

Potential use of *Sargassum* species: an overview

Dr. Bidyut Mohapatra

Department of Biological and Chemical Sciences

E-mail: bidyut.mohapatra@cavehill.uwi.edu



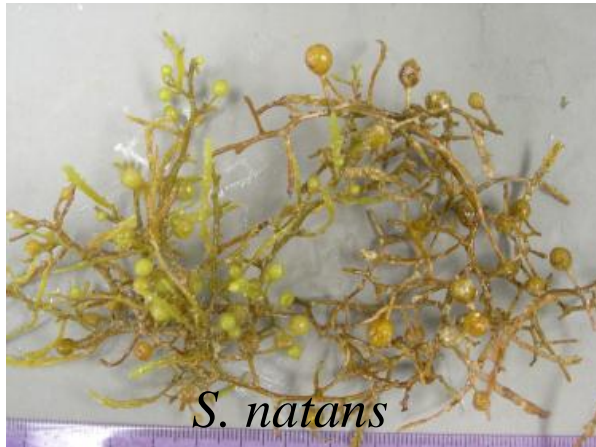
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Outline

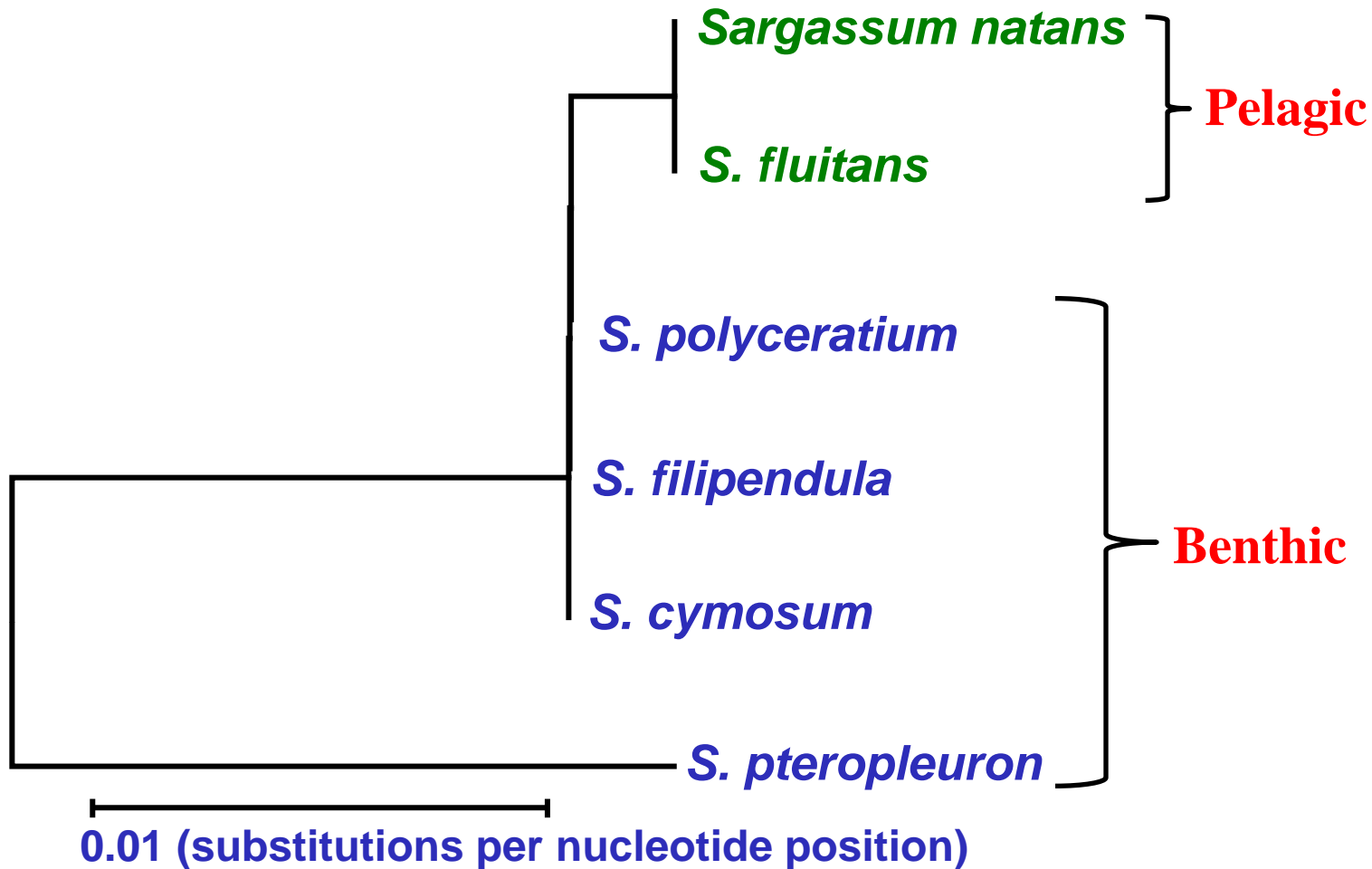
- **Classification of *Sargassum* species**
- **Potential use of *Sargassum* species**
 - **Nutraceuticals**
 - **Pharmaceuticals**
 - **Wastewater treatment**
- **Metagenomics: a tool to unlock the *full* industrial potential of *Sargassum* species**
 - **Biofuels**
 - **Novel enzymes and value-added products**

Sargassum species classification

1. **Domain:** Eukaryota (contains a nucleus)
2. **Phylum:** Ochrophyta
3. **Class:** Phaeophyceae (Brown algae)
4. **Order:** Fucales
5. **Family:** *Sargassaceae*
6. **Genus:** *Sargassum*
7. **Species:** 160 species are known to date (*2 are pelagic*)
 - **Six species are native to North Atlantic**



North Atlantic *Sargassum* – Phylogeny¹



¹Phylogenetic tree based on the divergence of internal transcribed spacer (ITS)-2 genetic region

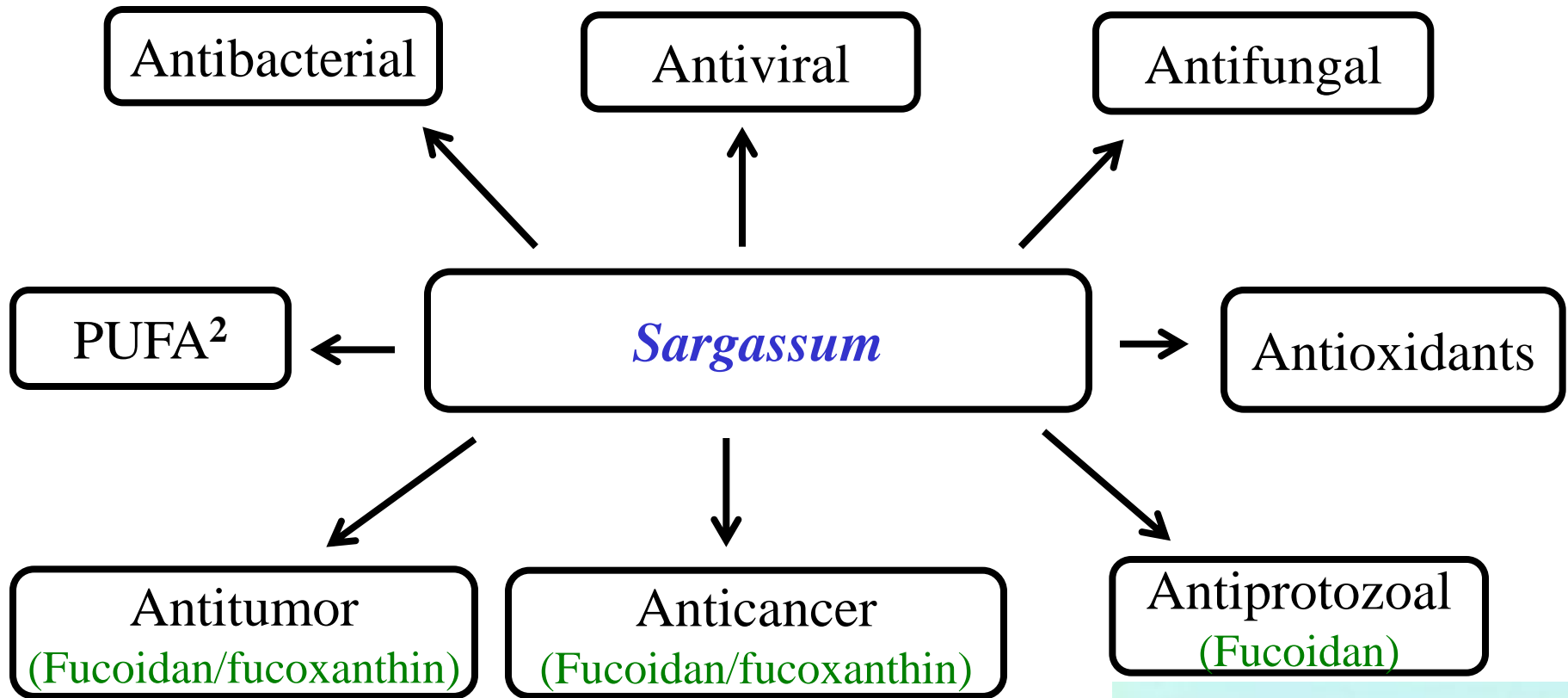
Potential use – Nutraceuticals¹

- Nutraceutical or functional food is “*any food or food ingredient that may provide a health benefit*”
- Benthic *Sargassum* species elsewhere have been consumed as nutraceuticals due to the presence of
 - PUFA (polyunsaturated fatty acids)
 - Dietary fiber, vitamins
 - Alginate, fucoidan
 - Other bioactive compounds
- *S. fusiforme* (Hijiki)
- *S. fulvellum* (Hondawara)



¹ Kim, S. (2013) Marine Nutraceuticals: Prospect and Perspectives. CRC Press, Boca Raton, FL.

Potential use – Pharmaceuticals¹



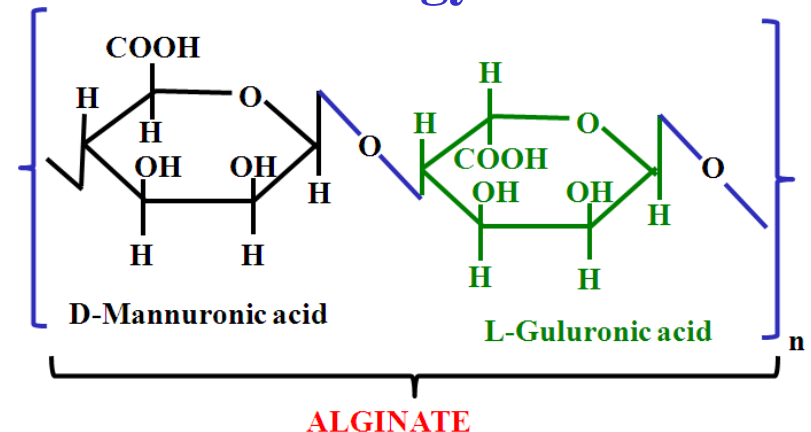
¹ Amelio, F. (1999). *Botanicals: a Phytocosmetic Desk*. CRC Press, Boca Raton, FL.

² Ginneken, V. *et al.* (2011). *Lipids Health Dis.* 10, 104.



Potential use – Wastewater treatment

- *S. natans* and *S. fluitans* contain 7-40% of alginate in the cell wall
 - **Alginate content varies with the environmental conditions**
- Alginate is an anionic polysaccharide that can chelate divalent and trivalent cations
- Dry biomass of *S. fluitans* has been reported to sequester cadmium and lead¹
- Dry biomass of *S. natans* has been reported to sequester gold from wastewater²
- Antimicrobial and gel-forming abilities of alginate can be exploited as a green material for membrane technology



¹ Fourest, E. & Volesky, B. (1996). *Environ. Sci. Technol.* 30, 277-282.

² Volesky, B. & Kuycak, N. (1988). US Patent No. 4,769,223.

Potential use – Alginate¹

Alginate

Food - Thickening and gelling agents,
FAO/WHO approved



Textile - Substrate for color paste
to print fabrics



Animal Feed - Binder and thickening
agent for pet, fish feed



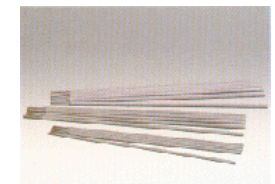
Pharmaceuticals - Forms gel in the acidic
stomach and protect stomach mucosa



Cosmetics - As a thickener, moisture retainer
and retain color of lipstick on lip surface

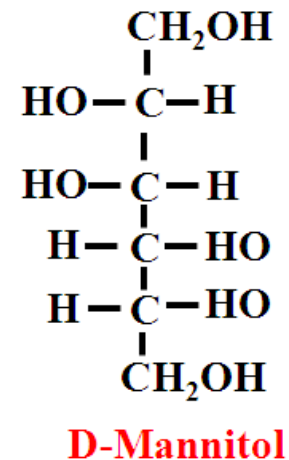
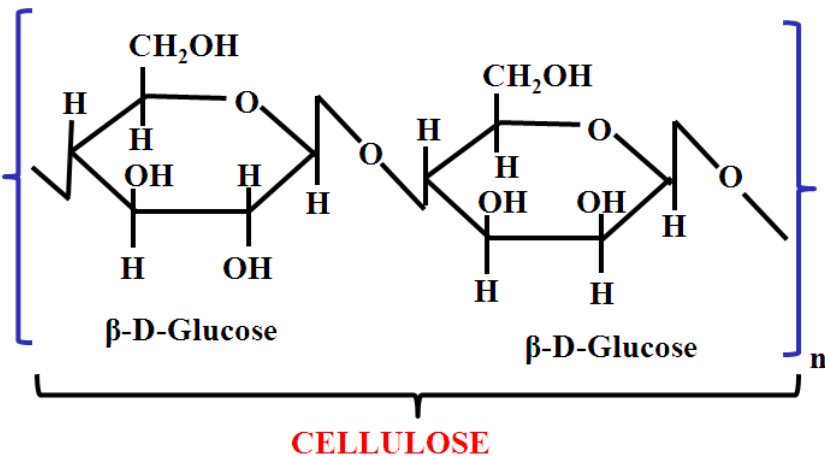
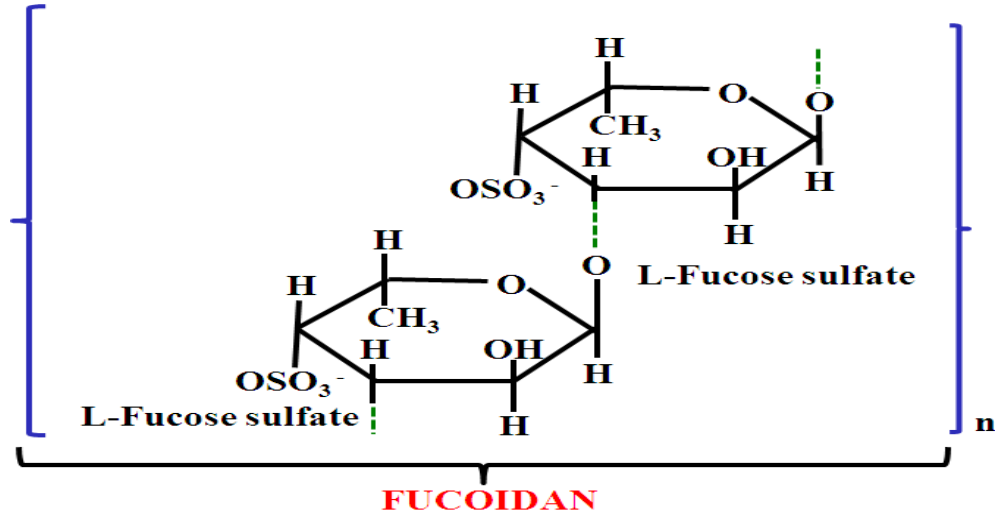
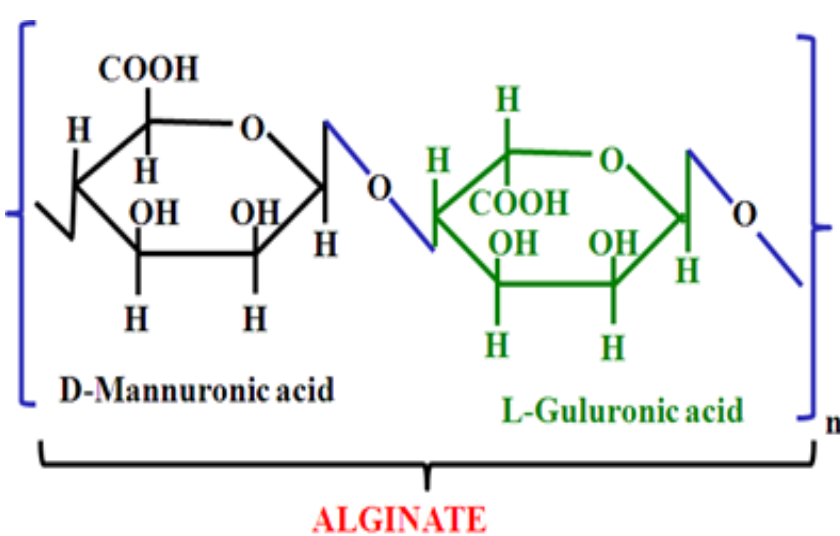


Welding rods - As a binder of flux
(temperature, oxygen and hydrogen)



Sargassum cell wall – Composition

- Sargassum* cell wall is composed of four major carbohydrates – **Alginate, cellulose, fucoidan and mannitol**



Potential of *Sargassum* biomass – Biofuels

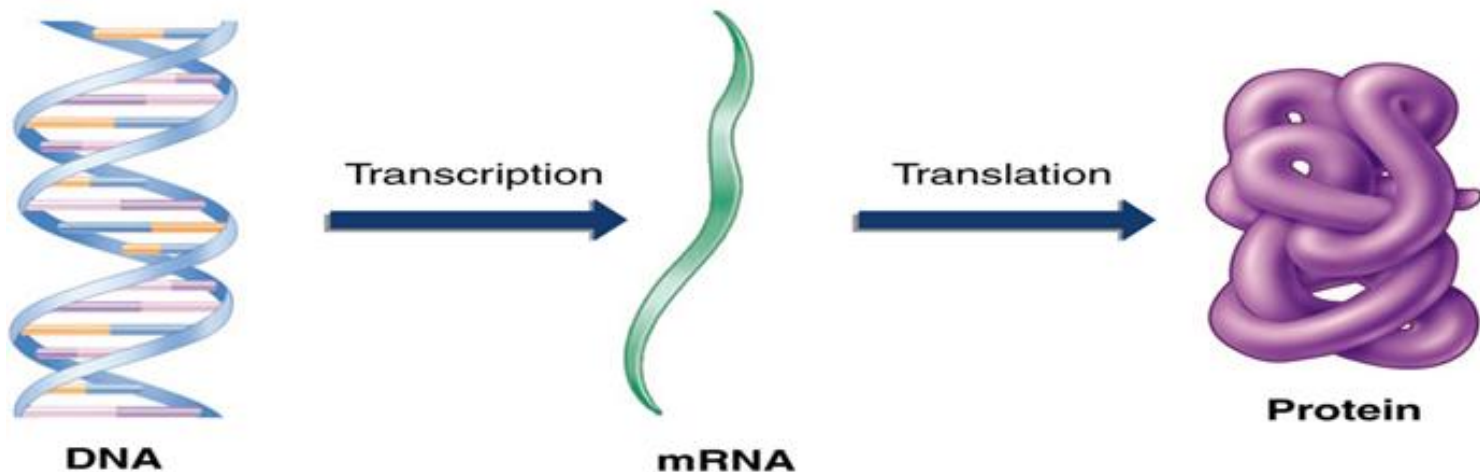
- Microbial processing of *Sargassum* biomass into biofuels
 - Biogas [methane and hythane® (methane + hydrogen)]
 - Bioethanol and biobutanol
- Microbial processing mimics the natural process of macroalgal degradation
 - Environmentally friendly
- *Majority (99%)¹ of these seawater-tolerant smart microbes do not grow under the standard culture methods used in the laboratory*

¹ Pace, N.R. (1997). Science 276:734-40.

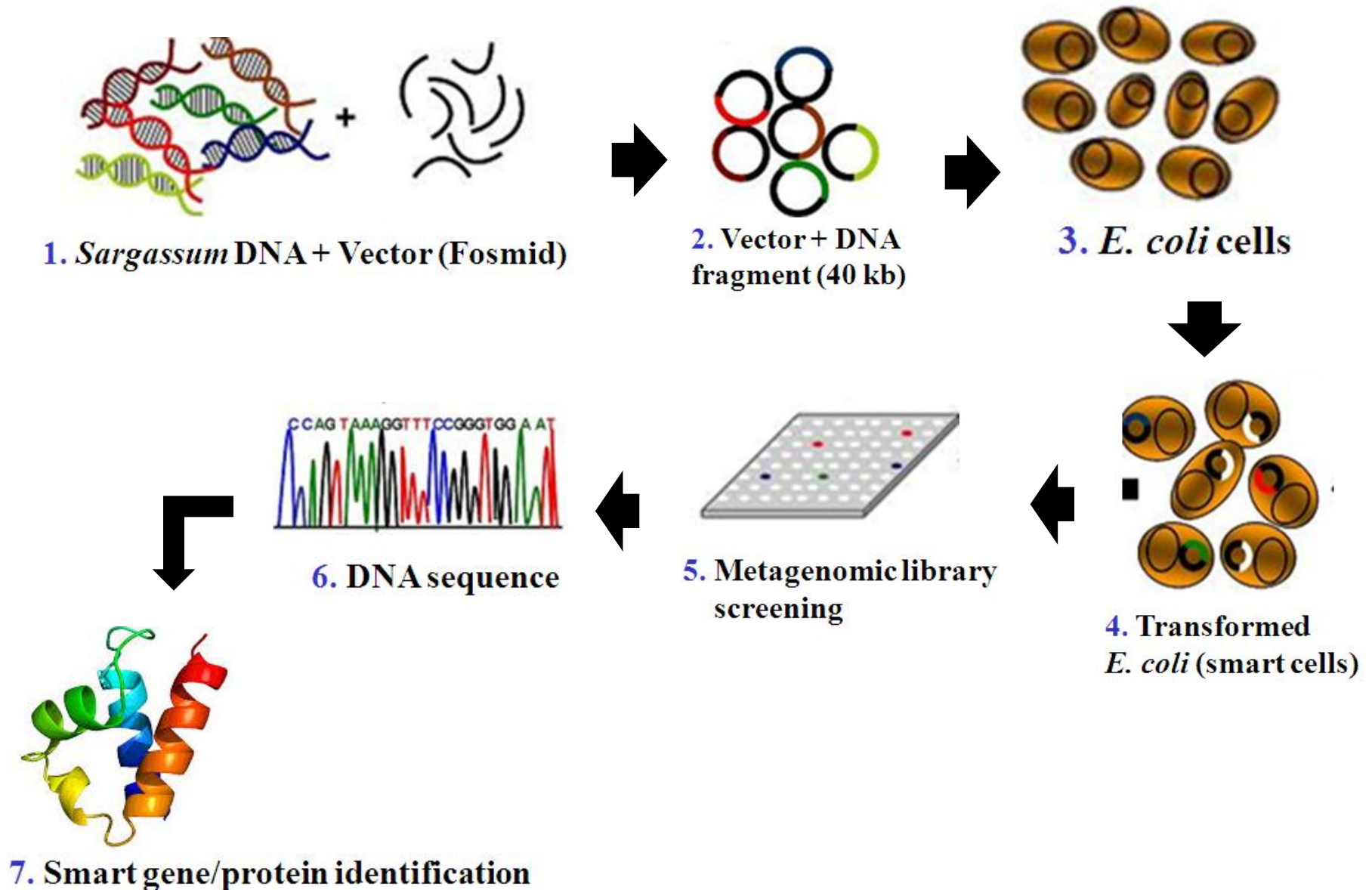


Metagenomics

- A metagenomics approach, in which all genome sequences from decomposing *Sargassum* biomass are non-selectively cloned into a single library
- This allows the study of genomes from both cultivable and uncultivable microorganisms
 - Accelerate the identification of novel genes with potential industrial applications, including biofuels



Metagenomics schematics



Thank you for your kind attention



Relevant Expertise at UWI – Dept. of Biological and Chemical Sciences (BCS)

- **Analytical, Inorganic, Organic, Physical Chemistry**
- **Biochemistry**
- **Earth science**
- **Fishery**
- **Marine Ecology**
- **Microbiology**
- **Plant Biology**

Contacts details of Head-BCS:

Dr. Francis Lopez

Phone: (246) 417-4323

E-mail: bcs_hod@cavehill.uwi.edu