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Microbiological quality and safety of farmed seaweed *Alaria esculenta* and salmon *Salmo salar* co-cultured in an integrated multitrophic aquaculture system

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AIM

This study aimed to the investigation of the spoilage potential as well as to the examination of the presence of human pathogens in two different species (salmon *Salmo salar* and seaweed *Alaria esculenta*) cultured in IMTA system. In addition, several nutritional parameters were evaluated so as to provide a preliminary view about the nutritional quality of such products.

MATERIALS AND METHODS

Marine Institute – Lehanagh pool

Seaweed and salmon sample transfer at 0ºC, Arrival within 3 days from harvest

Agricultural University of Athens

Sample preparation and storage (0, 4ºC – salmon, 0, 5ºC - seaweed

Microbiological analysis

Total Viable Counts (TVC), *Pseudomonas* spp., *Vibrio* spp., H_2S-producing bacteria, *Brochothrix thermpsphacta*, Enterobacteriaceae, lactic acid bacteria, *Bacillus*, *Aeromonas*, Gram (-), yeast and molds, *Listeria monocytogenes*, *Salmonella*, *E. coli*, *Staphylococcus aureus*

Nutritional analysis

Proteins, fat, fatty acid profile, carbohydrates, ash, moisture

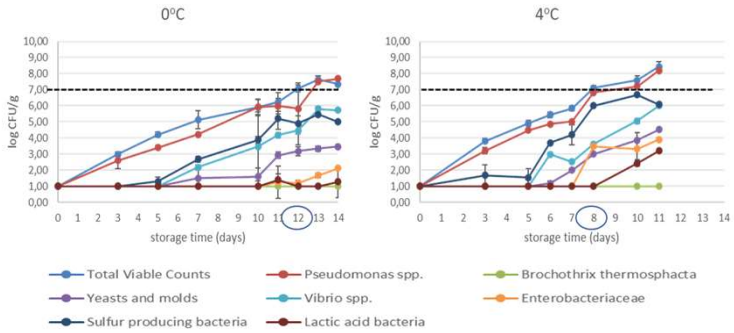
RESULTS

Presence of human pathogens

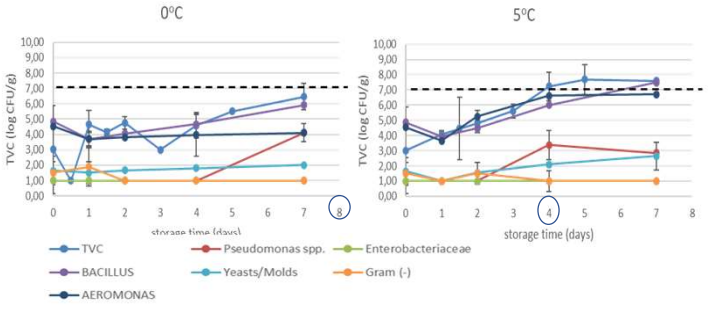
Microorganisms	Salmon	Seaweed
Salmonella	Absence in 25g	Absence in 25g
E. coli	Absence in 25g	Absence in 25g
Listeria monocytogenes	Absence in 25g	Absence in 25g
Vibrio spp.	Presence* (sporadically)	Absence in 25g
Staphylococcus aureus	Absence in 25g	Absence in 25g

* Further analysis is required to test if the isolates belong to any of human pathogenic species

Microbiological analysis - Salmon



Microbiological analysis - *Alaria esculenta*



- The microbiological spoilage threshold (7.0 log CFU/g) was reached at 8th and 12th day of storage at 4 and 0ºC, respectively.
- Dominant spoilage group → *Pseudomonas* spp.
- Growth of H_2S-producing bacteria (off-odors) begun after the 5th day of storage in both storage temperatures
- Low levels of Enterobacteriaceae family bacteria (hygiene indicator)
- *B. thermosphacta* (a common spoiler) → below enumeration limit throughout storage

- The microbiological spoilage threshold (7.0 log CFU/g) was reached at 8th and 4th day of storage at 0 and 5ºC, respectively.
- Dominant spoilage group → *Aeromonas spp. and Bacillus*
- Enterobacteriaceae family bacteria (hygiene indicator) → almost below the enumeration limit
- Low levels of *Pseudomonas* spp. (common spoiler)

Nutritional data for salmon and seaweed

	SALMON		SEAWEED	
	g / 100g	Indicative values*	g / 100g	Indicative values*
Protein	18.41	20.40	2,37	1,70
Fat	21.05	13.40	0,41	0,60
Saturated	5.74	3.10	0,23	0,20
	27.27%**	23.13%	56,09%	33,30%
Carbohydrates	0	0	14,61	9,60
Ash	1.23	1.00	4,88	6,60
Moisture	59.31	64.90	77,73	81,60

* Provided by USDA SR21 ** of total fat content

- Most of the tested parameters were close to the values provided by USDA, except for fat in salmon which was higher than the indicative value (USDA).
- Fat content was comprised of valuable fatty acids both in salmon (C18:1 cis, C18:2 cis, C18:3 n3 (ALA), C20:5 (EPA), C24:1) and seaweed (C18:1 cis, C18:2 cis, C18:3 n3 (ALA), C20:4 n6 (AA)

CONCLUSION

Based on the findings of this study, the tested IMTA products were considered as safe and of satisfactory microbiological and nutritional quality which at least were not negatively differentiated from the quality microbiological characteristics reported in literature for the same species grown as monocultures.

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IMPAQT Intelligent Management System for Integrated Multi-trophic Aquaculture