DETERMINATION OF FATTY ACID PROFILE AND EFFECT OF MIXOTROPHIC GROWTH IN SELECTED CYANOBACTERIAL STRAINS

Dajana J. Kovač[1], Olivera B. Babić[1], Jelica B. Simeunović[1], Ivan Lj. Milovanović[2], Aleksandra Č. Mišan[2]

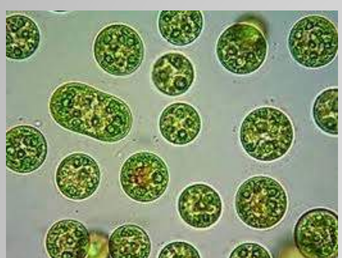
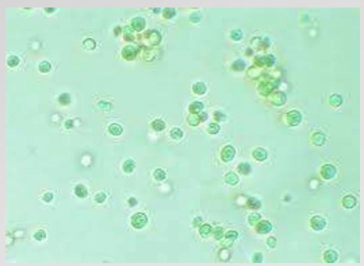
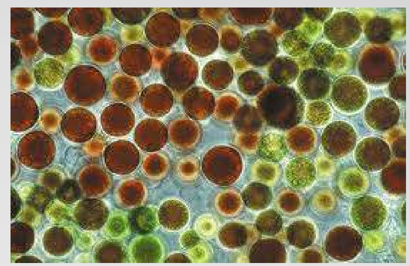
[1]University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, Novi Sad, Serbia
[2]University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, Novi Sad, Serbia

5th CASEE Conference
"Healthy Food Production and Environmental Preservation – The Role of Agriculture, Forestry and Applied Biology"

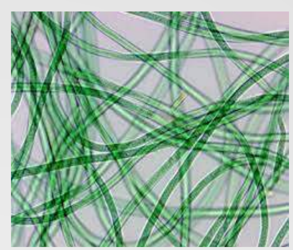
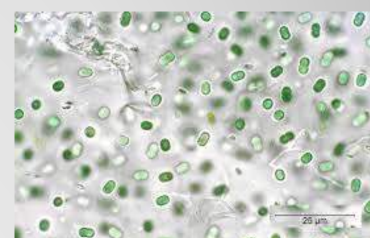
May 25 - 27, 2014, Novi Sad, Serbia

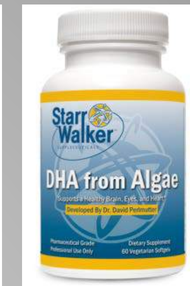
Microalgae

- Photosynthetic microorganisms with the vast potential in the production of food, feed and high-value metabolites
- **Cyanobacteria (blue-green algae)** are particularly recognized as health food, as well as producers of different bioactive compounds

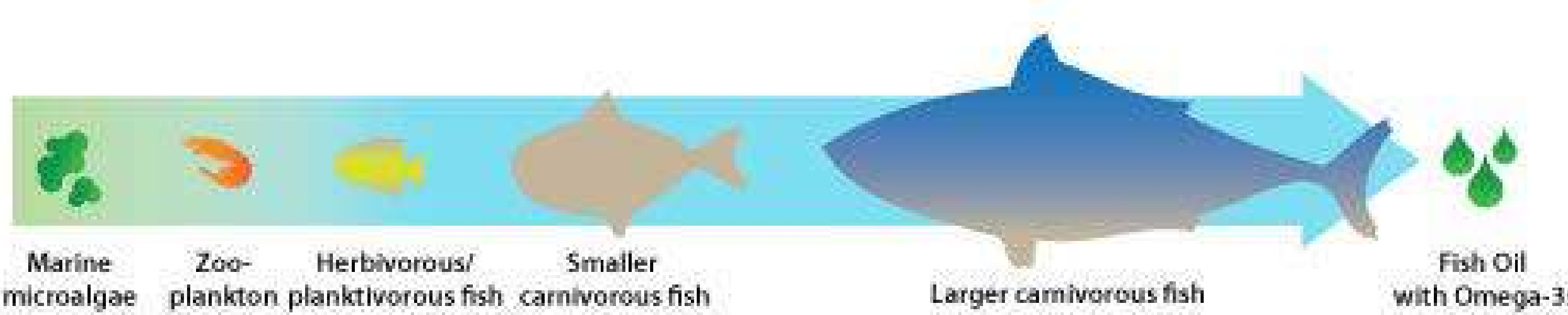




- Fatty acids of the microalgae origin are nowadays available on the market

- Algae are thought to be the principal producers of some polyunsaturated fatty acids (PUFAs) in the biosphere - although marine fish is the principal dietary source of some PUFAs, they are actually synthesized by microalgae and fish receive them via food chain








- Microalgae are usually cultivated in photoautotrophic cultures and their commercial application is limited by the low biomass yield and high production costs

- Using mixotrophic mode of nutrition:

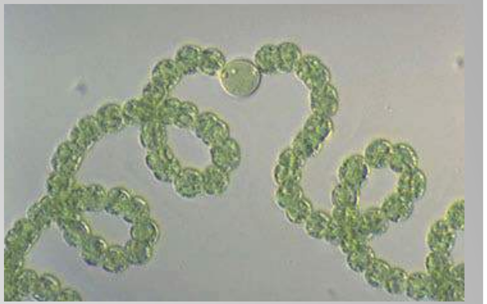
  1) during the night culture may continue to grow through heterotrophic nutrition
  2) lower light intensity is required

- It is expected that mixotrophic cultivation is especially suitable for the production of high value bioactive compounds, fine chemicals and pharmaceuticals

- **Filamentous, nitrogen-fixing cyanobacteria** can be an excellent biotechnological source because:

1) they do not need nitrogen in the culture medium
2) filamentous nature facilitates the process of biomass harvesting

- Some species of the *Anabaena* and *Nostoc* genera are used in human nutrition



Nostoc commune - a potential dietary fibre source

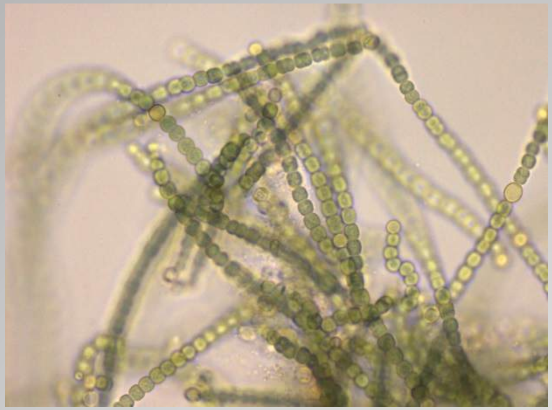
Nostoc flagelliforme - a species with high economic value, used in nutrition for more than 2000 years, with reported anti-tumor and anti-viral activity

The aim

- The aim of this study was to investigate the fatty acid profile and effect of mixotrophic nutrition with glucose in selected filamentous, nitrogen-fixing cyanobacterial strains, belonging to the Nostoc and Anabaena genera.

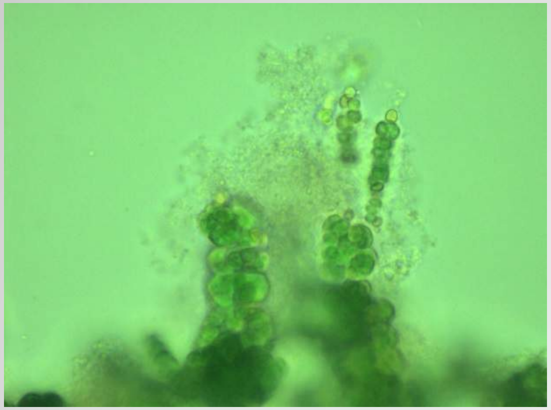
MATERIALS AND METHODS

- Tested strains:



Anabaena LC_1B

Nostoc S_8



Nostoc $2S_3B$

Nostoc $2S_1$

- The analyses of fatty acid methyl esters (FAMES) were carried out by gas chromatography coupled with flame ionization detection (GC-FID)

- Biomass production in mixotrophic conditions was determined at two concentrations of glucose, 1.5 and 3 g/l
- It was determined every seven days, by spectrophotometrically measuring of the chlorophyll a concentration, and it was calculated using an indirect method (Mckinney, 1941):

The concentration of chlorophyll a was calculated using the following formula:

$$cc\ Chl\ a = \frac{A_{663} \times 12{,}64 \times V_1}{V_2} \left[{}^{\mu g}/_{ml}\right]$$

Biomass production was calculated using the following formula:

$$B = ccChl\ a \times 67 \left[{}^{mg}/_{ml}\right]$$

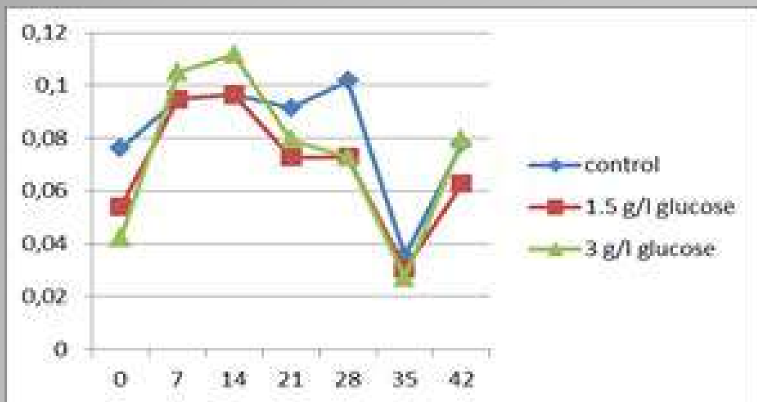
RESULTS

Fatty acid composition (% m/m) of tested cyanobacterial strains:

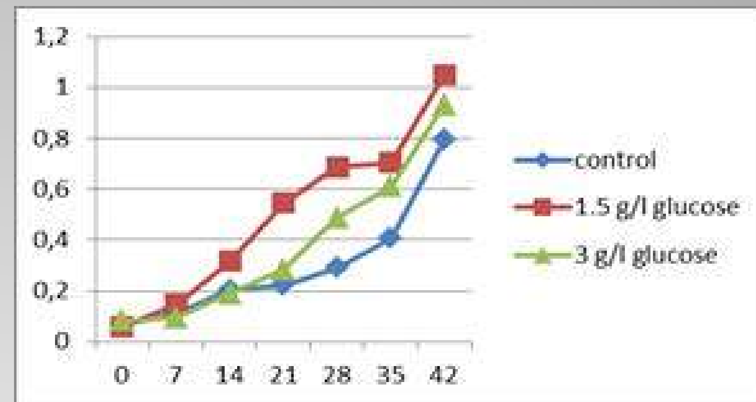
Fatty acid	*Anabaena* LC_1B	*Nostoc* S_8	*Nostoc* $2S_3B$	*Nostoc* $2S_1$
	%	%	%	%
6:0	0,00	20,75	0,00	2,21
14:0	0,54	0,66	0,66	0,68
14:1	0,00	0,49	0,00	0,47
16:0	21,57	12,23	15,94	18,29
16:1	26,45	31,63	24,83	36,75
18:0	0,80	0,47	3,11	0,70
18:1n9c	13,22	3,91	11,26	4,60
18:2n6c	19,59	16,00	20,09	15,64
18:3n3	17,82	13,85	24,10	20,13
22:1n9	0,00	0,00	0,00	0,53
SFA	22,90	34,11	19,72	21,88
MUFA	39,68	36,04	36,09	42,35
PUFA	37,42	29,86	44,19	35,77
UFA	77,10	65,89	80,28	78,12

SFA - saturated fatty acids, MUFA - monounsaturated fatty acids, PUFA - polyunsaturated fatty acids, UFA - unsaturated fatty acids

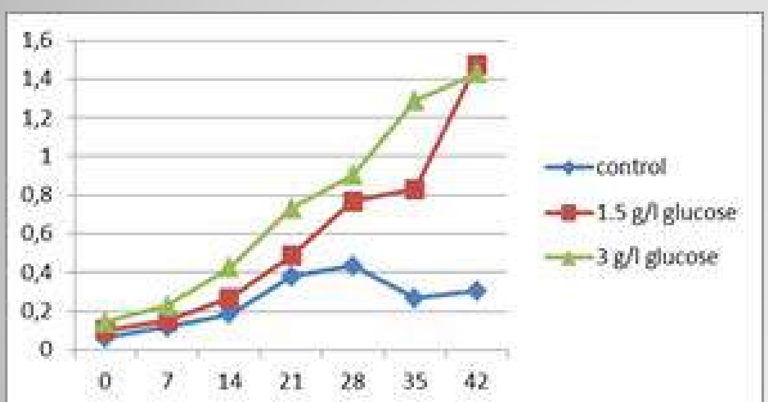
Biomass production in mixotrophyc cultures:



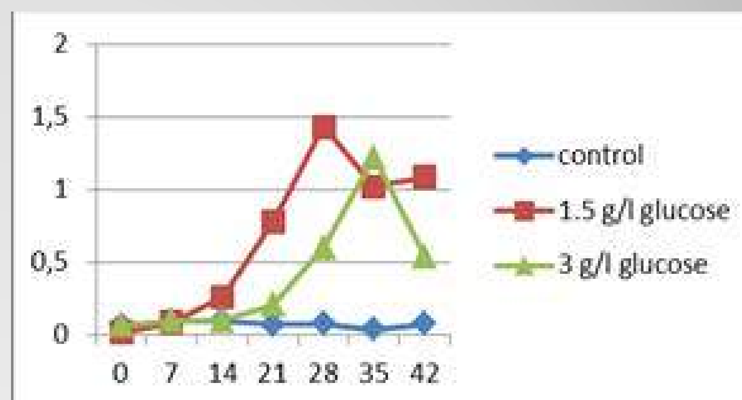
Biomass production in strain *Anabaena* LC_1B



Biomass production in strain *Nostoc* S_8



Biomass production in strain *Nostoc* $2S_1$



Biomass production in strain *Nostoc* $2S_3B$

In graphs x axis represents time period expressed in days, while y axis represents biomass production in g/l

CONCLUSIONS

- Strains which were tested in the present study showed ability to produce important fatty acids, as well as significant biomass increase in mixotrophic cultivation conditions;

- The highest proportion of **oleic acid (18:1n9c)** was found in the strain *Anabaena* LC_1B, **linoleic acid (18:2n6c)** in the strains *Anabaena* LC_1B and *Nostoc* $2S_3B$, and **α-linolenic acid (18:3n3)** in the strain Nostoc $2S_3B$;

- Taking into account the highest PUFAs content, as well as the highest biomass production, strain *Nostoc* $2S_3B$ has the greatest biotechnological potential;

- Manipulation of the cultivation conditions can affect the biomass production, as well as the target metabolites.

Acknowledgments

- This study has been supported by the funding of the Ministry of Education and Science of the Serbian Government (project number: TR 31029) which is greatly acknowledged

Thank you for your atention