Ecophysiological and molecular involvement of extracellular-regulated protein kinases (ERK 1/2) in the response of *Dunaliella viridis* to heat stress

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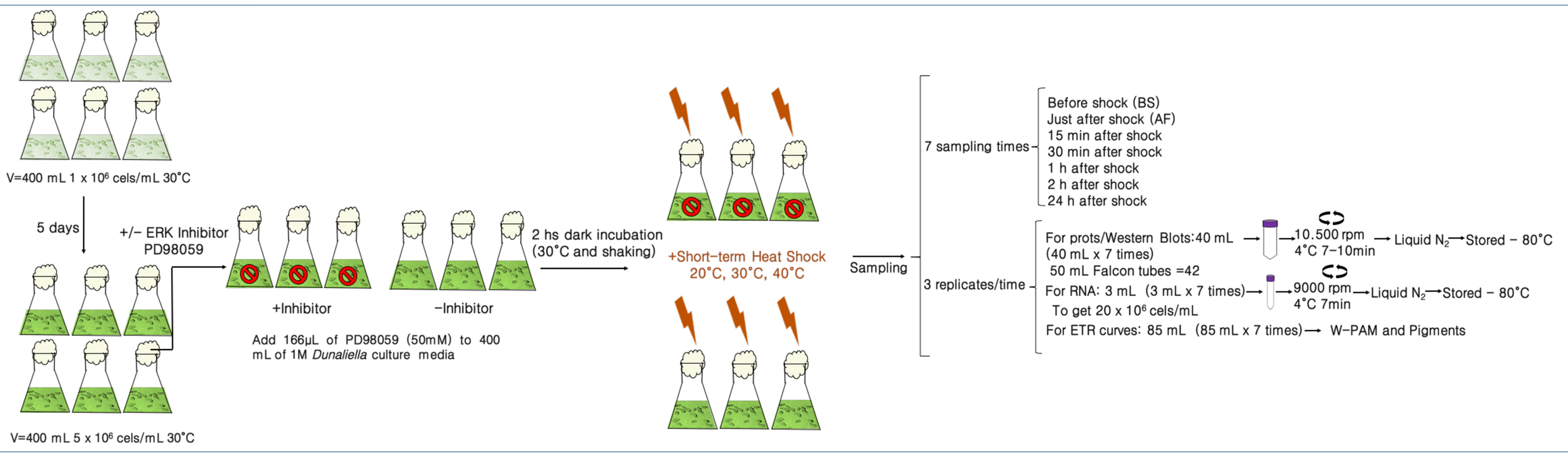
Background

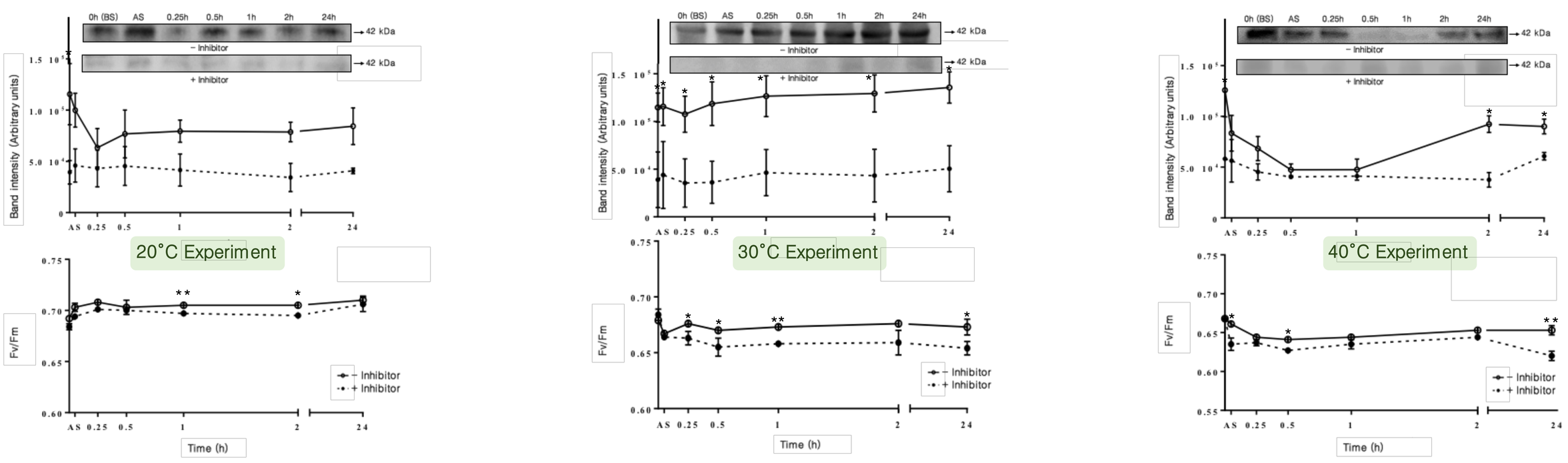
- The eukaryotic green microalga *Dunaliella viridis* has shown an outstanding capacity to face a broad range of environmental stressors (high irradiance, UV radiation, salinity, temperature....)
- The lack of a rigid cell wall and its unique ability to respond, adapt and grow under stressful conditions makes *Dunaliella* an excellent model to study stress signal transduction.
- Mitogen-activated protein kinases (MAPKs) are highly conserved serine/threonine kinases that convert extracellular stimuli into a wide variety of responses at both cellular and nuclear levels. In eukaryotic cells, MAPKs are involved in both environmental stress responses (JNK and p38 pathways) and cell proliferation and differentiation (ERK pathway) through protein kinase cascades.

Experimental Approach



Results

Evolution of the maximum quantum yield and protein immunodetection of ERK1/2 of *D. viridis* by western blotting after non-lethal Heat Shock



Analysis of the pigment content after non-lethal Heat Shock

Chlorophyll *a* (µg/mL)

	20°C				30°C				40°C			
	+inhibitor		−inhibitor		+inhibitor		−inhibitor		+inhibitor		−inhibitor	
	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd
Time												
0h	3,283	±0,320	3,283	±0,320	3,547	±0,189	3,460	±0,304	2,929	±0,040	3,515	±0,020
2h	3,210	±0,113	3,357	±0,522	3,876	±0,388	4,633	±0,491	3,365	±0,063	3,941	±0,252
24h	3,370	±0,696	3,140	±0,319	3,975	±1,051	5,152	±0,186	2,673	±0,314	2,214	±0,022

Chlorophyll *b* (µg/mL)

	20°C				30°C				40°C			
	+inhibitor		−inhibitor		+inhibitor		−inhibitor		+inhibitor		−inhibitor	
	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd
Time												
0h	1,034	±0,133	1,034	±0,133	1,012	±0,041	1,013	±0,144	0,946	±0,003	1,215	±0,132
2h	1,105	±0,170	0,964	±0,064	1,095	±0,171	1,297	±0,233	1,136	±0,155	1,530	±0,022
24h	1,557	±0,131	1,481	±0,312	1,280	±0,388	1,418	±0,108	1,040	±0,183	0,759	±0,092

Chlorophyll *a:b* ratio

	20°C				30°C				40°C			
	+inhibitor		−inhibitor		+inhibitor		−inhibitor		+inhibitor		−inhibitor	
	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd
Time												
0h	3,210	±0,113	3,357	±0,522	3,547	±0,189	3,460	±0,304	2,929	±0,040	3,515	±0,020
2h	3,184	±0,091	3,182	±0,478	3,876	±0,388	4,633	±0,491	3,365	±0,063	3,941	±0,252
24h	3,370	±0,696	3,140	±0,319	3,975	±1,051	5,152	±0,186	2,673	±0,314	2,214	±0,022

Xantophyls + Carotenoids (µg/mL)

	20°C				30°C				40°C			
	+inhibitor		−inhibitor		+inhibitor		−inhibitor		+inhibitor		−inhibitor	
	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd	Avg	sd
Time												
0h	344,2	±35,6	344,2	±35,6	320,7	±12,8	312,4	±30,5	365,8	±28,2	397,1	±22,5
2h	361,9	±34,3	326,5	±32,4	383,1	±60,3	456,2	±59,4	389,6	±14,0	465,3	±58,9
24h	415,2	±42,3	424,7	±86,0	467,1	±93,0	481,5	±30,3	411,5	±72,6	363,4	±61,4

Concluding Remarks

- The evolution of the maximum quantum yield of *D. viridis* after non-lethal Heat Shock, together with protein immunodetection by ERK1/2 western blotting reveal that the ERK1/2 proteins are not directly involved in the response to heat stress, and that they are rapidly deactivated after stress, leading to a transient inhibition of cell division.
- There is a variation in the pigment content by temperature. Under 40°C is observed an early response and a depletion phase after 24h. This response it becomes clearer in the case of Chlorophyll (treatment without ERK1/2 inhibitor). Therefore, under increased temperature, a better photosynthetic traits from treatments without ERK1/2 inhibitor have been showed.

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