HaloSYS

INTEGRATED SYSTEM OF BIOREMEDIATION – BIOREFINERING USING HALOPHYTE SPECIES

On bioremediation side:

a. Land affected by salinity - before

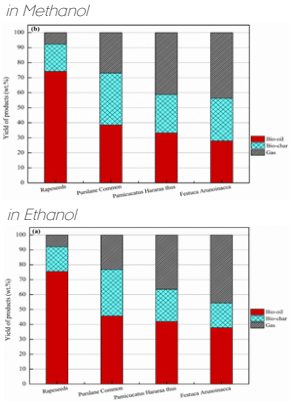
b. Native Salicornia from Lacu Sarat tested on affected land

c. Land affected by salinity – after 2 cycle of plant adaptation and treatment

On bioremediation side:

Compound	Soil 1 (3.0 dS/cm)	Soil 2 (11.8 dS/cm)	Soil 3 (0.3 dS/cm)
Festuca			
Vitexin (µg/g)	0.519	0.106	0.094
Isovitexin (µg/g)	0.350	0.166	0.018
Isoquercitrin (µg/g)	15.223	7.377	29.220
Quercitin (µg/g)	0.178	0.119	0.045
Isorhamnetin (µg/g)	0.424	0.162	0.169
Limonium			
Orientin (µg/g)	10.752	9.427	7.748
Isovitexin (µg/g)	0.038	0.058	0.023
Isoquertricin (µg/g)	2.131	3.073	1.904
Salicornia			
Isoquercitrin (µg/g)	26.658	24.720	12.822
Quercetin (µg/g)	0.224	0.171	0.056
Isorhamnetin (µg/g)	0.109	0.154	0.084
Portulaca			
Isoquercitrin (µg/g)	1.005	0.701	0.072
Quercetin (µg/g)	0.186	0.043	0.039
Isorhamnetin (µg/g)	0.018	0.020	0.026
Kaempferol (µg/g)	0.025	0.020	0.013

a. Bioactive compounds



b. integrated hydrothermal treatment of seeds (PhD thesis)

c. Bio-composite and briquets

2° Call: 2017

Project period: 06/2018 - 12/2021

Topic: Sustainable intensification of non-food biomass production and decentral-ised transformation systems, in particular small scale multi-product biorefinery concepts

Keywords: Soil salinity, adaptive mechanisms, biorefinery

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projects.au.dk/faccesurplus/research-projects-2nd-call/halosys/

FACCE SURPLUS
SUSTAINABLE AND RESILIENT AGRICULTURE FOR FOOD AND NON-FOOD SYSTEMS

HaloSYS

BACKGROUND

The dynamic development of economic activities often causes changes in the environment and human life quality. One example of such harmful changes is the extensive use of agricultural soils for dedicated biomass for biofuels (deforestation, food / feed competition, excessively use of fresh water). There is an urgent need to intervene by any means to reduce these impacts. Soil salinisation induced by natural causes and anthropic activities affects 1 to 3 million ha in EU. Such soils have low or zero suitability for traditional agriculture production, influencing the decline of regional economics. To achieve the restoration of agriculture production and thus economical growth, the remediation of affected soils through efficient and economic ways is necessary. HaloSYS project addresses the challenge of using halophytes to develop integrated bioremediation and biorefining system. Specific halophyte spp. are taken into account, such as:

- *Salicornia spp.* with high tolerance for salinity and drought, produces seeds that contain up to 26-33% oil and up to 30% proteins (Chaturvedi, 2013; Fidler, 2004).
- *Portulaca oleracea L.* is able to extracts a significant amount of salt from the soil. In one growing season it can remove up to 210 kg/ha of Cl and 65 kg/ha of Na. The plant has a short vegetation period and a production all year, can allow a continuous salt removal (Hasanuzzaman, 2014, 2018; Kilic, 2008).

OBJECTIVE

- Sustainable use of unsuitable lands for any agriculture purpose;
- Bio-based products through biorefining: separation of biomass major components (fibres, sugars, oils, proteins); extraction, identification and characterisation of specific bioactive molecules (flavonoids, phenols, alkaloids,etc.); developing new bioproducts;
- Biologic carbon sequestration.

METHODOLOGY

The project aims to develop economically feasible pathways, which couple the use of salt-affected soils for the production of halophyte biomass with advanced biorefining processes of obtained biomass, opening the opportunity for new added value bioproduct formulation. The experiments involve saline soil taken from natural sites and a study on ecological amplitude of investigated species (varieties) of plants is on going. Further, the work will be conducted on the use of obtained biomass to develop new value chains.

RESULTS AND KEY FINDINGS

On soil with controlled salinity, *Festuca arundinacea* showed the best performances in term of adaptation, while on soils sampled from real environment, it was found that best performances in adaptation at saline stress are shown by *Limonium sinuatum sp.*, which also is the richest in biological active compounds (antioxidants). *Salicornia europaea sp.* registered excellent salts absorption capacities, the electrical conductivity of soils decreasing during the applied bioremediation technology from 11.8 to 4.1 dS/cm, from 3.0 to 0.90 dS/cm, and from 1.6 to 0.6 dS/cm. The produced biomass is suitable to integrate the existing path for cellulosic resources valorisation: bioethanol through fermentative process, fibers extraction and biocomposite design, upgradable biooil for liquid fuels production. The residual biomass is either pelleted or transformed in biochar.

Sand-reed
Calamagrostis epigejos

Praire spartina
Spartina pectinata

Portulaca sativa

Glasswort
Slicornia europaea

Tall fescue
Festuca arundinacea

Hemp
Cannabis sativa L

Amaranthus cruentus

Sea lavender
Limonium sinuatum