Better use of entire biomass of willow

March 30 2016

VTT Technical Research Centre of Finland and Aalto University investigated how willow biomass can be utilised more efficiently. When processed correctly, willow is eminently suitable as a source of sugar in the production of ethanol. The lignin fraction formed as a by-product of the ethanol process and the fibres and compounds of willow bark are suitable for the manufacture of environmentally friendly chemicals and bio-based materials.

According to the results of the joint project of VTT and Aalto University, after appropriate preparation and enzymatic hydrolysis, willow is highly suitable as a source of sugar in ethanol production. The ethanol yield improved substantially when the willow bark was first separated from the biomass before steam explosion and yeast fermentation. A lignin-containing residue is produced in the ethanol manufacturing process from which various bio-based chemicals and materials can be manufactured.

It will be possible to utilise the results of the new research on using willow in ethanol production in industry using existing technology, especially if industrial or farm scale equipment suitable for debarking is available.

Willow has interesting fractions

The project aimed to make complete use of the biomass without producing material side streams. For this reason, the composition and structure of the bark was analysed carefully. The researchers identified a

number of compounds in the bark. These may include physiologically active components or natural antimicrobial compounds, which in the future could be utilised in bioprocesses to prevent the growth of harmful bacteria. The fibres of the bark component differed from those of the wood component in terms of composition and structure.

In addition to sugars suitable for ethanol fermentation, various fractions can be separated from willow: lignin, bark component fibres, and bioactive and antimicrobial compounds. The properties and their most suitable application areas require further studies. It is important to also investigate the environmental impacts of cultivating and processing willow as well as the economic profitability of processing.

Positive environmental impacts

There is an increasing global demand for environmentally friendly chemicals and plant-based raw materials for renewable fuels. With these, the aim is to reduce carbon dioxide emissions, replace oil-based components and produce renewable energy. These challenges can be met by using willow.

Fast-growing willow has not been widely utilised as a raw material in industry. In addition to its low price, it has numerous advantages compared to other forest or agriculture based raw materials. Willow can be grown, for example, on flood susceptible and nutrient poor land, i.e. in areas that are not suitable for forest or field cultivation. As it grows willow uses nutrients efficiently, therefore it reduces the nutrient load on water courses caused by agriculture or peat production areas.

Provided by VTT Technical Research Centre of Finland