CANS

Centre for New Antibacterial Strategies

2020 Annual Report

NORGES ARKTISKE UNIVERSITET • UIT •

TROMSØ FORSKNINGSSTIFTELSE

UNIVERSITETSSYKEHUSET NORD-NORGE
DAVVI-NORGGA UNIVERSITEHTABUOHCCEVIESSU

Contents

Photo: Nordgård

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CANS is hosted by the Department of Medical Biology and the Faculty of Health Science at UiT the Arctic University of Norway

@cans_uit

Summary 2020

The 2020 core centre annual activities have sustained although influenced by the pandemic. We would like to highlight the following activities:

1. The recruitment of six new associate professors funded by CANS is finalized:
   - Teppo Rämä, Norwegian College of Fishery Sciences, Faculty of Biosciences, Fishery and Economics: Expertise in antimicrobial activities in marine fungi.
   - Christian Lentz, Department of Medical Biology, Faculty of Health Sciences. Expertise in infection biology and the use of chemical probes to study host-microbe interactions.
   - Marius Myreng Haugland, Department of Chemistry, Faculty of Science and Technology. Expertise in chemical synthesis and multi-target hybrid drugs.
   - Veronika Pettersen, Department of Medical Biology, Faculty of Health Sciences. Expertise in gut microbiome research.
   - Einar Holsbø, Department of Computer Sciences, Faculty of Science and Technology. Expertise in health related bioinformatics and big data analysis.
   - Gabriel Almeida, Norwegian College of Fishery Sciences, Faculty of Biosciences, Fishery and Economics. Expertise in bacteriophages and large marine viruses.

2. The internal call and evaluation of applications for CANS-funded PhD (n=4) and postdoc (n=3) positions was finalized using the Scientific Advisory Board as external evaluators.

3. The CANS monthly/bi-monthly digital research seminars (n= 4) continued with internal and external presentations.

4. Applications for a centre of research excellence to the Research Council of Norway submitted November. One internal at UiT and one in collaboration with UiO.

5. Disseminating activities. We have made headlines and been invited to present CANS in the Norwegian Pharmaceutical Journal, the Norwegian Association for Academic Physicians and pestPOSTEN, a magazine for the Norwegian Association for Infectious Diseases.

6. Established the first collaboration with pharmaceutical industry evaluation in vitro pharmacodynamics and resistance development of a new antimicrobial peptide.

7. Research application at regional, national and international arenas. Overall 34 applications of which 12 (35%) were funded. See page 12 for details.

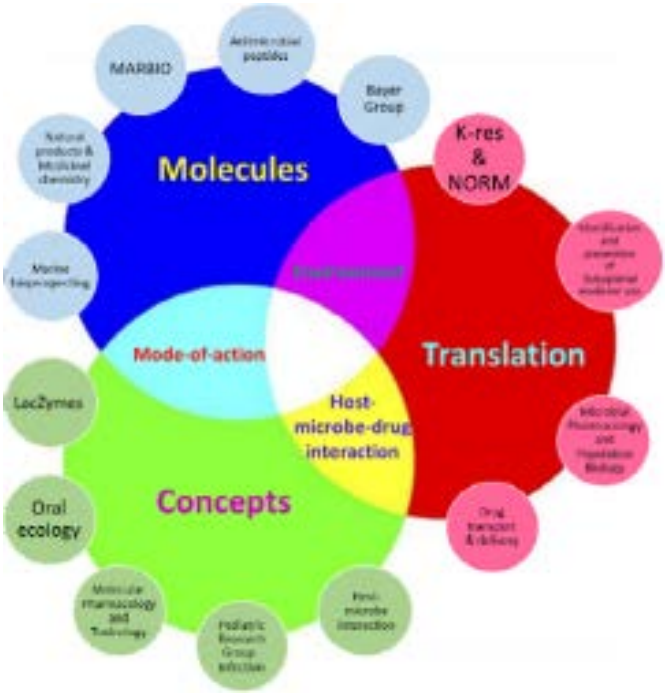
8. Scientific publications in peer reviewed journals (n= 73). Se page 14 for details.

About CANS

The Centre for New Antibacterial Strategies (CANS) is an interdisciplinary centre at UiT-The Arctic University of Norway. CANS was established in 2019 and focus on antimicrobial resistance activities encompassing:

- Research
- Education
- Innovation
- Dissemination

CANS includes 16 research groups located at three different faculties at UiT, the Faculty of Health Sciences, Faculty of Science and Technology, and Faculty of Bioscience, Fisheries and Economics. Since start-up, the focus has been on recruiting new tenure-track-, associate professor-, PhD- and postdoc positions, establish arenas for interactions and communication, publications and external funding.



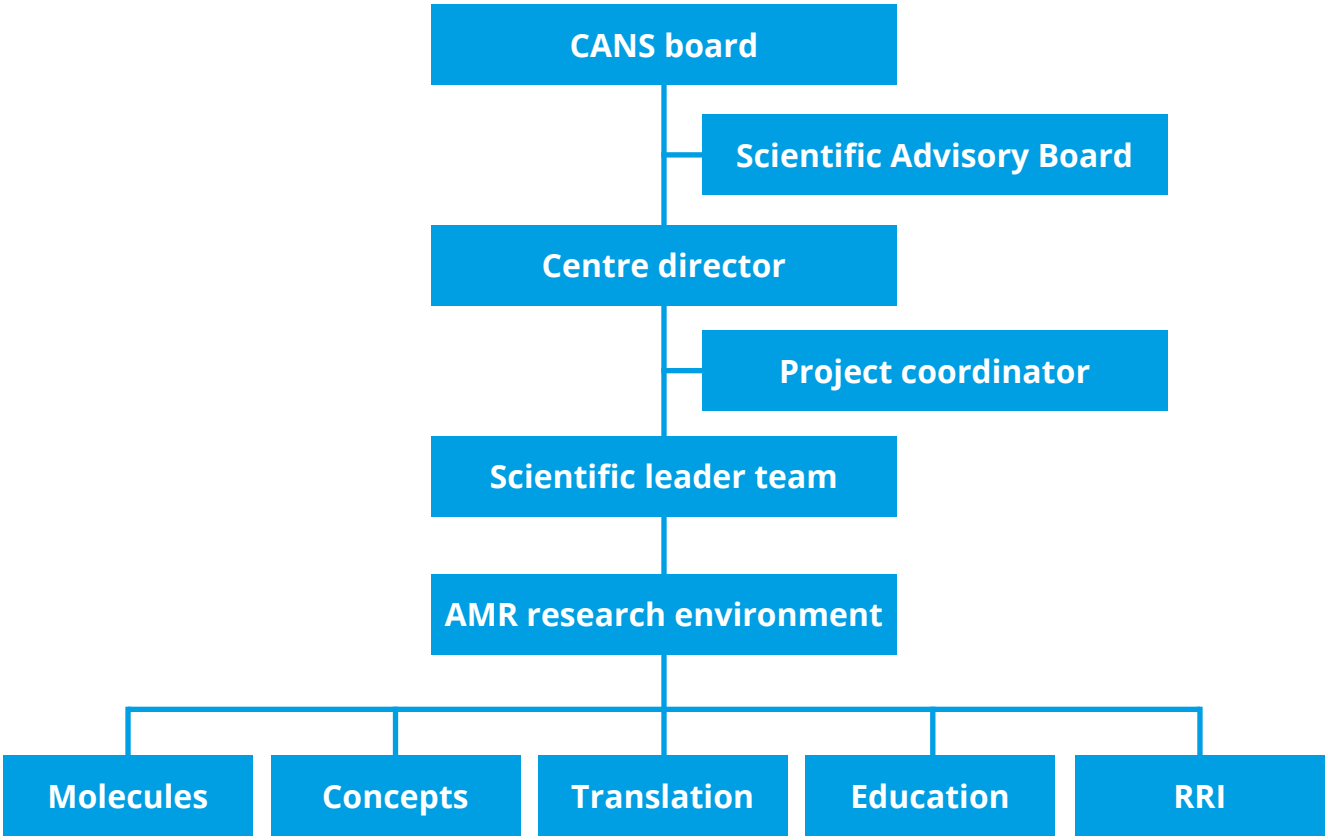
Research communities with expertise that form the basis for CANS

The development of CANS proceed along three strategic axes - consolidation, fortification and direction.

Consolidation by creating and nurturing a framework for ambitious interdisciplinary collaboration generated by a centre-structure with management and overreaching strategy. **Fortification** by adding resources to underdeveloped important areas within the existing portfolio of activity. Finally, adding the **direction** to the AMR research by establishing new research initiatives filling the competence gaps that inhibit our ability to realize the strategy.

The centre aims to strengthen current activities, but also support new basic research in novel concepts for sustainable activities in AMR-prevention and treatment strategies through new permanent and temporary (tenure-track, postdoc and PhD) positions.

CANS organization



CANS Board

The CANS board are made up of representatives from the three faculties and the Rector. The Board is in charge of the overall direction of the Centre.

Name	Faculty
Kenneth Ruud, chair	Prorector, UiT
Thrina Lønnechen	HVF
Terje Martinussen	BFE
Arne Smalås	NTF

Scientific leader team

The scientific leader team is formed of professors from the three faculties. The members hold a 10% operational role in CANS and provide academic support for the centre leader in a 50% position.

Name	Faculty
Arnfinn Sundsfjord, Centre Leader	HVF
Johanna E. Sollid	HVF
John Sigurd Mjøen Svendsen	NTF
Klara Stensvåg	BFE

Scientific Advisory Board

The scientific advisory board (SAB) consists of representatives from similar centres. The SAB will provide scientific input, evaluate CANS` activity and provide strategic advice for future activities.

Name	Affiliation
Deniz Tasdemir	GEOMAR Helmholtz Centre for Ocean Research Kiel
Jörgen Johansson	Department of Molecular Biology, Umeå University
Ursula Theuretzbacher	Center for Anti-Infective Agents, Vienna
Ben Howden	Microbiological Diagnostic Unit (MDU) Public Health Laboratory, Melbourne

CANS research groups

CANS 16 research groups are located at three faculties and covers topics within marine bioprospecting – identification and characterization of new antibacterial activities, design and synthesis of new antibiotics and resistance inhibitors, the evolution and molecular epidemiology of AMR, host-microbe-drug interactions as well as antibiotic stewardship.

Research group	Institute	Group leader
Antibiotic resistance breakers	IK	Anette Bayer
Digibiotics	IK	John S. Mjøen Svendsen
Drug Transport and delivery research group	IFA	Natasa Skalko-Basnet
Health Data Lab	IFI	Lars Ailo Bongo
The Host-Microbe Interactions (HMI) group	IMB	Mona Johannessen
Identification and Prevention of Suboptimal medicine use	IFA	Lars Småbrekke
K-Res: Norwegain National Advisory Unit on Detection of Anti-microbial resistance	UNN	Kristin Hegstad and Ørjan Samuelsen
The LacZymes group	IK	Hanna-Kirsti S. Leiros
Marbio – an analytic platform for natural products	BFE	Jeanette Hammer Andersen
Marine Bioprospecting	BFE	Klara Stensvåg
Microbial Pharmacology and Population Biology	IFA	Pål J. Johansen
Molecular Pharmacology and Toxicology	IMB	Ingebrigt Sylte
Natural Products and Medicinal Chemistry	IFA	Morten B. Strøm
NORM – Norwegian organization for surveillance of antimicro-bial resistance	UNN	Gunnar Skov Simonsen
Oral ecology	IKO	Mohammed Al-Haroni
Pediatric research group - Infection	IKM	Trond Flægstad and Claus Klingenberg

CANS members

Three selected Research Groups and their activities

Group leader
Professor Hanna-Kirsti S. Leiros
UiT

hanna-kirsti.leiros@uit.no

Team members
Christopher Frøhlich,
PhD fellow, UiT

Susann Skagseth
Researcher, UiT (until 03.2020)

Marc Boomgaren
Researcher, UiT

The LacZymes group has a structural view on enzymes involved in ß-lactam antibiotic resistance

Main research activities:

The LacZymes group focuses on the 3D structures of ß-lactamases, enzymes breaking down ß-lactam antibiotics and deactivating their antibacterial properties. The ßlactam antibiotics have long been a cornerstone for the treatment of bacterial diseases, but worryingly many bacteria are resistant towards the drugs. The most common resistance mechanism is the production of ß-lactamases, and transferable ßlactamases-encoding genes is spreading rapidly dramatically limiting treatment options. ß-lactamases include both metallo-ß-lactamases (MBLs) and serine-ßlactamases (SBLs), and occur mainly in Gram-negative pathogens including Enterobacterales, *Pseudomonas aeruginosa and Acinetobacter baumannii*.

Achievements in 2020:

- Our work of designing and synthetizing new inhibitors together with Annette Bayer have resulted in 1 PhD (Aya Ismael) and a publication with triazole inhibitor showing promising inhibitory potential against the MBL VIM (46). In collaboration with a group at Pharmacy in Oslo, we have determined the mode of action for a zinc chelating inhibitor (58).
- PhD student Christopher Frøhlich had a research stay in Vancouver, Canada to learn new protein evolution techniques, but during the stay the laboratory unfortunately closed down due to the SARS-CoV-2 virus. Still, he acquired new knowledge learnt new methods that will be used at UiT. Scientific results from the research stay are in the publication pipeline. In the field of protein evolution, we collaborate with Prof Pål Jarle Johansen (IFI, UiT) and Prof Ørjan Samuelsen (UNN). Here our new crystal structures of evolved SBL OXA-48 mutants unraveled loop flexibility, structural rearrangements and new details from binding of the antibiotic ceftazidime (unpublished).
- The newly resolved crystal structures of environmental MBLS (MYO-1, ECV-1) unravelled second shell amino acids adjacent to the active site, possibly responsi-ble for the relatively low hydrolytic activity of these enzymes (11). The new crystal structures the SBL identified from hospital wastewater OXA-655, complexed with meropenem; and OXA-10 complexed with imipenem and ertapenem gave valu-able molecular mechanistic results (41).
- Our new crystal structures and structural analysis have seeded lights on enzyme mechanist details, molecular mechanisms, aided inhibitor design, and proposed mode of action for promising inhibitors. The interdisciplinary collaborations have been important for all the results.

Geographical abstract *from the paper with triazole inhibitors" (46).*

- Aya Ismael, PhD defence, 21.10.2020. Tittle of thesis "Method development towards synthesis of carbapene-mase inhibitors".
- One PhD position has been announced
- Christopher Fröhlich gave a talk at GW4 Multidisciplinary Approaches to AMR: From Bench to Bedside and Beyond 2020, UK. 03.12.20. «Ceftazidime drives the evolution of the carbapenamase OXA-48».
- The LacZymes group and co-authors published papers in 2020: 11, 41, 46, 58.

Group leader
Professor Klara Stensvåg
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Team members
Tor Haug
Professor, UiT

Hans-Matti Blencke
Associate Professor, UiT

Ida Kristine Østnes Hansen
Senior engineer, UiT

Hege Devold
Dept. engineer

Céline Sarah Marine Richard
PhD fellow

Andrea Iselin Elvheim
PhD fellow

Christoffer Sivertsen
PhD fellow

Ataur Rahman,
PhD fellow

Hymonti Dey
PhD fellow

Bjarne Landfald
Emeritus professor

6 Master students; in 2020

4 Bachelor students
(individual thesis), spring 2020.

Marine Bioprospecting

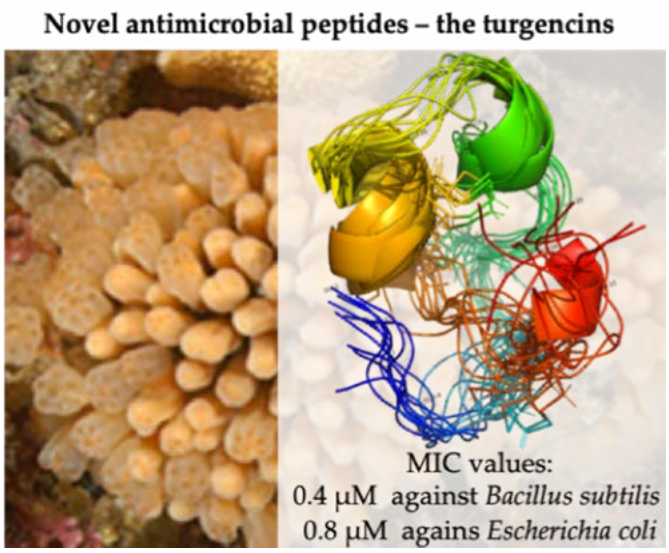
Main research activities:

The focus of the group is bioactive molecules from the marine environment with a particular focus on marine antibacterials and anti-biofilm secondary metabolites (including host defense peptides). The overall characteristics of novel compounds is essential to evaluate their potential in further developmental phases towards novel drug leads, or to be used to define and design novel antimicrobial leads.

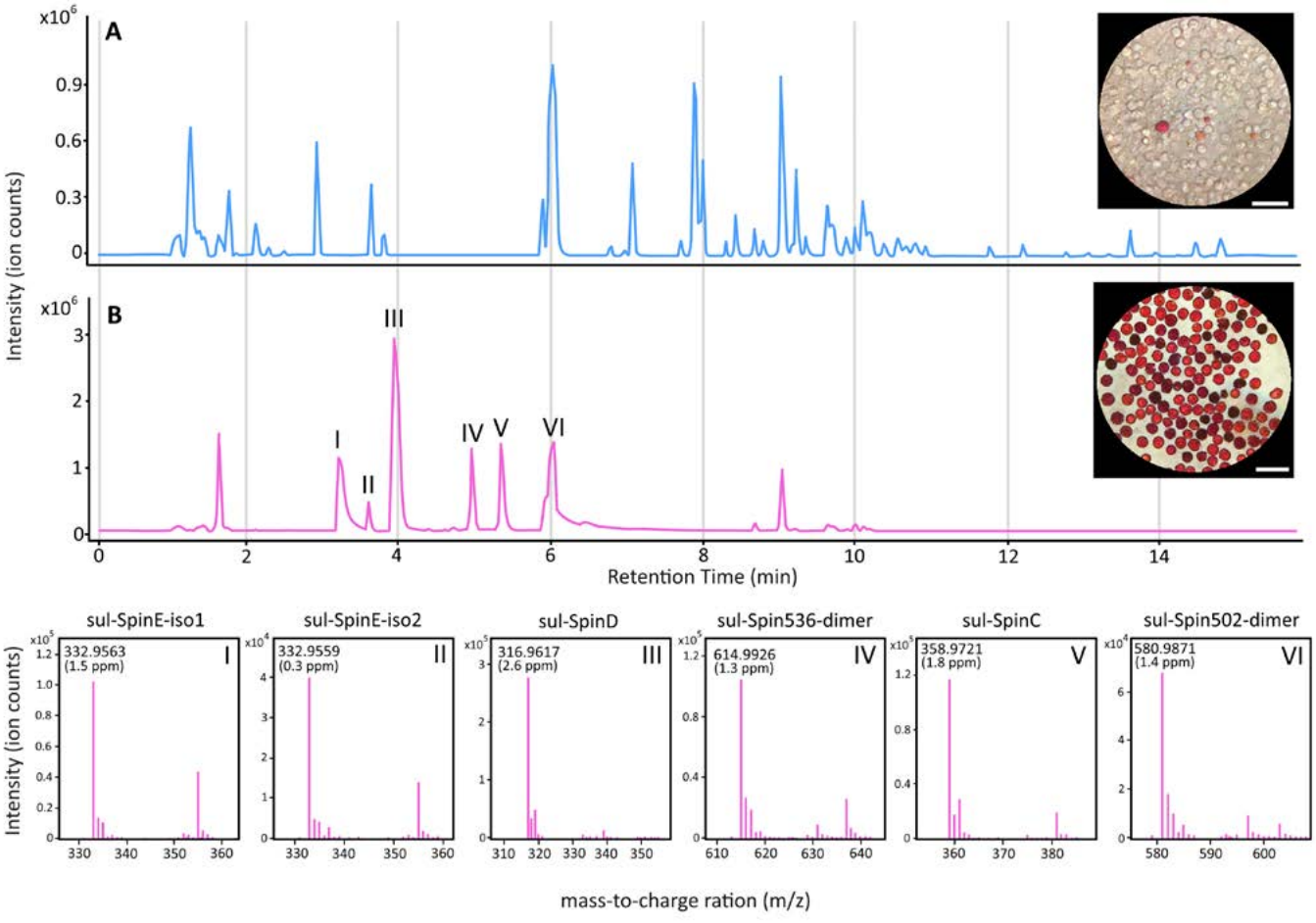
Achievements in 2020:

- Antimicrobial peptides with two novel cysteine-rich antibacterial peptides, turgencin A and turgencin B, along with their oxidized derivatives, from the Arctic marine colonial ascidian Synoicum turgens.
- In the interdisciplinary strategic AntifoMar project – on bioactive secondary metabolites, preferably novel anti-microbials or biofilm inhibitors, we have interestingresults half way into the project:
  - Marine bacteria, isolated from Artic cruises, characterized with MALDI-TOF, producing antibacterial active substances that is in ongoing follow up studies.
  - Identification on **PKS and NRPS clusters in marine bacteria** based on using Illumina and Nanopore sequencing (is ongoing).
  - **Novel synthesized marine natural products mimics** (MNPMs) are tested for antimicrobial activity. Among 73 tested, 14 are active against both Grampositive and Gram-negative bacteria, and 24 MNPMs are found to be active only against Gram-positive bacteria (follow up is ongoing).
  - Novel biosensor assays based on stable chromosomal inserts of luminescence producing gene (ongoing).
- Characterizations of bioactive spinochromes isolated from autofluorescence mediated red spherulocytes form sea urchins, Strongylocentrotus droebachiensis. A novel method for purification of cells before extraction, optimize the outcome of active substances.
- The Marine Bioprospecting group and co-authors published 4 papers in 2020 (21, 22, 26, 63).
- The Marine Bioprospecting group presented at several meetings in 2020:
  - Andrea I. et al. *Analysis of multiple displacement amplified "mini-metagenomes" from the prokaryotic populations of marine invertebrates.* Functional Metagenomics 2019, Trondheim, Norway, June 16th-19th, 2019.
  - Stensvåg, K. et al. *Marine antimicrobial host defense peptides – an inspiration for new bioactive compounds to fight bacteria.* Functional Metagenomics 2019, Trondheim, Norway, June 16th-19th, 2019.
  - Hira, J. et al. *A simplified and robust method for isolating red spherule cells, and important immune cell of echinoderms.* Norwegian Biochemical Society contact Meeting 2020; 2020-01-23 - 2020-01-26.
  - Richards, C.S.M et al. *Engineering a toolbox of novel biosensors for deeper biodiscovery by enhancing current screening strategies.* Norwegian Biochemical Society Contact Meeting 2020; 2020-01-23 - 2020-01-26.
  - Rahman, A. et al. *Novel antimicrobial and biofilm-inhibitors from marine resources.* Norwegian Biochemical Society Contact Meeting 2020; 2020-01-23 - 2020-01-26.
  - Elvheim, A. I et al. *Analysis of multiple displacement amplified "minimetagenomes" from the prokaryotic populations of marine invertebrates.* Norwegian Bio-chemical Society Contact Meeting 2020; 2020-01-23 - 2020-01-26.
  - Rahman, A. et al. *The adhesion and internalization of Staphylococcus aureus into human epithelial cells.* Next-generation live-cell microscopy; 2020-02-17 - 2020-02-19.

- One patent application by Solstad, R.G., Strøm, M.B., Johansen, C., Stensvåg, K. & Haug, T. (2020). Antimicrobial peptides. Publ. No. 16/467601. US Patent Application No. US20200071357A1, filed 2020.03.05, 28 pages.
- One disclosure of Inventions (DOFI) by Hansen, I.K.Ø., Lövdahl, T., Simonovic, D., Strøm, M.B. & Haug, T. (2020). StAMPs – novel antimicrobial peptides. Filed 2020.02.25.
- Master-PhD student started/completed.
- Six new master student started in 2020
- Exams 2020:
  - *Hannah Ildikó Johnstad: Gábor:* Biodiscovery of Novel RNA Ligases with Biotechnological Potential. Collaboration ArcticZymes.
  - *Pål Are Enbusk:* Hydrolysat fra raudåte (Calanus finmarchicus). Effekt av avsalting ved bruk av nanofilter. Collaboration Calanus AS.
  - *Liudmila Sorokina:* Enzymatic protein hydrolysis of residual raw material from Atlantic cod. Collaboration Nofima.
  - *Ariad-na Sabina Szczybelski Ciordi:* Effectiveness assessment of a biosurfactant-based dispersant for oil spill response. Col-laboration SINTEF.
  - *Frida Helen Broback:* Bioaktive forbindelser i brunalger.
  - *Emilie Kristensen:* Bioaktive forbindelser i brunalger.
  - *Patricie Niemcova:* Recombinant expression of antimicrobial peptides from marine invertebrates. Collaboration UCT, Czech Republic.



Novel antimicrobial peptides- the turgencins



UHPLC-MS analysis of MPCs and RSCs H2O extracts. (A) and (B) illustrate different compounds identified from mixed and pure population of coelomocytes.

Group leaders
Professor Claus Klingenberg
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Professor Trond Flægstad
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Team members
Pauline Cavanagh
associate professor UiT

Hildegunn Granslo
associate professor UiT

Veronika Pettersen
associate professor UiT

Hermoine Venter
Post Doc

Runa Wolden
PhD student

Dagny Hemmingsen
PhD student

Martin Christensen
PhD student

Trym Flygel
PhD student

Ina Høiland
laboratory engineer/researcher

Aline Bjerkhaug
medical research student

Synnøve Holmebukt
medical research student

Oda Aspenes Gundersen
medical research student

Tore Gutteberg
prof emeritus, UiT

Eirin Esaiassen
associate professor UiT

Pediatric Research group - Infection

Main research activities:

Infections and antibiotics to neonates: We are collaborating with the Norwegian Neonatal Network and a network of European neonatologists. By using high quality, population based epidemiological data we aim to improve therapy for vulnerable neonates. We perform own studies on long-term follow up of side effects (gut problems, antibiotic resistance and ototoxicity). We do experimental sepsis studies in whole blood models using stimulations with different types of bacteria and novel inflammatory inhibitors. Finally, we look into metabolic response in newborns with infections.

Gut microbiota of preterm infants and in children with HIV: We aim to detect the impact of antibiotic and probiotic treatment, in different pediatric populations. In children with HIV we are specifically studying the effect of azithromycin given to prevent respiratory problems in HIV-positive African children. In preterm infants, the effects of probiotics are of great interest as probiotics are increasingly used in order to prevent gut inflammation and avoid antibiotic resistance development.

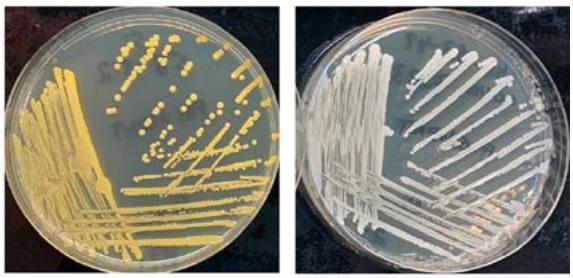
Molecular investigations of S. haemolyticus and *S. borealis:* This has been an area for our research for more than a decade and it was a break through when we also in 2020 presented a completely new staphylococcal species, S. borealis, discovered by our research group.

COVID-19 in children: 2020 was a special year for all around the world. Our group has contributed with some research and surveys on COVID-19 in neonates and children

Achievements in 2020:

Research-/Innovation highlights:

- We have reported the discovery of a new staphylococcal species *S. borealis (fig 1)*
- We have participated in several publications on COVID-19, in particular in neonates



S. borealis 58-52 | *S. haemolyticus* CCUG 7323^T

- We have reported data from a large RCT on azithromycin vs placebo in Africa in JAMA
- We have had in total 23 publications in PubMed by members of the research group

Master-PhD student started/completed:

- Maria Pain, PhD thesis completed 2020

Presentations/workshops/etc.

- PhD student Runa Wolden presented her project at IBA.
- Several talks by Claus Klingenberg on infection and newborn infants
- We have had several public outreach presentations
  - https://forskning.no/mikrobiologi/norske-forskere-har-funnet-en-ny-bakterie/1775836
  - https://www.pingvinavisa.no/med-barne-og-nyfodtforskning-som-lidenskap/
  - https://www.pingvinavisa.no/jakten-pa-antibiotikaens-lille-hjelper/

Recruitment of new employees 2020:

- Associate professors; Pauline Cavanagh
- New research medical student: Synnøve Holmebukt and Oda Gundersen

Education and training

PhD thesis completed

Name	Research group	Title of thesis
Aya Ismael	Chemical synthesis and analysis	Method development towards synthesis of carbapenese inhibitors
Antal Marinecz	Computational Pharmacology group	Mathematical Models of Antibiotic treatment
Maria Pain	The Host-Microbe Interactions group	Exploring the pangenome of Staphylococcus haemolyticus
Adriana Sanabria-Morena	The Host-Microbe Interactions group	A Shotgun-metagenomics approach for laboratory diagnostics in clinical microbiology

New projects

In 2020, CANS applied for funding from different external funds. The table shows projects that were granted funding.

Project leader	Faculty	Research group	Funding source	Project title
Sybil Obuobi	HVF	Drug Transport and Delivery Research	TFS starting grant	Bacteria responsive and intrinsically active antimicrobial nanohybrids
Arnfinn Sundsfjord	HVF	The Host-Microbe Interaction group	Trond Mohn Foundation	AMR-Bridge (2020-24)
Arnfinn Sundsfjord	HVF	The Host-Microbe Interaction group	Trond Mohn Foundation	KLEB-GAP (2019-24)
Christian Lentz	HVF	The Host-Microbe Interaction group	Helse Nord	Activity- based proteomic mining of enzyme targets for clinical control of vancomycin-resistant Enterococcus faecium 2021-24.
Veronika Pettersen	HVF	The Host-Microbe Interaction group	Helse Nord	Gut microbiome-based biomarkers to prevent infections by antimicrobial resistant bacteria in infancy 2021-24.
Arnfinn Sundsfjord	HVF	The Host-Microbe Interaction group	Helse Nord	Novel insights in gut microbiome-resistome composition and Klebsiella pneumoniae colonization patterns in mitigation of antimicrobial resistance: A population-based study among adults and elderly in Norway 2021-24.
Johnsen/ Harms/ Samuelsen	HVF	MicroPop	Helse Nord	Can cancer Chemotherapy drive antibiotic resistance evolution 2021-24.
Veronika Pettersen	HVF	The Host-Microbe Interaction group	Norwegian Cancer Society	Endringer i tarmmikrobiomet hos barn med kreft, 2021-24.
Partner Arnfinn Sundsfjord	HVF	HMI	The Research Council of Norway	Antimicrobial Resistance in One Health Interfaces (CORNELIA), 2021-25.
Partner Jeanette Hammer	BFE	Marbio	The Research Council of Norway	New integrated approach for fungal natural product discovery based on co-occurrence networks of interacting microbes. 2021 -
Partner Klara Stensvåg	BFE	Marin Bioprospektering	The Research Council of Norway	DeepSeaQuence- Uncovering the metabolic secrets and capacity of Arctic deep-sea hydrothermal vent microbiomes - 2021
Anne-Merethe Hanssen	HVF	The Host-Microbe Interaction group	Odd Berg Medisinske forskningsfond	

Outreach activities

The research has been communicated to the scientific- and general public in different ways. Outreach activities includes meetings with e.g. Norwegian Cancer Society, publications, regular scientific seminars with invited- or internal speakers. Due to Covid-19, the CANS annual conference has been postponed and there has been less outreach activities at the international level, such as conference/workshop activities, than expected.

CANS seminars

Name	Institution	Title of presentation
Carlos Bezuidenhout	North-West University, South Africa	Microbial dynamics and environmental dimensions of antimicrobial resistance: Studies at the North-West University
Teppo Rämä	Marbio, UiT	Fungal cultivability and activation of silent gene clusters encoding the production of antibacterial secondary metabolites
Octavio Luiz Franco	Universidade Católica Dom Bosco, Campo Grande, MS, Brazil	In silico optimization of antimicrobial peptide enables combinatorial exploration for novel compounds with anti-infectious activities
Stephen Dela Ahator	South China Agricultural University	A combination of population dynamics and environmental factors drive the adaptive evolution of Pseudomonas aeruginosa during phage infection

Conferences/Workshops/Meetings

- BIOPROSP_21, Nordic Natural Products Conference 2021 (NNPC21),
- Keystone Symposia eSymposia meeting, "The Microbiome: From Mother to Child," (HMI group)
- Talk at Dyphavssenteret, Department of Biological Sciences, KGJ Centre for Deep-Sea Research, University of Bergen, 17.mars 2021 (Marin Biopros.)
- Forskningsdagene (HMI group)
- Overseas activity of a PhD from marine Bioprospec. group going to Dan Andersons Director Uppsala Antibiotic Center, Uppsala University, Dept. of Medical Biochemistry and Microbiologylab in Uppsala

Award

- BFE Research award 2020 to Marbio

Publications

Journal Papers

1. Achten, N.B., Klingenberg, C., Plötz, F.B. (2020) Neonatal Early-Onset Sepsis Calculator and Antibiotic Therapy-Reply. JAMA Pediatr. 2020 May 1,174(5):508-509. doi:10.1001/jamapediatrics.2019.6269.

2. Dretvik, T., Solevåg, A.L., Finvåg, A., Størdal ,E.H., Størdal, K., Klingenberg, C. (2020) Active antibiotic discontinuation in suspected but not confirmed early-onset neonatal sepsis-A quality improvement initiative. Acta Paediatr. 2020 Jun,109(6):1125-1130. https://doi.org/10.1111/apa.15202

3. Elvebakk, A., Park, S.G., Haeng, C., Rämä, T. (2020) Psoroma capense and P. esterhuyseniae (Pannariaceae), two new alpine species from South Africa. The Lichenologist 2020, Volum 52.(5) s. 345-352. https://doi.org/10.1017/S0024282920000377

4. Ezawa, T., Saito, R., Suzuki, S., Sugiyama, S., Sylte, I., Kurita, N. (2020) Protonation states of central amino acids in a zinc metalloprotease complexed with inhibitor: Molecular mechanics optimizations and ab initio molecular orbital calculations. Biophys Chem. 2020 Jun, 261:106368. https://doi.org/10.1016/j.bpc.2020.106368

5. Ezawa ,T., Sugiyama, S., Ara, A., Sylte, I., Kurita, N. (2020) Design of galardine analogs as putative psudolysin inhibitors based on ab initio fragment molecular orbital calculations. J Biomol Struct Dyn. 2020 Jul,38(11):3307-3317. Epub 2019 Aug 29.PMID: 31422741 http://dx.doi.org/10.1080/07391102.2019.1656672

6. Fellner, M., Lentz, C.S., Jamieson, S.A., Brewster, J.L., Chen, L., Bogyo, M., Mace, P.D. (2020) Structural Basis for the Inhibitor and Substrate Specificity of the Unique Fph Serine Hydrolases of Staphylococcus aureus. ACS Infect Dis. 2020 Oct 9,6(10):2771-2782. https://pubmed.ncbi.nlm.nih.gov/32865965/

7. Ferrand, R.A., McHugh, G., Rehman, A.M., Mujuru, H., Simms, V., Majonga, E.D., Nicol, M.P., Flaegstad, T., Gutteberg, T.J., Gonzalez-Martinez, C., Corbett, E.L., Rowland-Jones, S.L., Kranzer, K., Weiss, H.A., Odland, J.O., BREATHE Trial Group.(2020) Effect of Once-Weekly Azithromycin vs Placebo in Children With HIV-Associated Chronic Lung Disease: The BREATHE Randomized Clinical Trial. JAMA Netw Open. 2020 Dec 1,3(12):e2028484. https://doi.org/10.1001/jamanetworkopen.2020.28484

8. Flygel, T.T., Sovershaeva, E., Claassen-Weitz, S., Hjerde, E., Mwaikono, K,S., Odland, J.Ø., Ferrand, R.A., Mchugh, G., Gutteberg, T.J., Nicol, M.P., Cavanagh, J.P., Flægstad, T., BREATHE Study Team. (2020) Composition of Gut Microbiota of Children and Adolescents With Perinatal Human Immunodeficiency Virus Infection Taking Antiretroviral Therapy in Zimbabwe. J Infect Dis. 2020 Jan 14,221(3):483-492. https://doi.org/10.1093/infdis/jiz473

9. Frid, P., Baraniya, D., Halbig, J., Rypdal, V., Songstad, N.T., Rosèn, A., Berstad, J.R., Flatø, B., Alakwaa, F., Gil, E.G., Cetrelli, L., Chen, T., Al-Hebshi, N.N., Nordal, E., Al-Haroni, M.(2020) Salivary Oral Microbiome of Children With Juvenile Idiopathic Arthritis: A Norwegian Cross-Sectional Study. Front Cell Infect Microbiol. 2020 Nov 4;10:602239. https://doi.org/10.3389/fcimb.2020.602239

10. Fröhlich, C., Gama, J.A., Harms, K., Hirvonen ,V.H.A., Lund, B.A., van der Kamp, M.W., Johnsen, P.J., Samuelsen, Ø., Leiros H.-K.S. (2020) Cryptic β-lactamase evolution is driven by low β-lactam concentrations. Submitted to Communications Biology, Jan 2021 https://doi.org/10.1101/2020.12.01.404343

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Poster presentations

1. Veronika K Pettersen - The World of Microbiome: Pregnancy Birth & Infancy 2020 (04/11/2020 - 06/11/2020) and CSHL Microbiome (October 20–October 23, 2020)

2. Theresa Wagner, Mona Johannessen, Kristin Hegstad. Towards a vaccine based on enterococcal membrane vesicles. Poster Optimmunize: Improving the beneficial effects of vaccines; Cambridgeshire, UK.

3. Srijana Bastakoti. Oral poster presentation «Identification of key determinants for S. aureus throat colonization: a transcriptomic approach" meeting at National graduate school in infection biology and antimicrobials (IBA) PhD school 26th of November

4. Andrea I. Elvheim, Chun Li, Bjarne Landfald. Analysis of multiple displacement amplified "mini-metagenomes" from the prokaryotic populations of marine invertebrates. Functional Metagenomics 2019, Trondheim, Norway, June 16th-19th, 2019

5. Klara Stensvåg, Jonathan Hira, Ekaterina Mishchenko, Hans-Matti Blencke, Morten Strøm, Bjarne Landfald, Johanna Sollid, and Tor Haug. Marine antimicrobial host defense peptides – an inspiration for new bioactive compounds to fight bacteria. Functional Metagenomics 2019, Trondheim, Norway, June 16th-19th, 2019

6. Celine Sarah marine Richards, Hans-Matti Blencke. Engineering a toolbox of novel biosensors for deeper bio-discovery by enhancing current screening strategies. Norwegian Biochemical Society Contact Meeting 2020; 2020-01-23 - 2020-01-26

7. Rahman, Ataur; Langer, Manuel Karl; Dey, Hymonti; Hira, Jonathan; Mishchenko, Ekaterina; Bayer, Annette; Haug, Tor; Landfald, Bjarne; Sollid, Johanna U Ericson; Strøm, Morten B.; Stensvåg, Klara. Novel antimicrobial and biofilm-inhibitors from marine resources. Norwegian Biochemical Society Contact Meeting 2020; 2020-01-23 - 2020-01-26

8. Rahman, Ataur; Mishchenko, Ekaterina; Wolfson, Deanna; Dey, Hymonti; Sollid, Johanna U Ericson; Stensvåg, Klara. The adhesion and internalization of Staphylococcus aureus into human epithelial cells. Next-generation live-cell microscopy; 2020-02-17 - 2020-02-19.

9. Andrea I. Elvheim, Chun Li, Bjarne Landfald. Analysis of multiple displacement amplified "mini-metagenomes" from the prokaryotic populations of marine invertebrates. Norwegian Biochemical Society Contact Meeting 2020; 2020-01-23 - 2020-01-26

Other Disseminations

1. Sollund, B.L. og Sundsfjord, A. Tromsø-forskere går foran i kampen mot en pandemi som er skumlere enn korona. Kronikk, Nordnorsk debatt, 23. November 2020, https://www.nordnorskdebatt.no/tromso-forskere-gar-foran-i-kampen-mot-en-pandemi-som-er-skumlere-en-korona/o/5-124-3692

2. Forskere i nord samles til krig mot antibiotikaresistens, Farmatid.no, 2020, https://www.farmatid.no/artikler/forskere-nord-samles-til-krig-mot-resistens

   - Arnfinn har kjempet mot resistensproblemet i over 20 år.
   - Tarmen og Google Maps kan skjule løsningen på antibiotikaresistens.
   - Første nye antibiotikum på 30 år kan komme fra nord.
   - Kjemikerne prøver å stoppe kjeften på antibiotikadreperne.
   - Bakterienes egne våpen kan brukes mot dem.
   - Tromsø tar hånd om verstingbakteriene i Norge.

3. Nordgård, L., og Sundsfjord, A. (2020) CANS – UiTs tverrfaglige Senter fro nye antibakterielle strategier, LVS info 2/2020, https://www.legeforeningen.no/contentassets/e521d59936494b50828219a9630c70de/lvsinfo-2-2020-lr.pdf

4. Nordgård, L., Stensvåg, K., Sundsfjord, A.CANS - Tverrfaglig senter for nye antibakterielle strategier ved Norges universitet. NBS-nytt 03.08.2020, https://fagpressenytt.no/artikkel/cans-tverrfaglig-senter-nye-antibakterielle-strategier-ved-norges-arktiske-universitet-uit

5. Antibiotikaresistens, en trussel mot folkehelsen?, Åpent folkemøte 18.11.2019, Verdensteateret, Tromsø.

6. Kampen mot sykehusets skrekk: Klebsiella pneumoniae, 06.12.2019, NRK radio P2, Ekko.

7. BFE research award 2020 to Marbio

8. Jakta på det gode livet, NRK: https://tv.nrk.no/serie/jakta-paa-det-gode-livet/sesong/1/episode/1

9. Interview i Forskning.no: «Små hjelpestoffer kan få gammel antibiotika til å virke igjen» https://forskning.no/bakterier-helse-kjemi/sma-hjelpestoffer-kan-fa-gammel-antibiotika-til-a-virke-igjen/1711852

10. Milliondryss til tre nye forskningsprosjekt ved UiT: https://uit.no/nyheter/artikkel?p_document_id=708658https://uit.no/nyheter/artikkel?p_document_id=708658

11. An article in Norwegian where Hanna-Kirsti is interviewed entitled: «Vil ha 40 prosent kvinner i toppstillingar», http://kifinfo.no/nb/2020/09/vil-ha-40-prosent-kvinner-i-toppstillingar

12. Norske forskere har funnet ny bakterie, Forskning.no, https://forskning.no/mikrobiologi/norske-forskere-har-funnet-en-ny-bakterie/1775836

13. https://www.pingvinavisa.no/med-barne-og-nyfodtforskning-som-lidenskap/

14. https://www.pingvinavisa.no/jakten-pa-antibiotikaens-lille-hjelper/