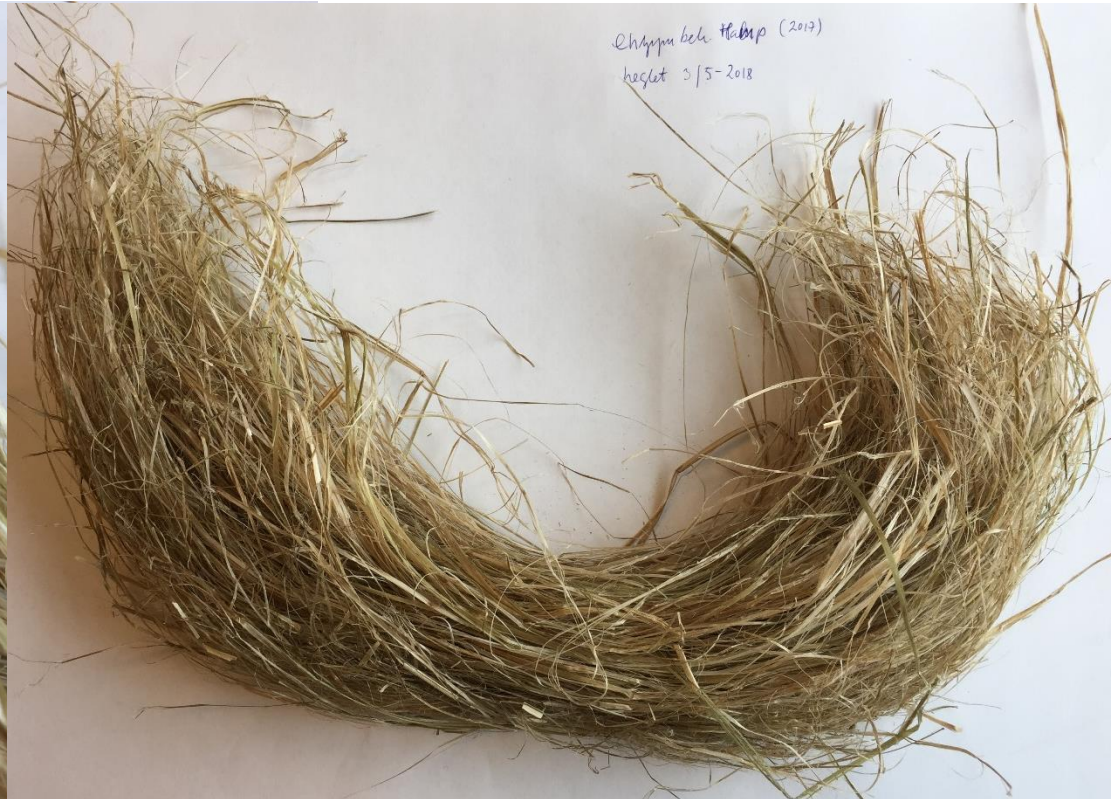




# Hackled hemp fibres



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# Hackling of hemp stalks (15 cm)





# Characterization and test of quality of the treated hemp fibers

- Tensile strength
- Degree of release - via microscopy
- HPLC-analysis of sugars in enzyme water. Loss during process
- Fiber yields – long fiber and fiber-share
- Fiber lengths - long fibers, short fibers
- Carding and spinning tests for making yarns
- Finishing - Bleaching
- Fabric of knitted and woven items
- LCA
- Etc.

# Enzyme retted hemp – hackled and below also carded



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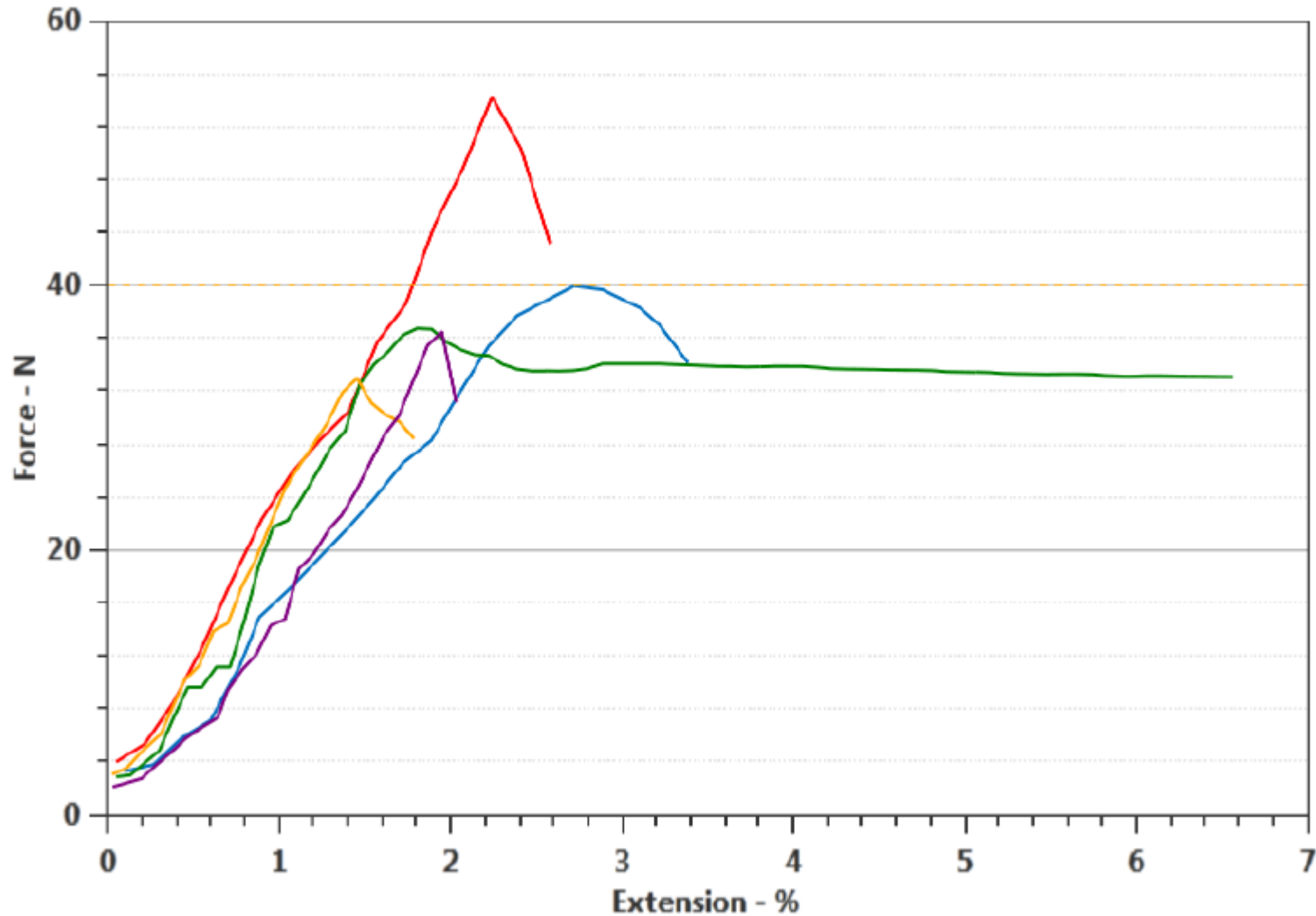


# Samples of enzyme waste water for HPLC tests and fiber analysis

- Cellulose
- Hemicellulose
- Lignin
- Glucose (cellulose)
- Xylose (Hemicellulose)
- Lactic acid
- Acetic acid
- Ash
- Protein
- The fat / wax
- Etc.



# Strength of fibre – Force N and Elongation at max force

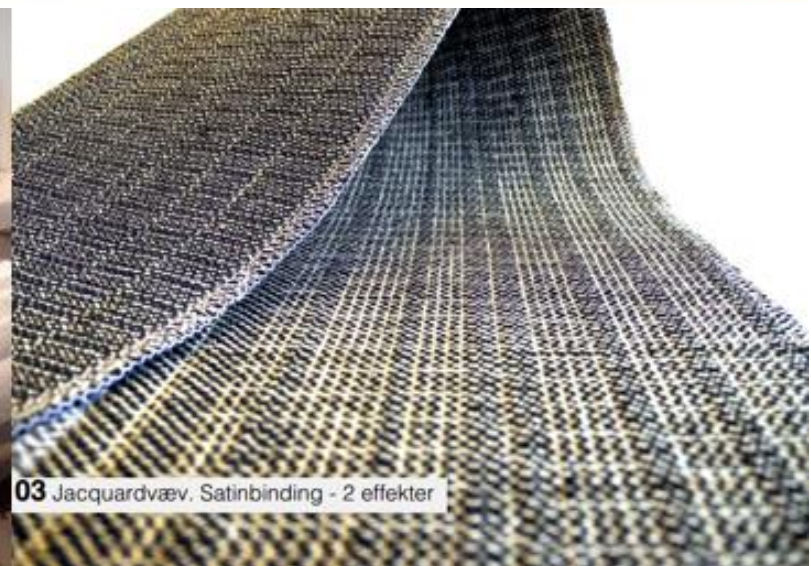




# Outputs – design of Rachel Kollerup



01 Jacquardvæv. Skudforstærket kipper i delvis dobbeltvæv



03 Jacquardvæv. Satinbinding - 2 effekter





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# Designs af Rachel Kollerup



# NICE

Nordic Initiative, Clean and Ethical is a joint commitment from the Nordic fashion industry to take a lead on social and environmental issues. Make sure that we try hard enough at [www.nicefashion.org](http://www.nicefashion.org)



rachel kollerup



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# Interior textiles - Kvadrat



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kvadrat

Products

Designers

In use

Collaborations

About

Contact



Upholsteries



Curtains



Acoustics



Rugs



Accessories



Clouds

# Outputs:

## Cover stocks and fibertex-products

- Using a game-changing technology at Advance Nonwoven, Danmark
- Patented CAFT-technology





# Non-woven products

- Replacement of non-woven syntetic produkts from fx. Fibertex – and other cover stocks

## F U R N I T U R E



## B E D D I N G



# Development and optimization of prototypes of woven fabrics in new sustainable designs with hemp fabrics for testing in the textile industry.

- Research with carding of hemp fiber and spinning of hemp yarns. Analyzes of yarn grades
- Creation of sample designs of textiles.
- Research with Bio-polishing to improve the quality of the textile
- Processing of fibers to finished yarns that can be woven into fabrics.
- Manufacture of woven textile prototypes
- Preparation of prototypes of substances in various mixtures with hemp and for example. wool.

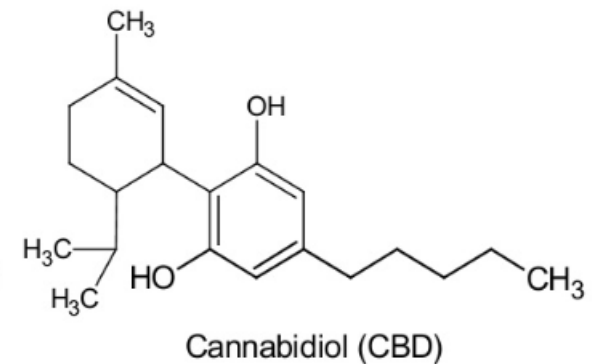
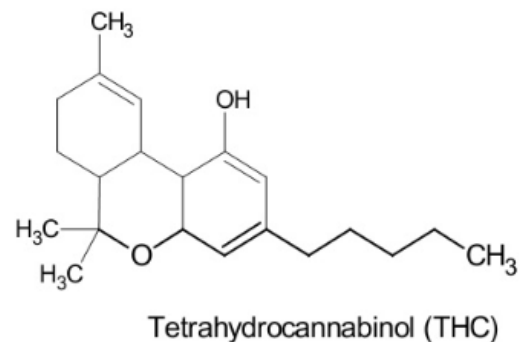


# Conclusions – it's a challenge

- The retting process can be controlled by alternative retting methods such as enzyme retting and other methods providing a strong fiber quality of long fibers for textile purposes – which industry demands
- Raw material quality in green hemp high. Optimization of the cultivation issues such a variety, plant density etc. will be solved.
- The processing need to be scalable and less labor intense
- Introducing a wet process creates costs, that need to be covered by higher prices.
- Innovation and new ways of handling the hemp straw in harvest is essential for a success
- Designers and innovative end-users are involved in the process, giving a driver for the development work
- As well a positive attention from the fashion industry demanding more sustainable solutions
- Cooperation with players in the hemp processing industry essential as well

# Bioaktive stoffer i hamp – Cannabis sativa

- Cannabinoiderne er de aktive stoffer, der findes i cannabisplanten – særligt blomster og blade. Der er mere end 104 forskellige cannabinoider i cannabis, herunder cannabidiol (CBD) og delta-9-tetrahydrocannabinol (THC), som de mest kendte.
- Den første cannabinoid-receptor, CB1, blev identificeret i hjernen i 1990.
- En anden cannabinoid-receptor, CB2, blev identificeret i 1993. De fleste CB2-receptorer findes i celler, der indgår i immunforsvaret, hvilket tyder på, at det har en funktion i dette.
- Man har desuden identificeret cannabinoider i kroppen, der kaldes for endocannabinoider. Det tyder på, at disse kan spille en rolle i forhold til oplevelse af smerter, bevægelseskontrol, sult og hukommelse.





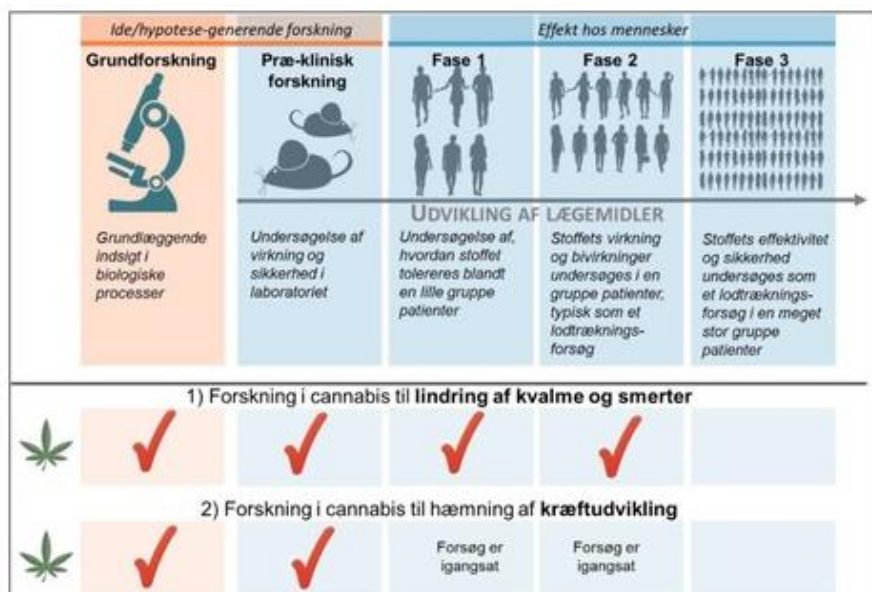
# Effekter af de bioaktive stoffer – hvoraf nogle er dokumenteret andre er ikke i tilstrækkelig grad

## CBD

- kvalme og opkastning efter kemoterapi, appetitstimulation ved HIV/AIDS, kronisk smerte, antiinflammatorisk

## THC

- Smerter, kvalme, uønsket vægttab, spisevægring, sklerose, nervesmerter og spasticitet m.fl.



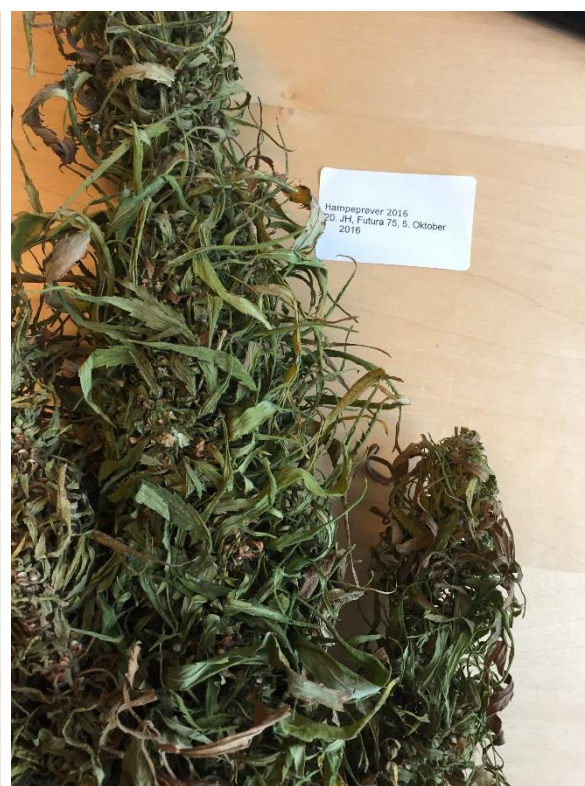
Fra bl.a. [www.cancer.dk](http://www.cancer.dk)  
[www.eiha.org](http://www.eiha.org)

# Resultater fra projekt under Grøn Omstilling – Erhvervsstyrelsen – højværdistoffer i udvalgte planter, bl.a. hamp

- Indhold af CBD og THC i hamp afhænger af sorter, dyrkningsmetode, konserveringsmetode og ekstraktionsmetode
- Projektdeltagere en række private virksomheder og landbrug samt Teknologisk Institut - AgroTech samt SDU
- Uddrag af resultater med bestemmelse af THC og CBD i hampesorter 2015 og 2016
- Vi skal vide hvor indholdsstofferne kommer fra og hvordan de er dyrket, kontrolleret produktion – som vi kender fra vores fødevarer.



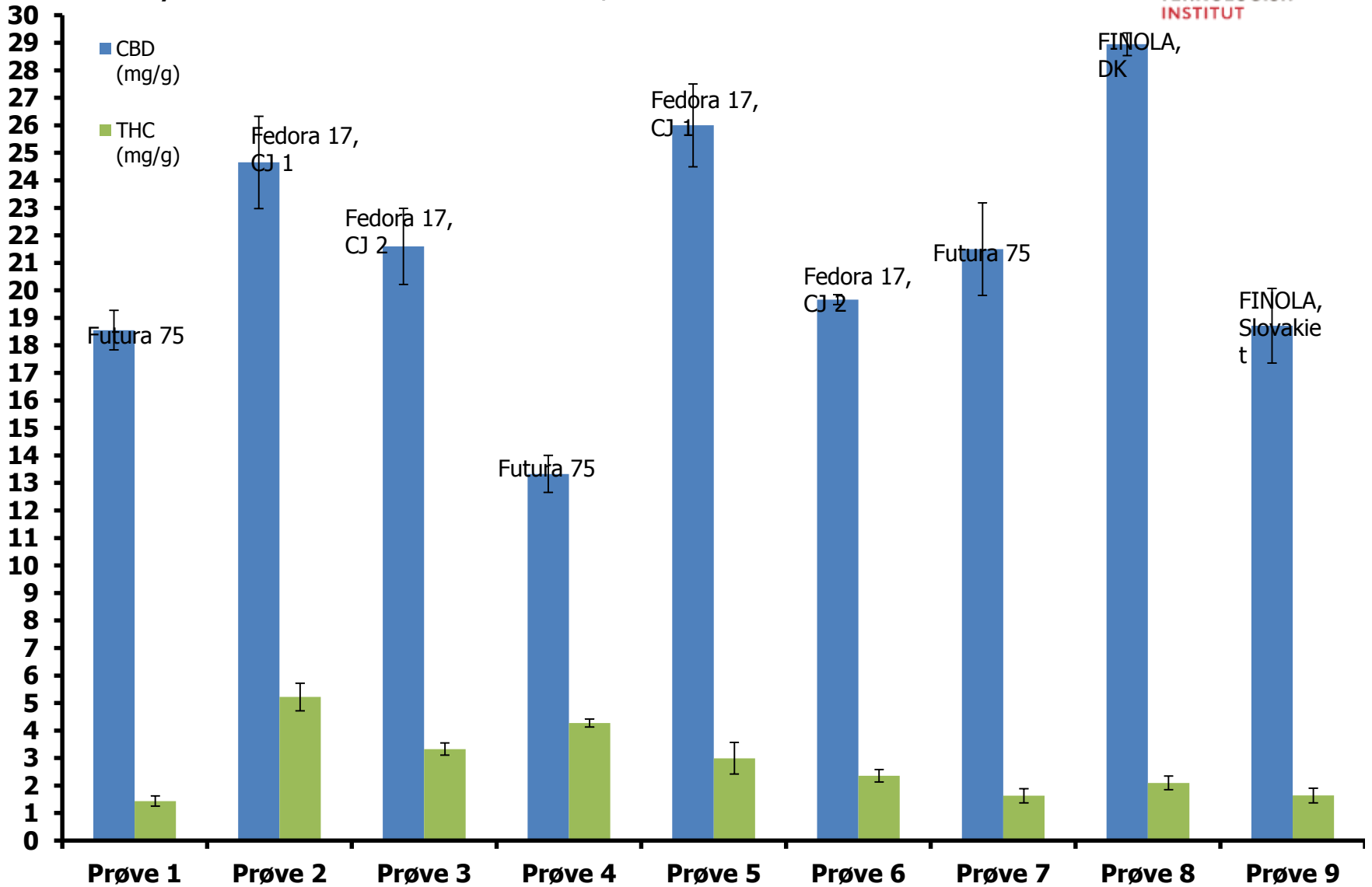
# Råvarer - eksempler



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# Analyseresultater for høst 2015, DK





Udnyttelse af hele plante - til højværdistoffer, fødevarer og fiberprodukter kræver opbygning af nye industrier – dækkende hele værdikæden



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## Hamp og hør til byggematerialer

Udviklet af Bodil E. Pallesen, Agrotech. I produktion hos Advance Nonwoven. **Patents:** METHOD FOR MANUFACTURING A FIBRE MAT, FIBRE MAT AND USE OF SUCH FIBRE MAT



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# Hampeprodukter fra Møllerup Gods

[www.moellerup.dk](http://www.moellerup.dk)



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## 2018 BAG MED HAMP

HENT INSPIRATION  
UNDER OPSKRIFTER



KLIK HER  
OPSKRIFTER



FØDEVARER

Fødevarer



HUDPLEJE

Hudpleje



ALLE PRODUKTER

Alle produkter



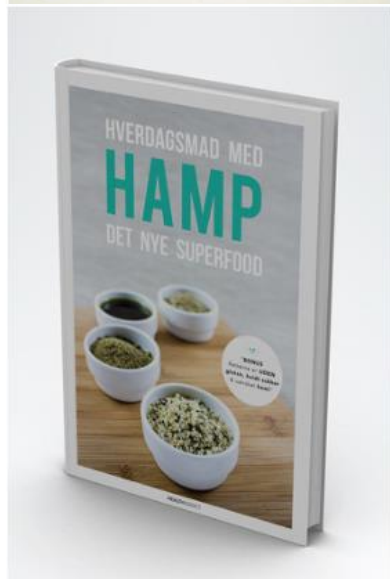
TILBUD

Tilbud

# Hampeprodukter fra Møllerup Gods - fremstillet af frøene



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Hamp er rig på:

**PROTEIN • OMEGA • FIBRE**

Hamp har et højt indhold af protein, hampefrøene indeholder 25 g pr. 100 gram. Hampen er rig på omega 3 ALA men også omega 6 fedtsyren GLA. Endeligt er hamp rig på kostfibre, magnesium, jern, zink, vitamin B1, B2, vitamin E og vitamin D.

## Hamp er et superfood

På Møllerup Gods arbejder vi med hamp og hampens unikke ernæringsmæssige egenskaber. Resultatet er en række gode produkter, du kan bruge til hverdag og fest.

God appetit

Besøg vores hjemmeside for inspiration og opskrifter. Du kan også se og købe produkterne på:  
**www.moellerup.dk**  
Sælges også ved udvalgte forhandlere.







# Hampeskæver til hestestrøelse, byggematerialer m.m.



# Thanks to



- MUDP – The Danish Agency of Environment



# Contact information



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