



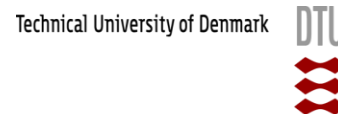
# SEASONAL VARIATION OF VALUE-ADDED COMPOUNDS

Speaker: Urd Grandorf Bak, Research manager, Ocean Rainforest Sp/F

Partners involved: Ocean Rainforest & Matis

24-03-2021

MacroCascade Final Conference



# Aim and impact

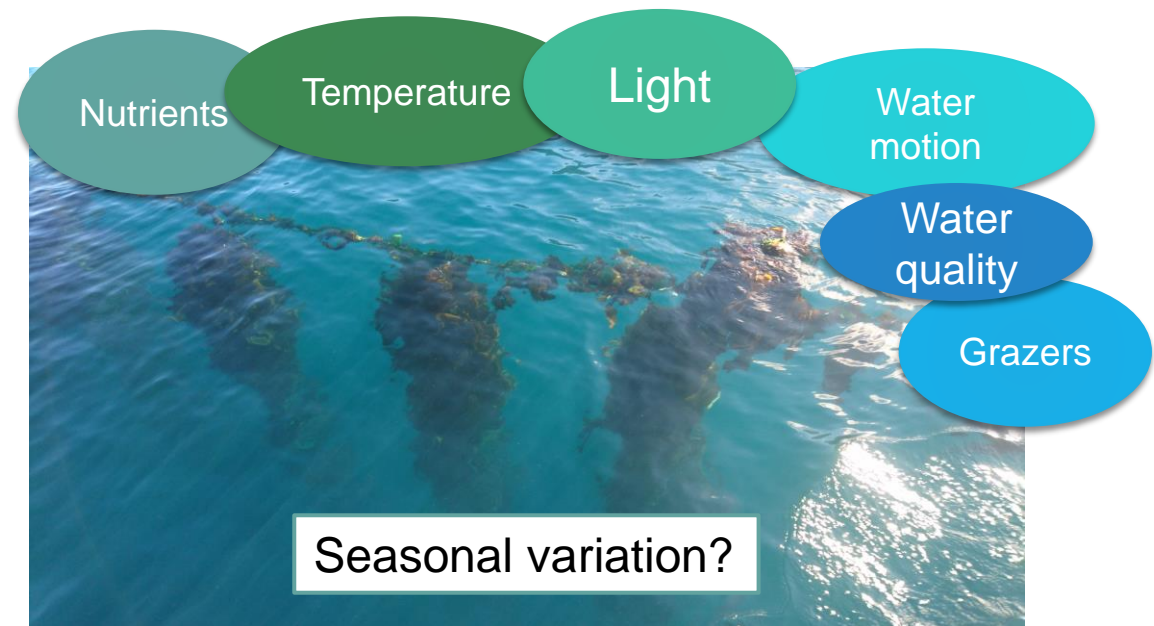
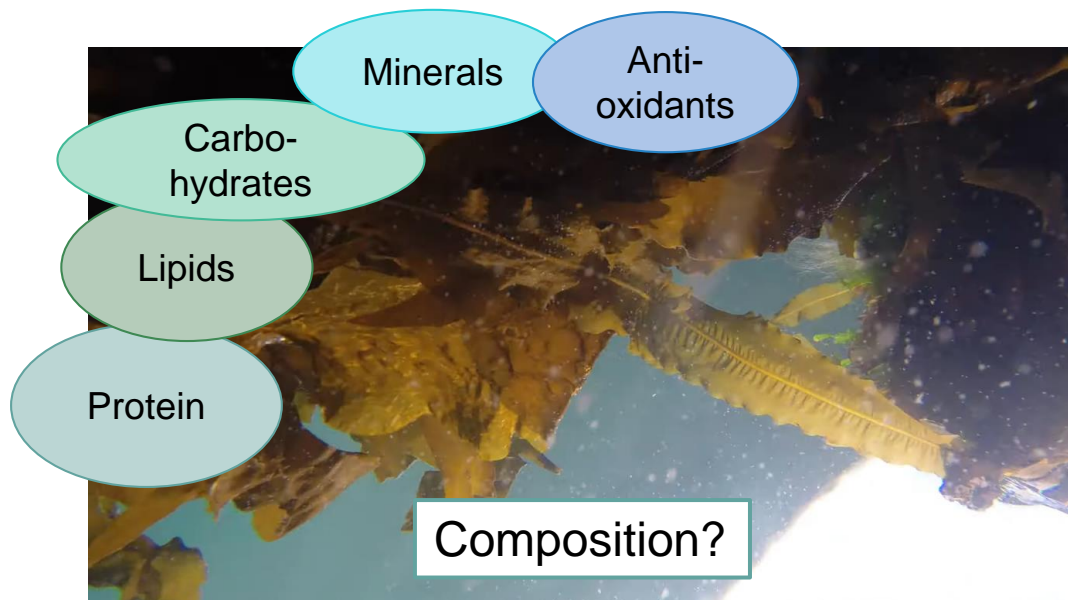
A main challenge for increasing the efficiency of the marine cascading conversion is to obtain a full **understanding of the chemical composition and the seasonal variation** of the cultivated macroalgae.

**Direct impact on the innovative biorefinery processes for turning seaweed into a commodity,**

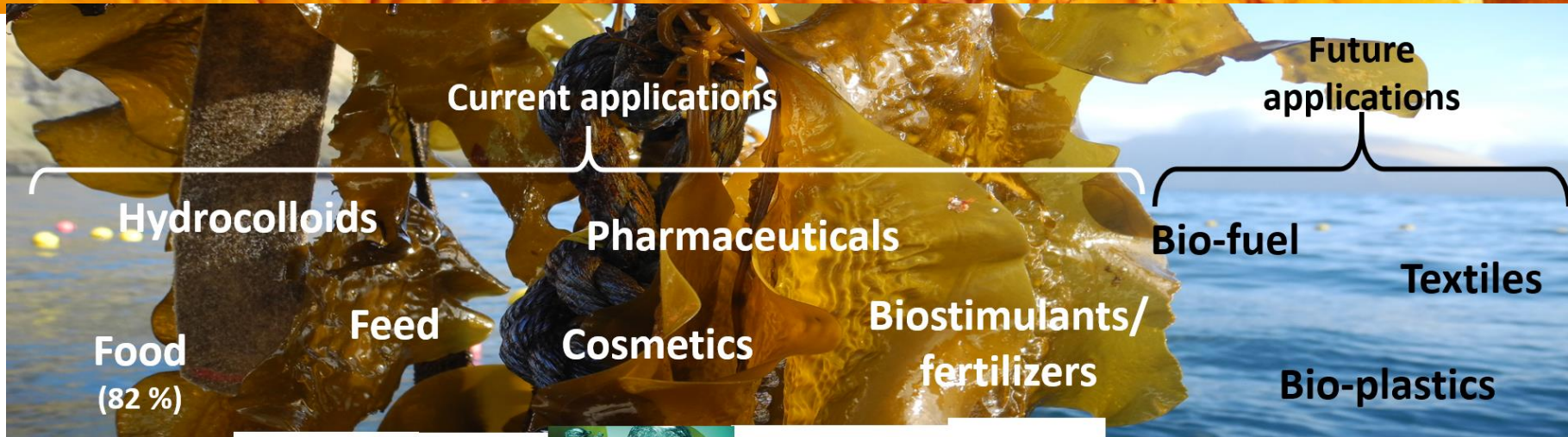
Expected results from MACRO CASCADE	How will this impact be obtained	How to ensure use, what steps are needed	Measures to maximise impact
Ability to <b>predict seasonal and regional variation</b> in growth	Mapping composition of biomolecules (WP2)	Optimise cascading, extraction, conversion	Present seasonal and regional information at MACRO CASCADE conference and external events and in open access publications

# A challenge: Variation? Content?

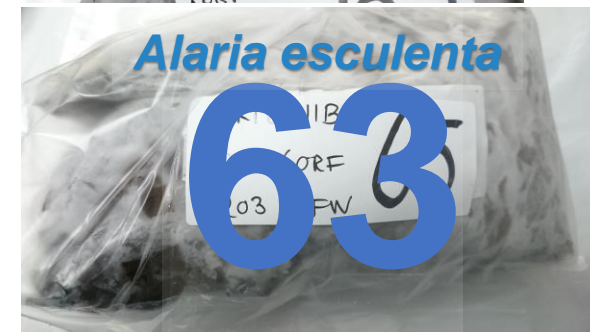
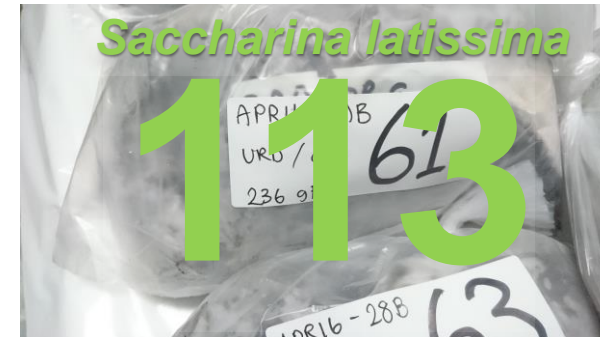
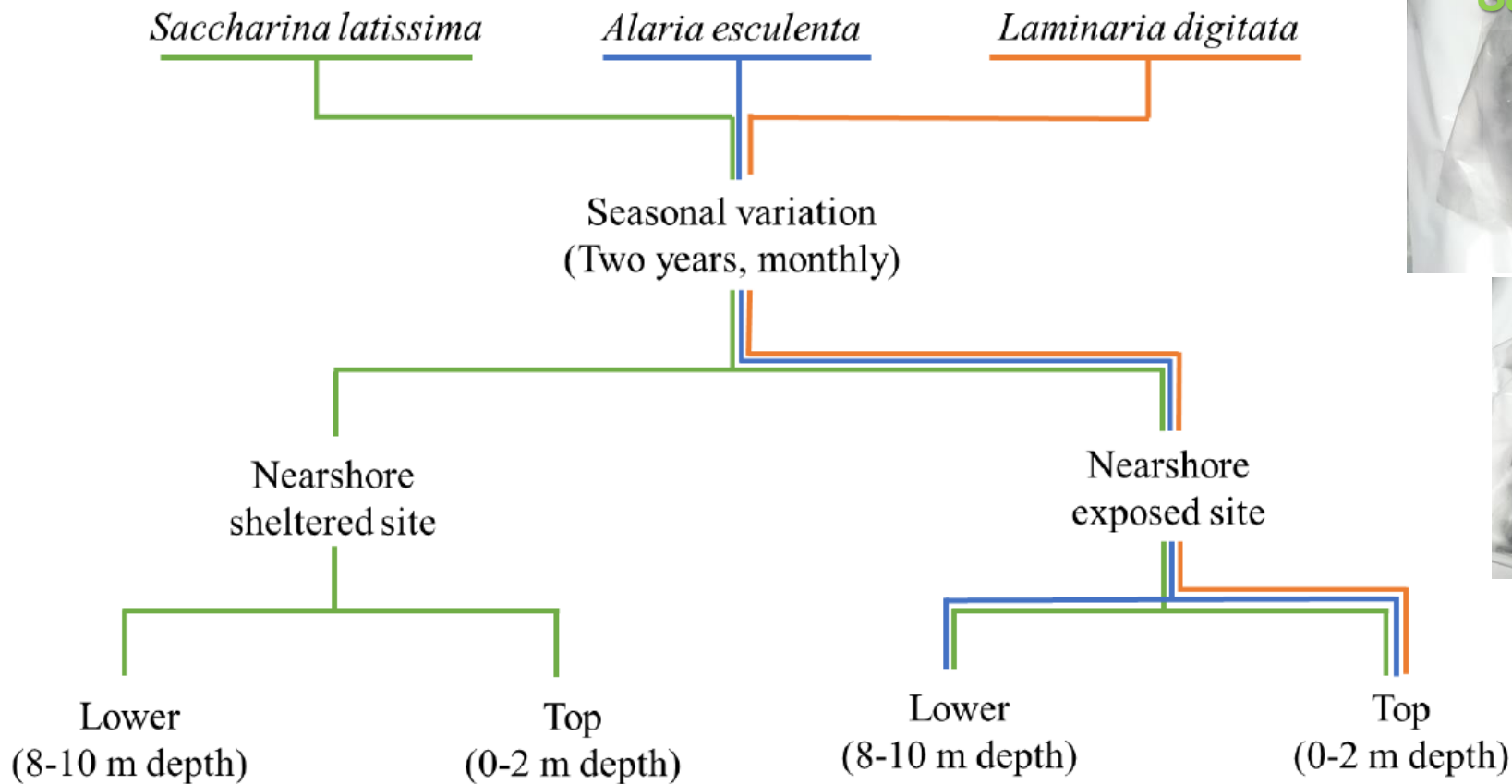
Harvested multiple times.  
Harvest period April-Oct.



# Seaweed-based products



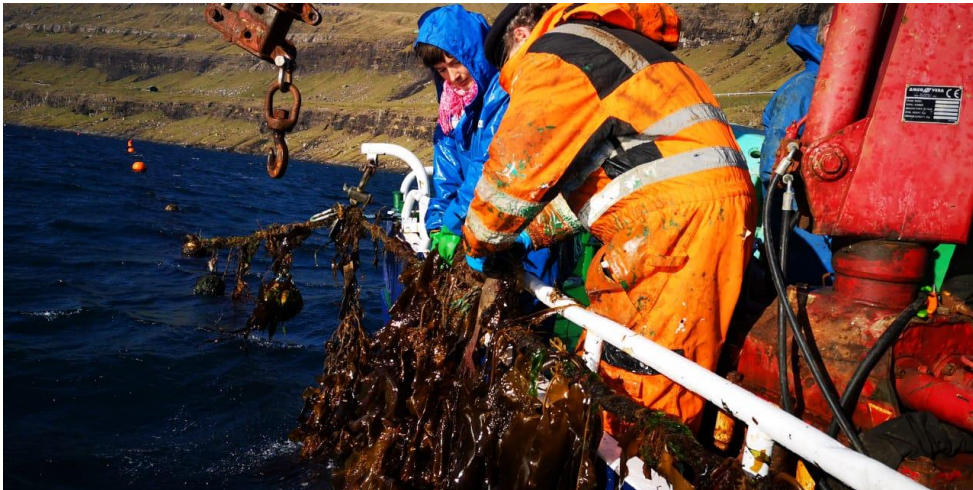
# Sampling method



# Target compounds

- Analyses are standardized and described in detail:

Bak (2019). “*Seaweed cultivation in the Faroe Islands – An investigation of the biochemical composition of selected macroalgal species, optimised seeding techniques, and open ocean cultivation methods from a commercial perspective*”. PhD thesis. The Technical University of Denmark (DTU)



Water (dry matter)  
Minerals (ash)

All institutes

Iodine  
Inorganic arsenic  
Nitrogen  
Amino acid composition  
D-vitamin +  $\alpha$ - and  $\beta$ -carotene

Collaboration with  
DTU Food



Mercury  
Lead  
Cadmium  
Arsenic  
Protein  
Lipid  
Fatty acid composition  
Carbohydrates (calculated)  
Monosaccharides  
Antioxidants



Phosphorus  
Carbon

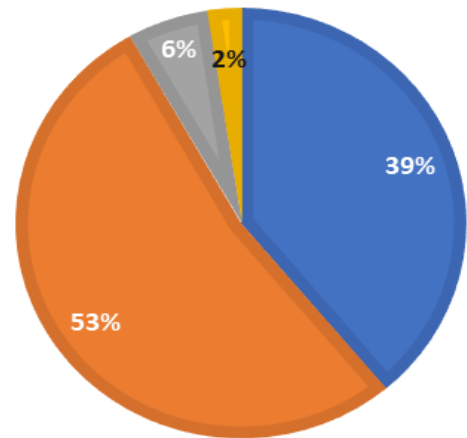
Collaboration with  
Aarhus University



# Results – what's in it?

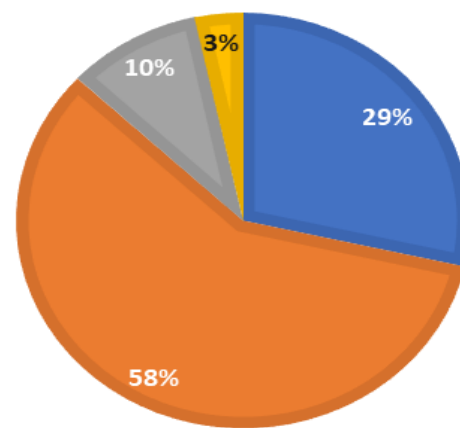
- Mean dry matter content:
  - *S. latissima*: 11.8±2.7 % of ww
  - *L. digitata*: 16.2±2.8% of ww
  - *A. esculenta*: 16.4±3.7% of ww

**SACCHARINA LATISSIMA**



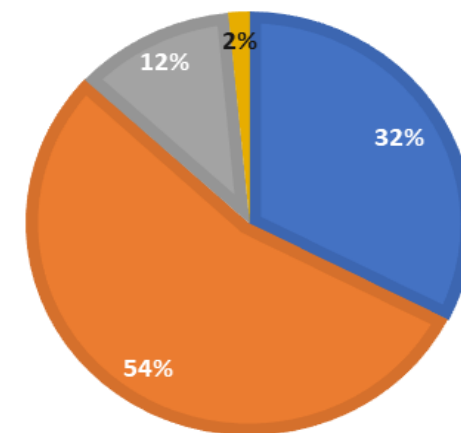
- Ash
- Carbohydrates (calc.)
- Protein (ΣAA)
- Lipids

**ALARIA ESCULENTA**



- Ash
- Carbohydrates (calc.)
- Protein (ΣAA)
- Lipids

**LAMINARIA DIGITATA**



- Ash
- Carbohydrates (calc.)
- Crude Protein (N\*6.25)
- Lipids

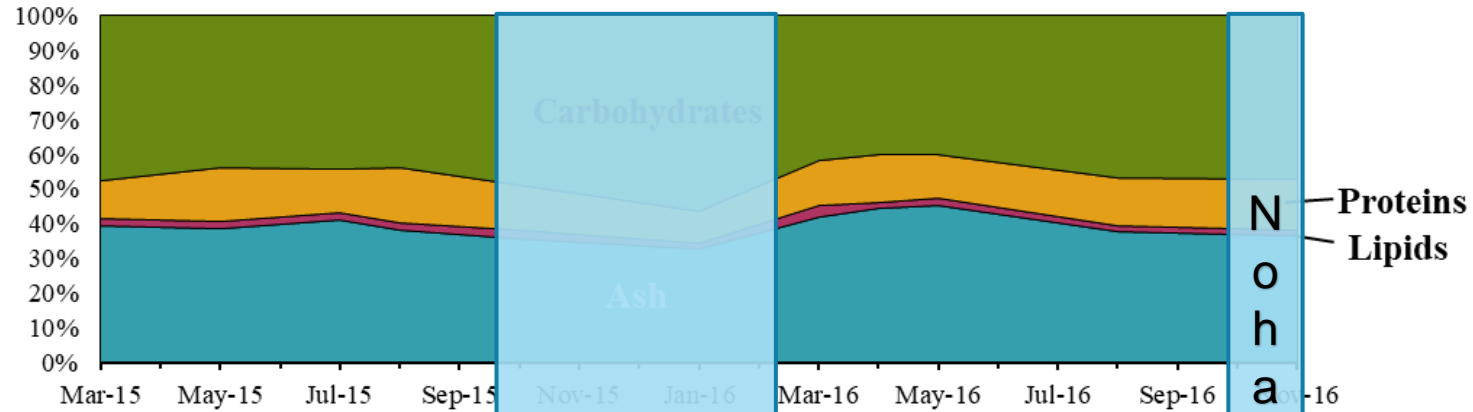
# Results – lack of seasonal variation

## *Saccharina latissima*

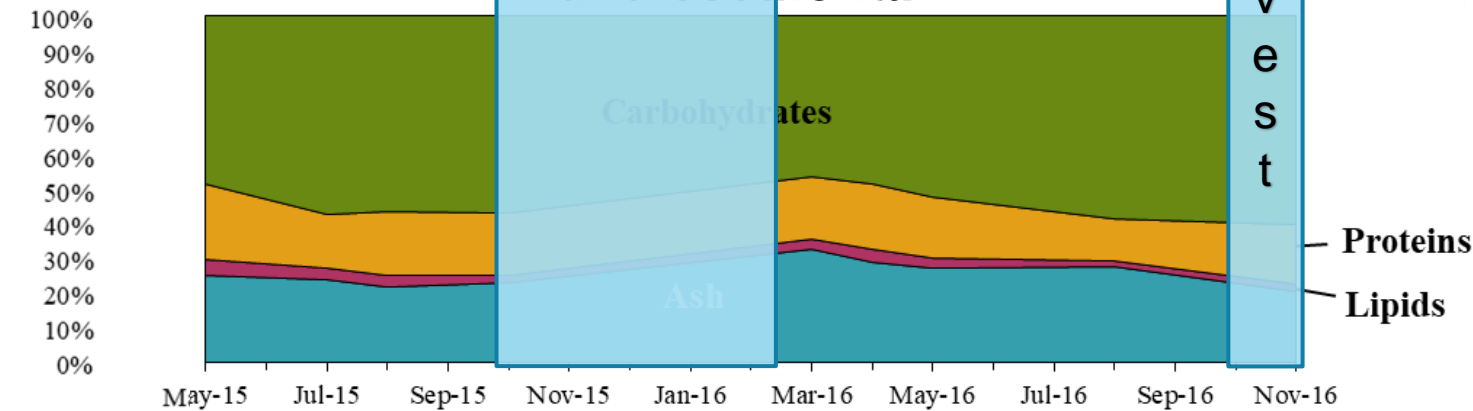


*Saccharina latissima*

Percentages of dry weight

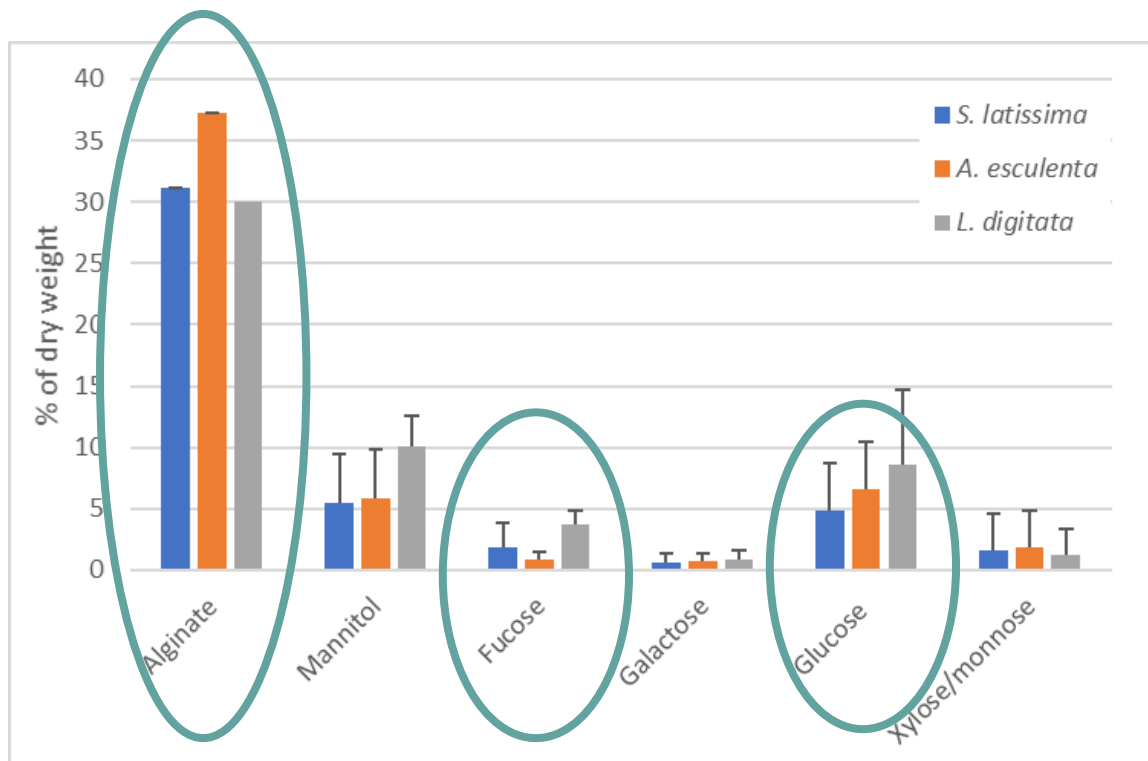


*Alaria esculenta*





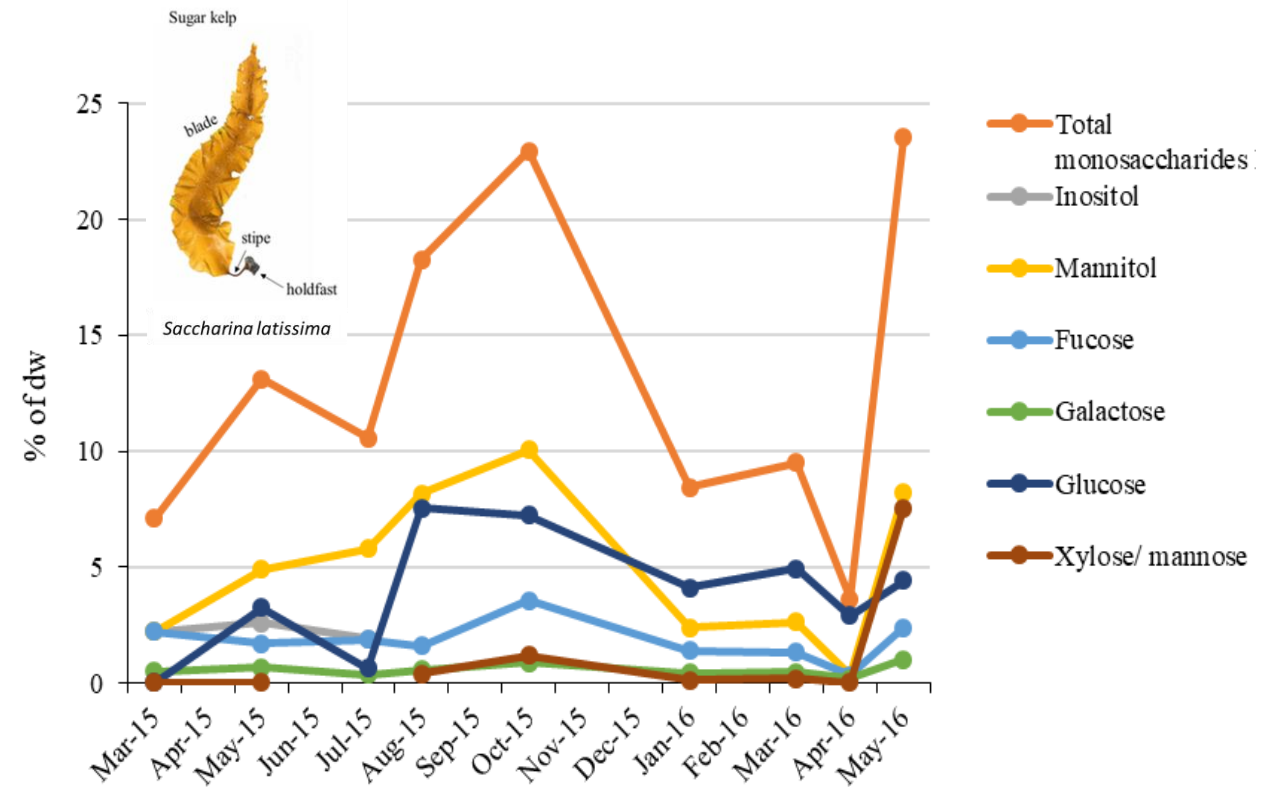
# Poly-, oligo- and monosaccharides!



Large quantities

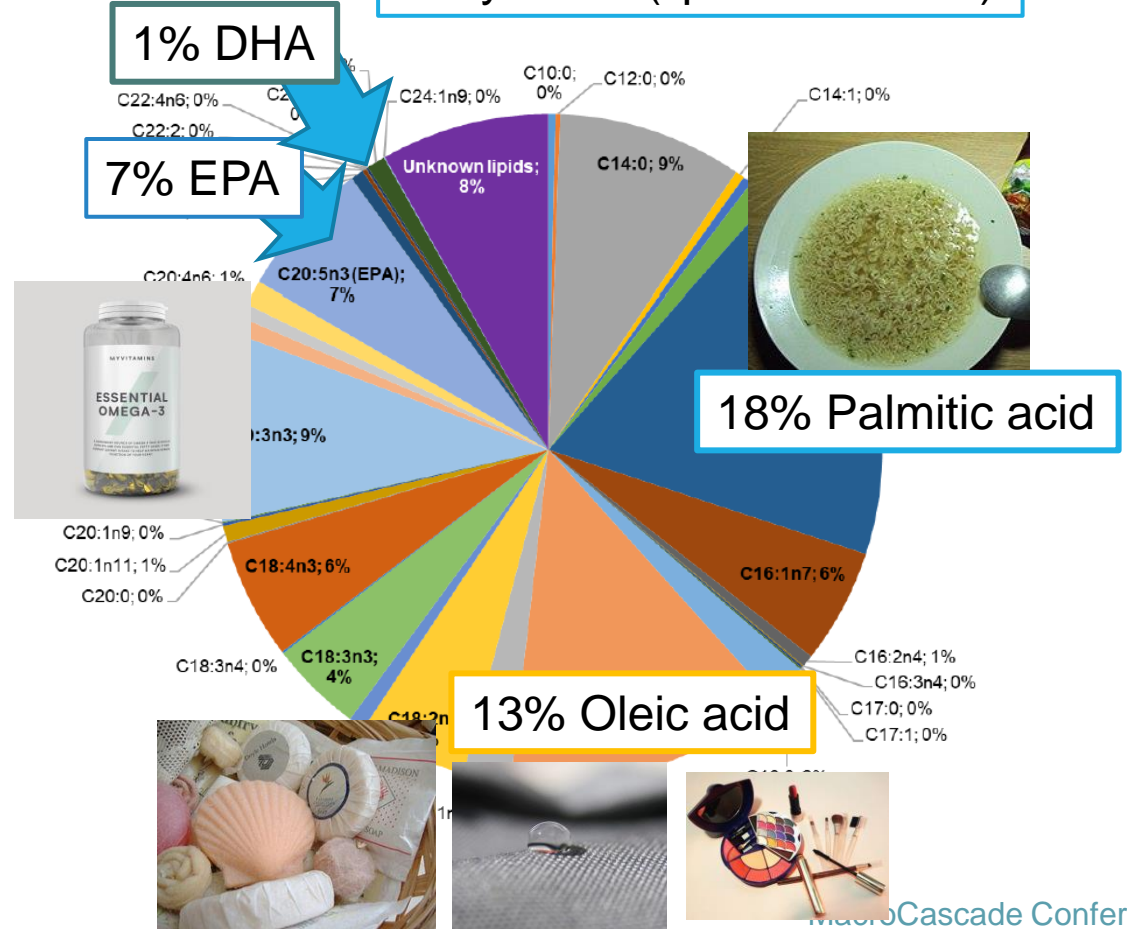
High end-product

Laminarin / glucans

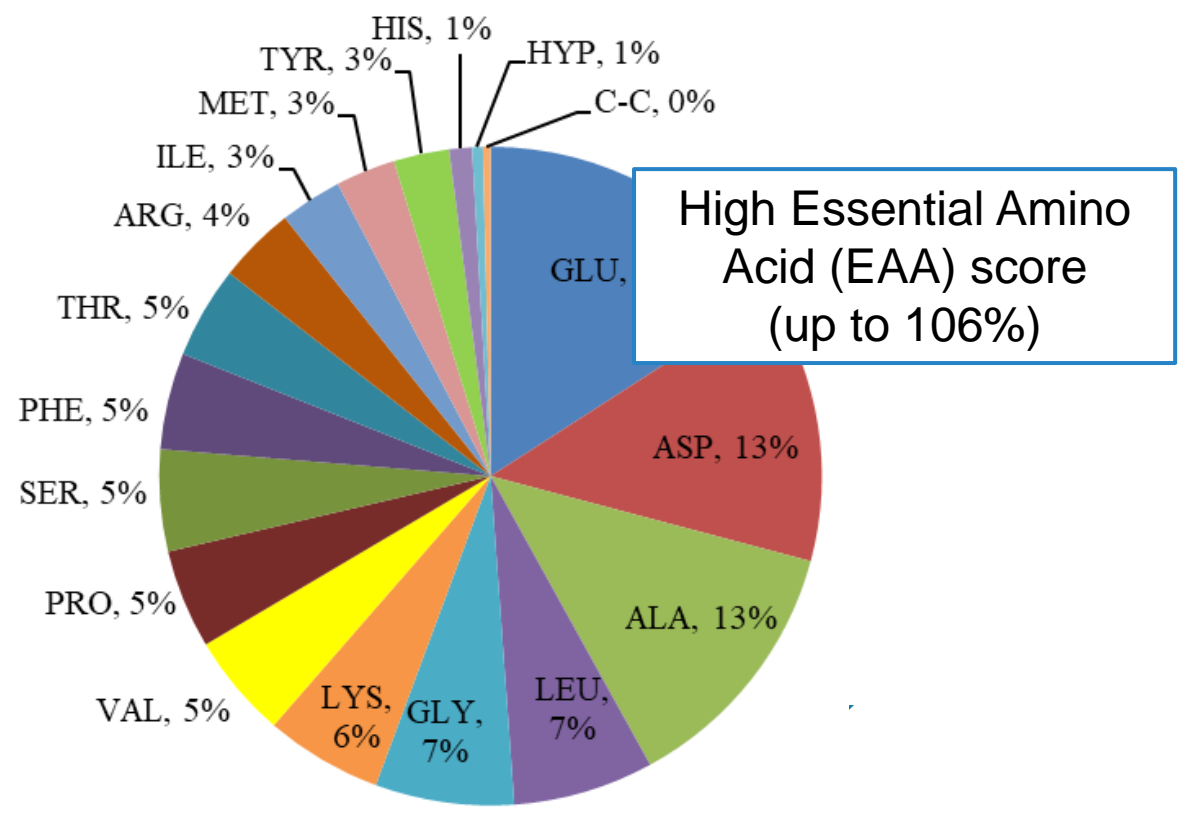


# Target compounds?

Fatty Acids (lipids 2% of dw)



Amino Acids (6% of dw)

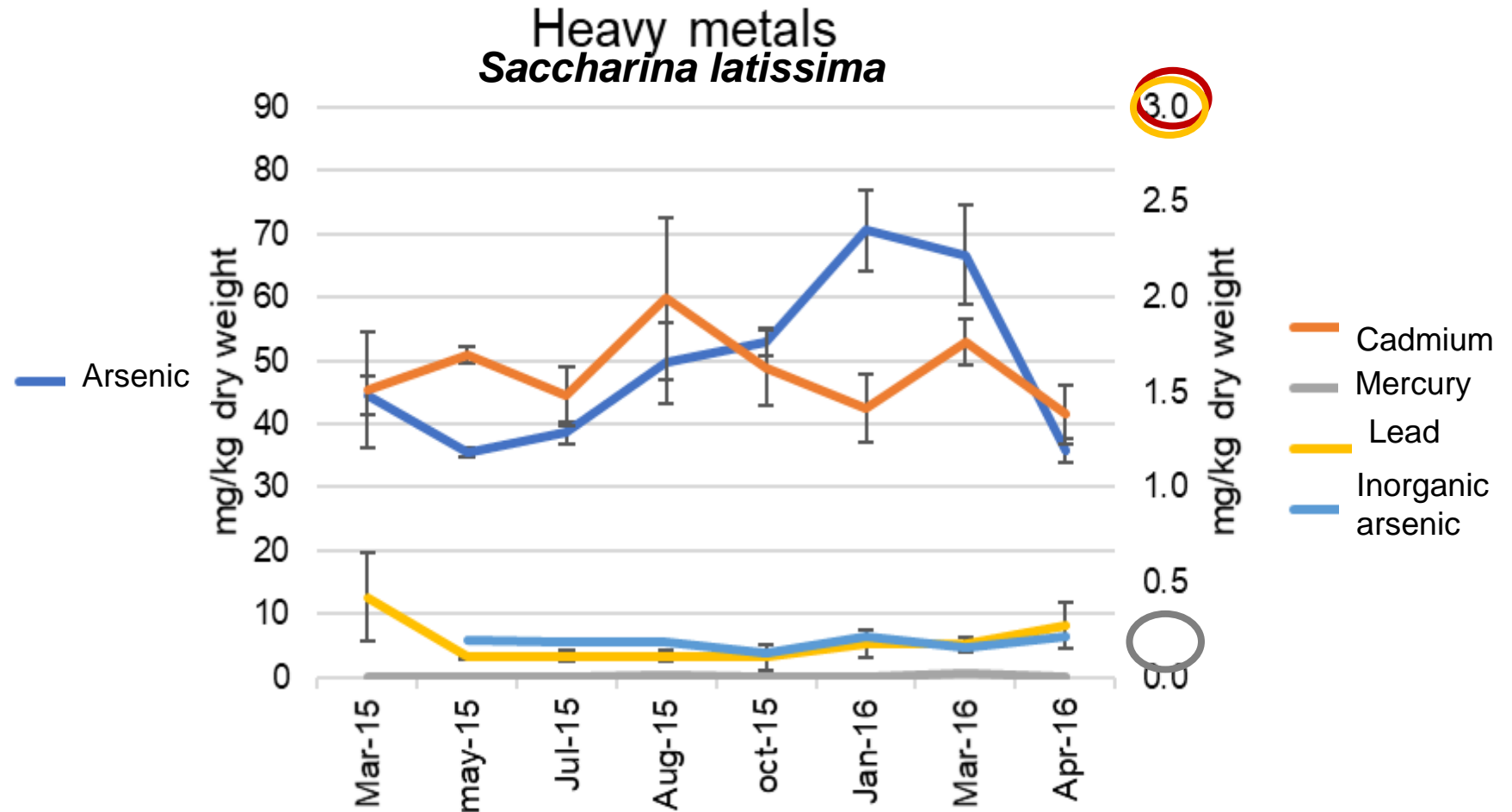


High Essential Amino Acid (EAA) score (up to 106%)

# Heavy metals

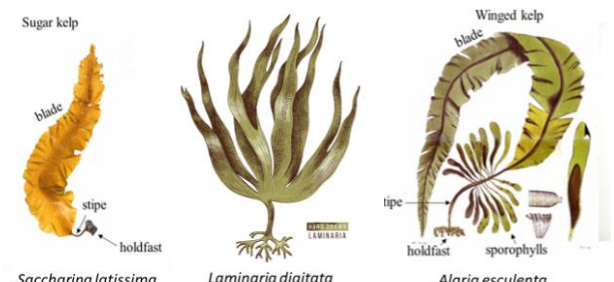
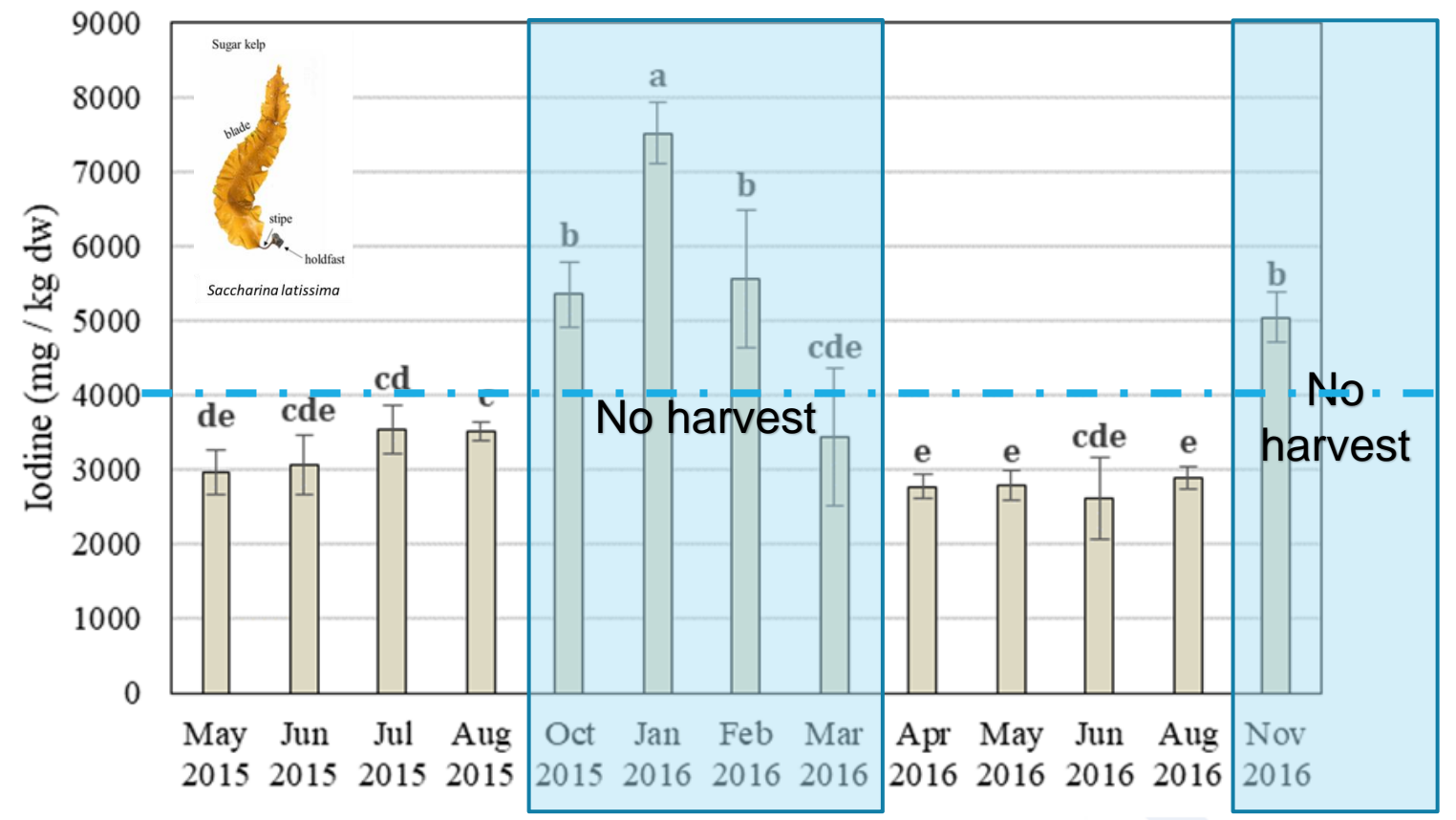
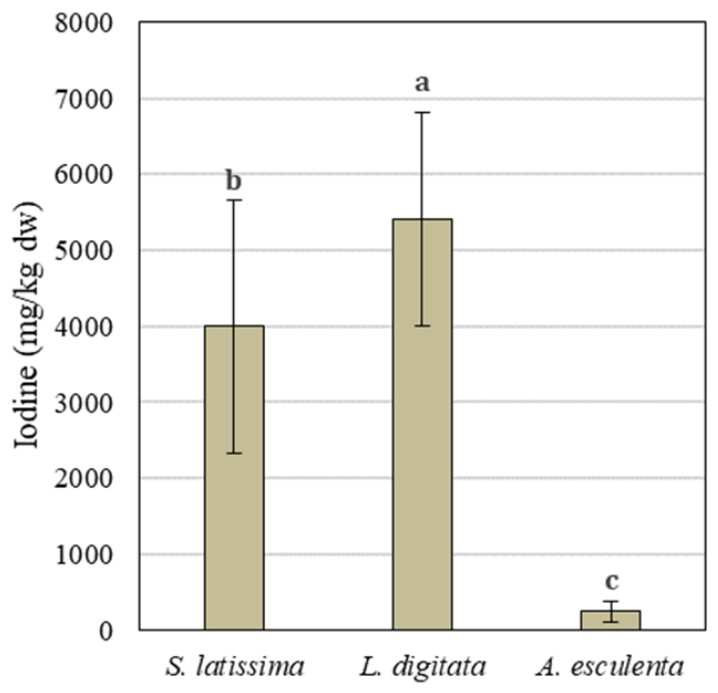
The maximum levels are set based on reasonably achievability and the risks related to the consumption (also taking into account the most vulnerable groups). Preamble (4) Regulation 1881/2006.

Limit (mg kg <sup>-1</sup> DM, ppm)	
Compound	EU
Lead	<3.0
Cadmium	<3.0
Mercury	<0.1
Inorganic arsenic	/
Iodine	/





# Iodine



# Recommended intake (*S. latissima*)

Japanese iodine intake is 1000 µg per day with seaweed as main contributor

(Zava and Zava 2011).

WHO (2009) Recommend daily iodine intake 150 µg

uptake

Uptake rate of iodine from seaweed in the human body is suggested to be only 17%.

Ref. Romarís-Hortas et al. 2011

Correlates to a daily intake of 0.04 g (dw) *S. latissima* or an upper tolerable intake of 0.25 g (dw) per day (WHO 2009)

Correlates to a daily upper tolerable intake of 1.4 g seaweed (dw) per day

Blanching reduces the iodine content by 59%!

(Azadeh Bahmani 2018)



Seaweed smoothie



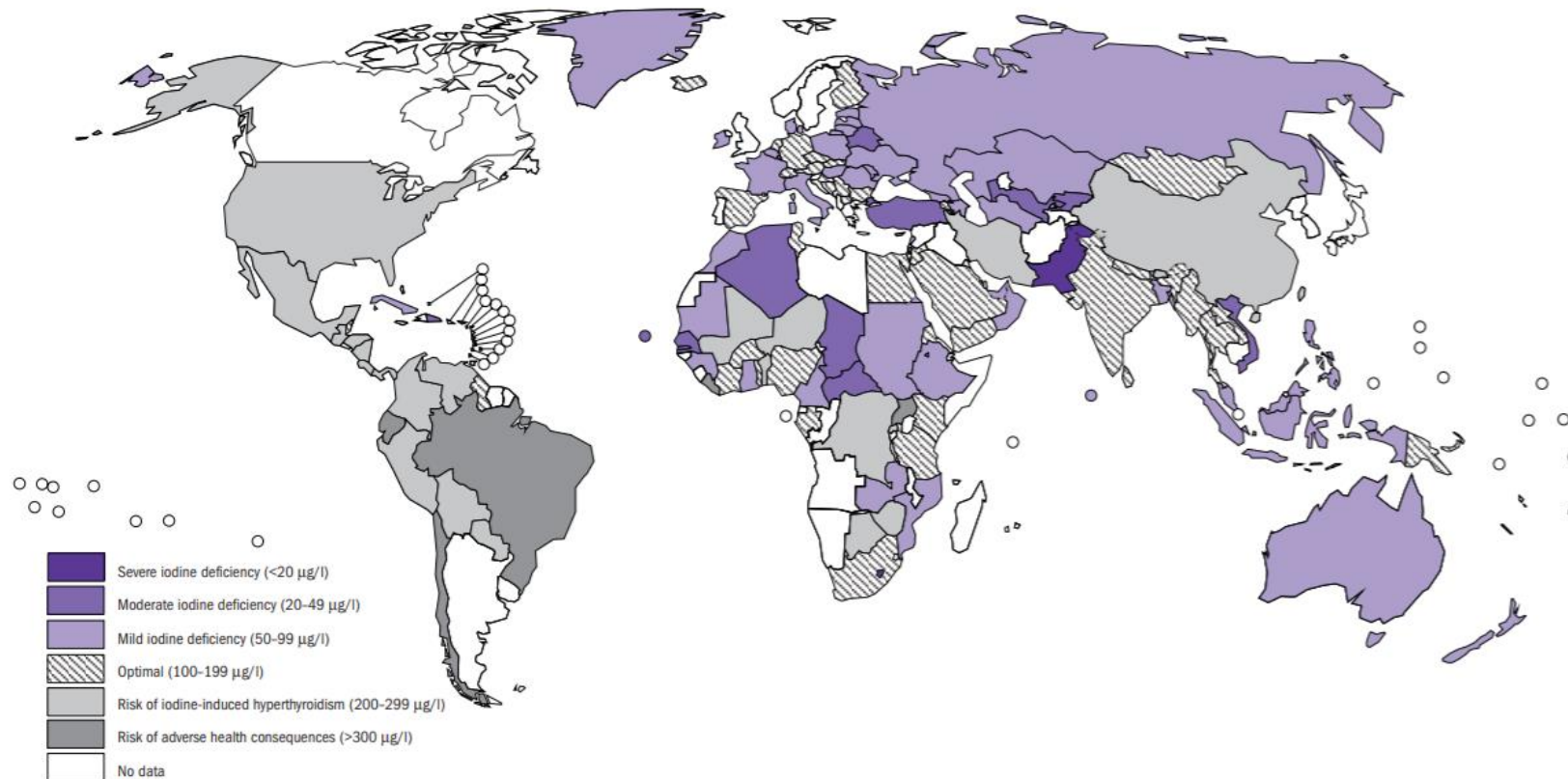
One box Nordisk tang Fermented Salad

Pre-treated or cooking

# Iodine Deficiency

3. RESULTS AND DISCUSSION

Figure 3.3 Degree of public health significance of iodine nutrition based on median UI



“Iodine status worldwide” WHO Global Database on Iodine Deficiency

# Conclusion (*S. latissima*)

- The biochemical composition had no **depth, site or seasonal** variation
  - except of the compounds: **dry matter, ash, nitrogen, iodine, and glucose** showed seasonal variation.
- Fatty acids: 8% essential **omega-3 fatty acids** (DHA & EPA)
- High Essential **Amino Acid** (EAA) score (up to 106%)
- Consumption of cultivated *S. latissima* poses a low risk for humans regarding **heavy metals**.
- **Vitamins:**
  - High content of *trans*-isomer  **$\beta$ -caroten** (precursor for **vitamin A**): 12.2±4.6 mg/kg dw. Low levels (<5ng/g) of **D-vitamin** was found.
- **Polyphenols** was 0.8 % of dw in average.
- **Iodine** is found in a high concentrations but could be part of the solution to solve iodine deficiency.
- Analysing the biochemical composition has enabled us to make **nutritional labelling** and understanding the content of target bioactive compounds.





# Acknowledgement



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<https://www.macrocascade.eu/>