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Possibilities of Bioethanol Production from Brown Seaweeds

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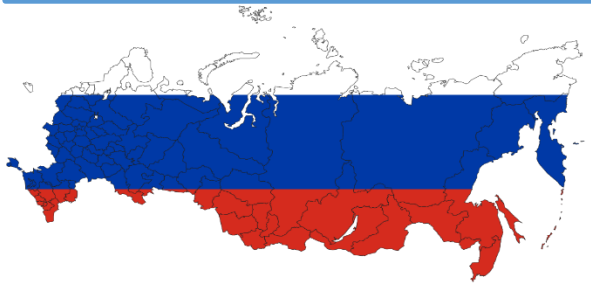
Keywords: seaweeds, bioethanol, biofuels, bioethanol production, Russia

Research Objective:

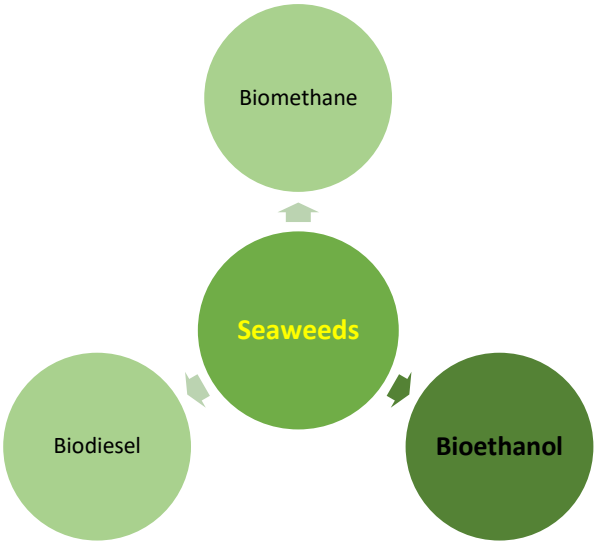
Marine seaweeds are attracting great attention all over the world as the main source of 3rd generation biofuels. One of the sources of bioethanol production (the most widely used biofuel in the world - in 2017 its production amounted to 106 billion liters) can be brown seaweeds.

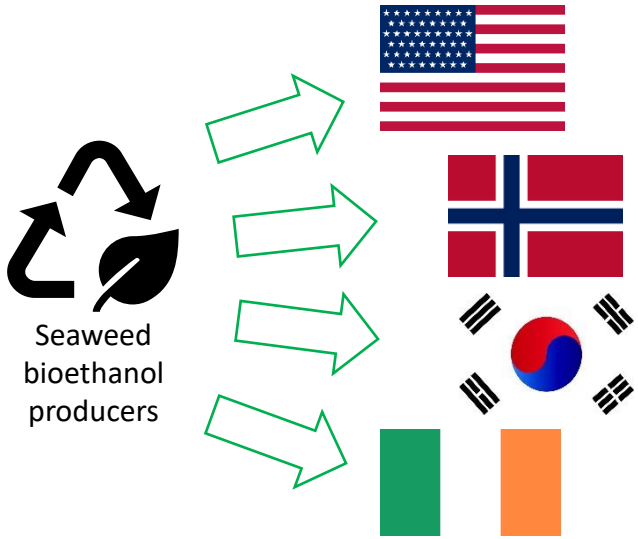
The aim of the work is to analyze the possibilities of producing bioethanol from brown seaweeds from the point of view of feedstocks preliminary processing, technological scheme, the use of strains of microorganisms for the fermentation process, identifying the advantages and disadvantages of the obtained bioethanol and assessing the global warming potential.



Seaweeds in Russia

Laminaria sp.
More than 2 mln. tons





Seaweed bioethanol producers

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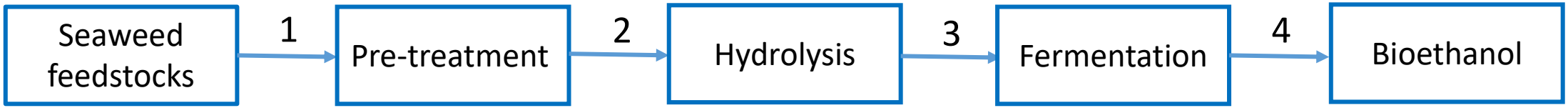
Technological scheme of bioethanol production from seaweed feedstocks



1. **Pre-treatment:** washing with sea water, drying in the sun and wind, grinding
2. **Hydrolysis:** thermal dilute acid and / or enzymatic hydrolysis.
3. **Fermentation:** it is preferable to use *Saccharomyces cerevisiae* or *Escherichia coli*.
4. **Bioethanol production:** distillation yields up to 96% bioethanol.

The technological scheme for the bioethanol production from brown seaweeds is similar to the bioethanol production from lignocellulosic biomass with the difference that seaweeds contain alginate, mannitol, fucoidan and laminarin instead of lignocellulose.

Alginates can account for up to 50% of the carbohydrate fraction in brown seaweeds and are considered essential for maximum bioethanol recovery during yeast fermentation

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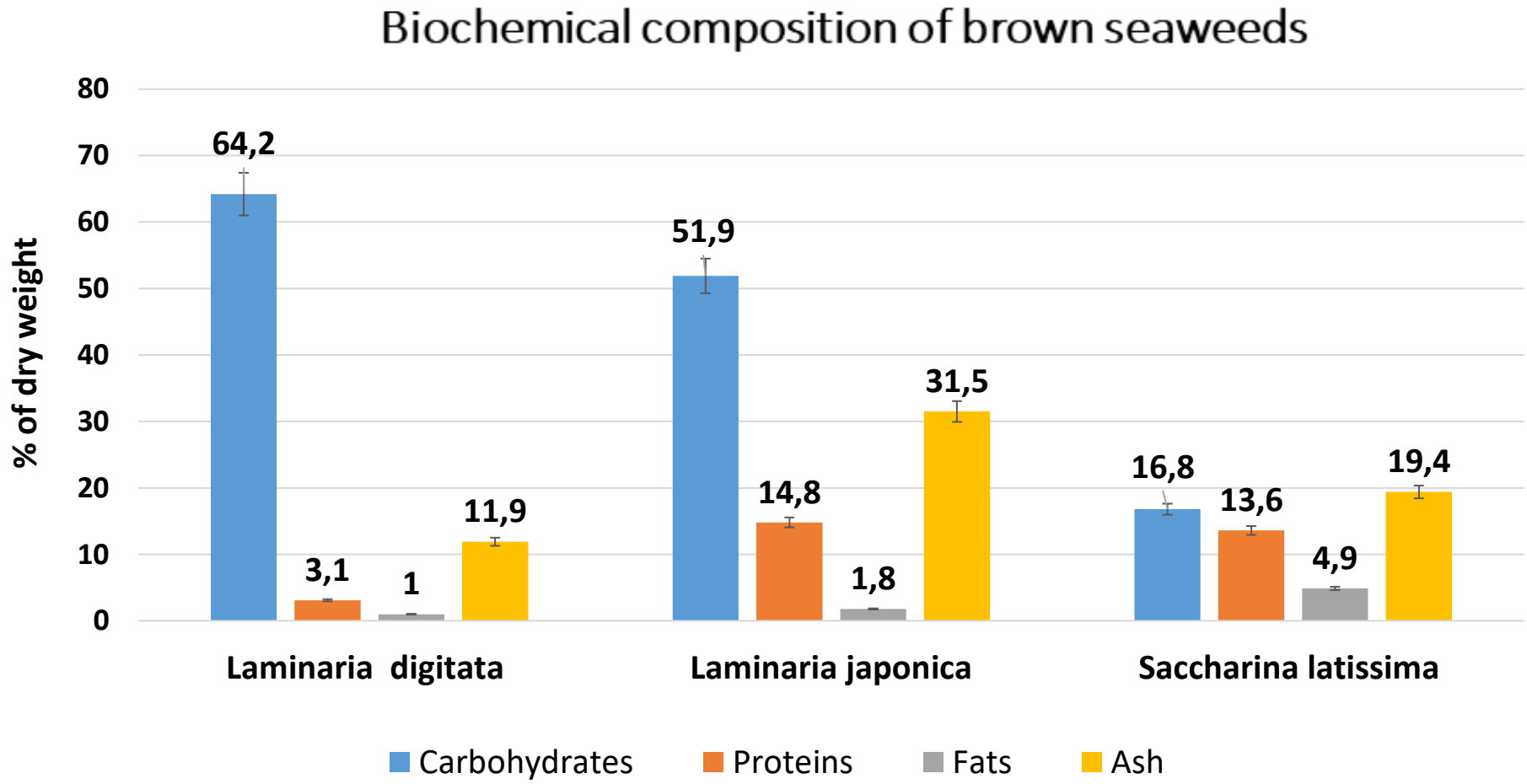

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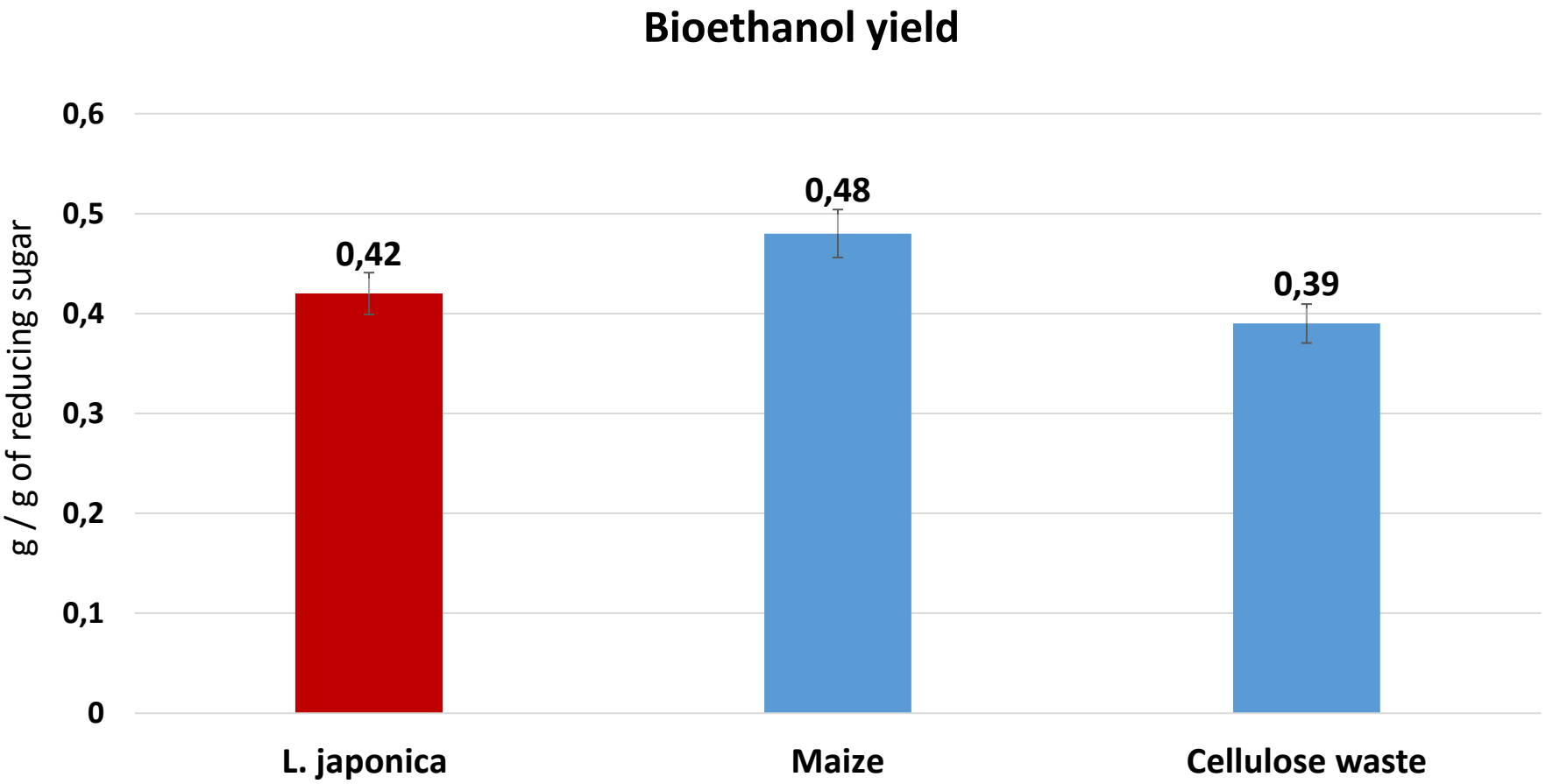

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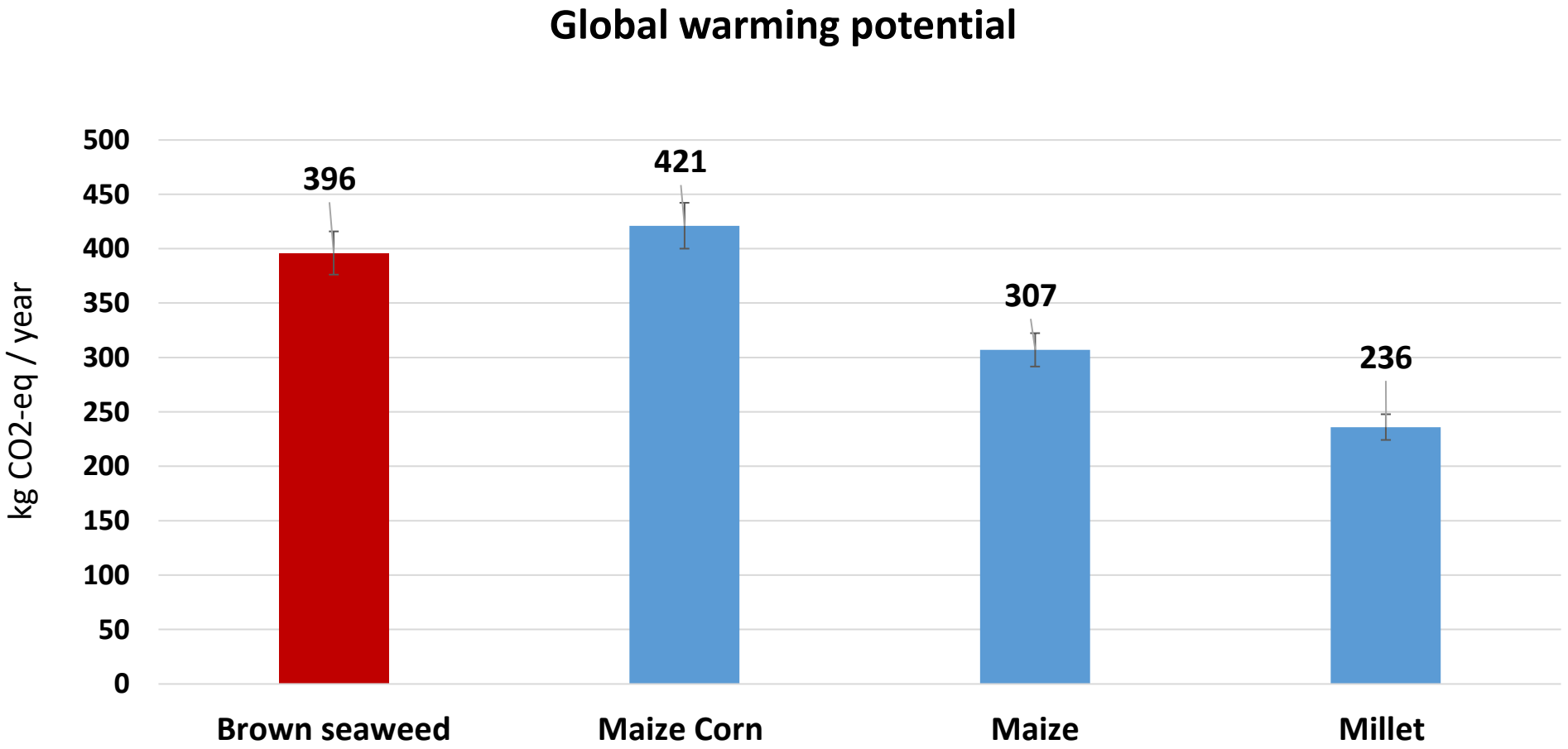

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Conclusions

The main **benefits** derived from the use of seaweed as a feedstock: they don't use agricultural land, fertilizers, pesticides and water.
Seaweeds have a much higher photosynthetic efficiency (6–8%) than land biomass (2%).
Bioethanol derived from brown seaweeds and land-based feedstocks can have significantly different global warming potentials (GWPs), since the GWP of bioethanol is influenced by biomass cultivation and bioethanol production.
Bioethanol from seaweed has no carbon debt as no crop area is used for its production.

Potential **difficulties** for the bioethanol production from brown seaweeds can be harvesting (both manual and mechanical), transportation to the biorefinery, preprocessing (drying, grinding), energy costs and materials to maintain the desired level of the process.
Another problem is the uneconomical collection of algae 1-3 months a year (in Russia, the collection of algae takes place from May to October) and the distillation of ethanol from the fermentation broth.

Considering all the difficulties and potentials of bioethanol production from brown seaweeds, over time, it is possible to transfer research from laboratories to industry and further construction of the first seaweed enterprises producing bioethanol.

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Thank you for your attention!

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