

BarkCure

November 2017

www.barkcure.no

Newsletter no.1

Project facts:

BarkCure is funded by the Norwegian Research Council through the BIONÆR programme.

NOK 11 mill. funding

Project period:
June 2017-October 2020.

Project owner: Norwegian Centre of Organic Agriculture (NORSØK)

Project leader:
Håvard Steinshamn, NIBIO

Dear reader

This is the first Newsletter for the research project called “Condensed tannins from Norwegian pine and spruce bark - antiparasitic effects and potential commercial exploitation”, abbreviated BarkCure. With our newsletter, we will inform you regularly about our activities and progress.

The background for the BarkCure project is that most of the bark from the Norwegian sawmill industry is burned as an energy source. Bark contains condensed tannins (CTs), which have antiparasitic properties when ingested by ruminants like sheep and cattle. In the BarkCure project, we will try to utilize and thereby increase the value of bark, through the extraction of CTs, for use as antiparasitic additives in ruminant feed. The project will increase the knowledge of the relationship between the bark composition, structure and biological activity of selected components. At present, the lack of appropriate procedures for tannin extraction and isolation is an important barrier for development of commercial products, e.g. for commercial utilization of CT as antiparasitic agent for ruminants.

The project runs over three years with a budget of NOK 11 million, where 10 million is financed by The Research Council of Norway through the BIONÆR program. The work is a cooperation between researchers from Norway, Denmark and Scotland, as well as the wood and feed industry represented by Bergene Holm AS, Norske Skog Saugbrugs and Felleskjøpet Fôrutvikling. In addition, the farmers advisory and interest organisations are represented through Animalia,



Norwegian Farmer’s Union and Norwegian Association of Sheep and Goat Farmers (NSG). Norwegian Centre for Organic Agriculture (NORSØK) is the project owner in cooperation with the research institutions The Norwegian Institute of Bioeconomy Research (NIBIO), Norwegian Institute of Wood Technology (Treteknisk), SINTEF Materials and Chemistry (SINTEF), Norwegian Veterinary Institute (VI), Scotland’s Rural College (SRUC) and University of Copenhagen (UCPH).

The project was initiated in June 2017, when we had a kick-off meeting with all research partners present. We have recruited Berit Marie Blomstrand as PhD-student on the project, and Ms Blomstrand is now formally enrolled at the University of Copenhagen with Professor Stig Milan Thamsborg as main supervisor.

In addition to this newsletter, we will also communicate our research activities and results on our project web page (www.barkcure.no) and on Facebook.

Best regards
Håvard Steinshamn
Project leader

Background

Parasite infections in livestock production have huge economic impact on the farming industry leading to decreased animal welfare and reduced productivity. Conventional control of gastrointestinal parasites relies mainly on the use of antiparasitic drugs. However, emergence of anthelmintic resistance in ruminants has been noted worldwide over the past decades. Resistance against antiparasitic drugs may lead to severe challenges for the sheep and beef production, which has led to a need of more sustainable treatment and preventive strategies. Condensed tannins (CTs) are polymers found in many plants, and when eaten by animals they may reduce the gastro intestinal (GI) parasite burden. Several alternatives for parasite control have been suggested, including the use of plants containing bioactive compounds, such as CTs. In a preliminary in vitro study, anthelmintic activity of water and acetone extracts of bark samples from Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) was observed against the brown stomach worm (*T. circumcincta*), common in sheep.

This indicates that Norwegian bark may have a potential as a feed additive, which will improve the health of livestock. If CT supplementation from bark reduces the burden of gastrointestinal parasites, such as nematodes and coccidia, it will improve animal health and productivity and thereby greatly benefit sustainable agriculture in Norway. The discrepancies in the biological activity of CT in various studies call for a better understanding of CT structure activity relationships and the characterisation of the bioavailability of CT in extracts.

The current project will fill the knowledge gaps on: 1) bark CT composition, concentration and temporal variation, 2) the relationship between bark CT composition and concentration and their biological activity in vitro and in vivo against selected parasites without adverse effect on fibre digestion and animal production, 3) large scale extraction and production of bark CT, and 4) the production line of bark CT, from log to final CT product, to ensure a high-quality product.

Main research areas within BarkCure

1. Value chain of bark production

Research goal

To identify the most suitable type of bark material for the extraction of CT from Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*).

Leader: The Norwegian Institute of Wood Technology

Bark is produced all year round, and the trees are debarked by using different methods. The key characteristics for the selection of raw material are the value and the costs of the bark material in addition to the bark composition and the seasonal variation in composition. Initially, we will sample bark from Norway spruce and Scots pine on two occasions. The bark will be used for extraction and characterization of condensed tannins and stored for later use in testing for biological activity and chemical characterisation.



Photo: Berit Marie Blomstrand

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2. Chemical characterization, isolation and fractionation of bark CT

Research goal

To determine the CT concentration and their chemical characteristics in bark from various processing methods and seasons, and to develop a scalable extraction process.

Leader: SINTEF Materials and Chemistry



Photo: Inga Marie Aasen

The CT in bark varies in quantity and quality. In the BarkCure project, we will test different ways to extract CT. Samples showing promising antiparasitic properties, will be further characterized, fractionated and tested biologically in the laboratory to find those extracts with the strongest antiparasitic effect. Based on the biological tests (see activity 3 and 4), structure and quantities

of compounds in fractions with antiparasitic activity will be determined.

An industrial extraction process will be developed taking biological activity, extraction efficiency, costs and HMS-measures into account. Finally, extracts showing the highest bioactivity in vitro will be processed and tested against nematodes in live sheep.

Spiridoula Athanasiadou



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3. Biological activity of bark CT extracts against nematodes

Research goal

To test the efficacy of CT extracts from bark against selected sheep and cattle nematodes in the laboratory (in vitro) and in live sheep (in vivo).

Leader: Scotland's Rural College (SRUC)

In this work package, different crude and purified bark extracts, which vary in their composition of CTs, will be tested in the laboratory (i.e. in vitro) against the most pathogenic gastrointestinal nematodes of sheep and cattle. Effects of the extracts will be tested in vitro against various lifecycle stages of the parasites, and subsequently, the bark extracts with the highest bioactivity will be selected for in vivo trials in sheep experimentally infected with specific gastrointestinal nematodes.



Photo: Berit Marie Blomstrand

Heidi Enemark



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4. Biological activity of bark CT extracts against protozoa

Research goal

To test the efficacy of CT extracts from bark against coccidia from sheep in the laboratory (in vitro).

Leader: Norwegian Veterinary Institute



Photo: Angela H. Valente

In this work package, we will infect different cell cultures with common, pathogenic protozoa from lambs and test the antiprotozoal efficacy of various crude and purified bark extracts which differ in their composition of CTs. Similar to the studies of efficacy against nematodes, we will test the extracts against several lifecycle stages of the parasites.

Research partners and expertise

Norwegian Centre for Organic Agriculture (NORSØK) is the project owner. NORSØK conducts applied and especially targeted research linked to organic farming and works specifically with animal health and welfare in the contexts of sheep farming. Research on alternatives to synthetic chemical antiparasitic drugs is important to organic as well as conventional farming, especially to avoid development of resistance against antiparasitic drugs. Doctor of veterinary medicine, Berit Marie Blomstrand has been appointed as PhD student in the project. Ms Blomstrand is employed by NORSØK and will focus on substitutes for chemical antiparasitic agents in ruminants. NORSØK will lead the dissemination and communication of project results.

Norwegian Institute of Bioeconomy (NIBIO) and the Department of Grassland and Livestock has research on animal health and welfare as one of its strategic research priorities. Dr Håvard Steinshamn is the coordinator of the BarkCure project. He has experience in project coordination and research in grassland management, ruminant nutrition, and preventive measure and robustness against diseases in ruminants.

Norwegian Institute of Wood Technology has strong contact with the wood industry and has the equipment and experience to sample, analyse and characterize bark raw material as it is commercially produced in Norway today. Dr Karl-Christian Mahnert will lead the work. Dr Mahnert studied forest sciences at the TU Dresden (BSc.) and wood biology and wood technology (MSc.) at the University of Göttingen. Since his doctoral thesis in the area of wood modification at the Department of Wood Biology and Wood Products at the University of Göttingen, he has been working at the Norwegian Institute of Wood Technology (Tretknisk) in Oslo. His scope of activities includes industrial wood protection and testing and rendering expert opinion on parquet and wood floorings.

SINTEF Materials and Chemistry has expertise in biochemical and chemical engineering, and is a national leading laboratory for mass-spectrometric analyses. Equipment for extraction and separation are available via the NorBioLab infrastructure. Dr Inga Marie Aasen and Dr Hans Fredrik Kvitvang are experts in separation processes and mass spectroscopy analyses, respectively, and will lead the work in chemical characterization, isolation and fractionation of CTs in bark.

Norwegian Veterinary Institute (VI) is a national biomedical research institute with the main focus on animal and fish health and food safety. Research Professor Heidi L Enemark has solid expertise in gastrointestinal parasites of ruminants including experimental animal infections, in vitro characterization of protozoa and nematodes, bioactive plants and drug efficacy. She will supervise a postdoc employed at the BarkCure project at VI and co-supervise the PhD student. She will be responsible for the in vitro testing of antiparasitic effects against bovine nematodes and pathogenic protozoa.

Scotland's Rural College (SRUC) is an academic and government funded institution with its main campus located in Edinburgh. Dr Spiridoula Athanasiadou at SRUC is an international leading expert on investigating plant based parasite control strategies against gastrointestinal parasites in livestock and will run in vitro assays and an in vivo nematode experiment in sheep.

The Veterinary Parasitology Group at University of Copenhagen, led by Professor Stig Milan Thamsborg, has an internationally recognized reputation including pioneering work on the use of bioactive forages for parasite control. Professor Thamsborg is the main supervisor of the PhD student.



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Berit M Blomstrand



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Ms Blomstrand studied to become a veterinarian in Hannover, Germany 1993-1999. The study language was German, and she is very happy to have gotten the opportunity to live in a foreign country; to get to know the language, the people and its culture.

After graduating, Ms Blomstrand started working as a supervising veterinarian for the Food Control Authority where she did meat

inspection and general surveillance at abattoirs and food manufacturers for 1.5 years.

Following this, she got an opportunity within clinical practice, diagnosing and treating both livestock and companion animals. In 2016 Ms Blomstrand got a temporary position at the Norwegian Veterinary Institute in Tromsø performing autopsies and associated diagnostic procedures like bacteriological and parasitological examinations. Ending this period, she was able to start working at NORSØK as a PhD student in August 2017, enrolled at the University of Copenhagen.

As a PhD student, it is compulsory to attend courses adding up to a total of 30 ECTS credits. Ms Blomstrand plans to attend courses in Copenhagen, Edinburgh and Oslo. Furthermore, she will conduct in vitro and in vivo trials on nematodes and protozoans in cattle and sheep.

The first collection of bark



Photo: Karl-Christian Mahnert

Karl-Christian Mahnert, Forsker
Norsk Treteknisk Institutt

The first collection of bark as raw material was completed in August. The industry partners Norske Skog Saugbrugs and Bergene Holm collected three bark samples from the material flow in their plants during three weeks. Treteknisk homogenized these single batches and acquired a masterbatch for each type of bark (ring debarked spruce, drum debarked spruce, ring debarked pine). From each masterbatch, 25 kg bark were

sent for explorative extraction to SINTEF Material and Chemistry. Additional 10 kg are stored at Treteknisk for analysis of moisture content and wood percentage in the bark. About 130 kg per masterbatch are stored in a freezing warehouse as source material for extraction later in the project. Additionally, samples from process liquid were collected for analysis of content of tannins.



Photo: Karl-Christian Mahnert



Research partners:



Industry Partners:



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