Perspective Sanitary Control for Seafood Safety under Predicted Changes in Climate with Special Focus on Korea

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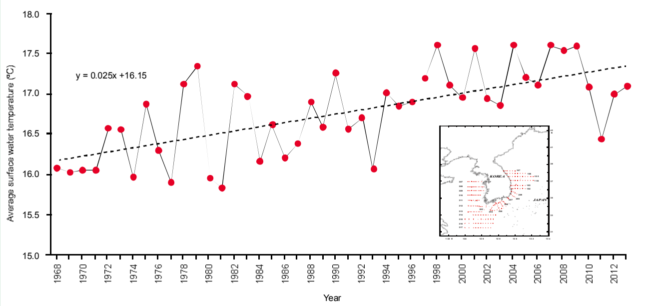
Intorduction

Ocean warming and climate change will be the possible factors which can impact on food contamination and foodborne diseases. And the comprehensive strategies are required in consideration of changes in the nature and occurrence of food safety hazards which are being provoked by climate change and its variability. Long term data from the sanitary survey and monitoring for biological and toxicological hazardous elements in seafood and its surrounding marine environment for several decades were analysed to evaluate the effect of climatic factors on various food safety risks to suggest their counter measures and supplementary element for the national level safety control strategy in Korea.

Predominant changes around Korean Peninsula

Fig. 1. Change of the average surface seawater temperature around Korean Peninsula (1968-2012).

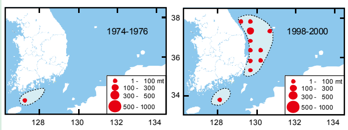


Adapted from NIFS Annual Report (National Institute of Fisheries Science, 2014).

Average surface water temperature around Korean Peninsula was increased by 1.2 °C for 45 years (Fig. 1). Current flow and distribution of food organisms were likely to be affected.

A cuttle fish had been catched at the south coast of Korea but catchable area has been expanded into the north-east areas since the end of 1990's (Fig. 2).

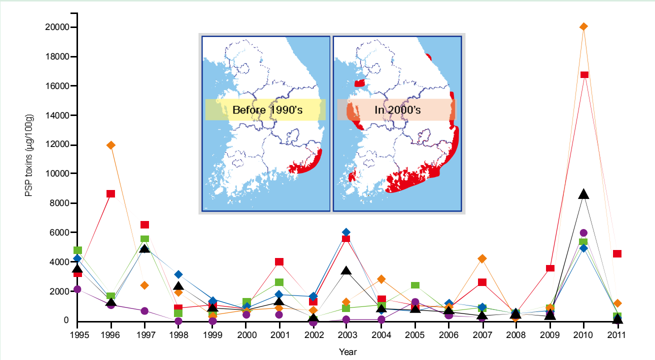
Fig. 2. Distribution of a cuttle fish chatching area during winter time.



Adapted from NIFS Annual Report (National Institute of Fisheries Science, 2014).

Levels and affected areas of PSP toxins occurrence

Fig. 3. PSP occurrence levels in 6 monitoring stations (mussels) in the south coast of Korea, 1995 - 2011.



Adapted from NIFS Annual Report (National Institute of Fisheries Science, 2012).

Though relatively little work has been done to characterize the specific link but it is generally accepted that frequency, intensity and duration of harmful algan blooms and relevant shellfish toxins occurrence are increasing in aquatic environments on a global scale. Some of this may be caused by changes in climate. In Korea the period of PSP toxins occurrence extended from 15 weeks to 31 weeks in the south coast and the affected areas has also expanded into the whole coastal areas since 2000 (Chang et al., 1986). The levels of PSP toxins also showed trend of increase and extremely high toxin level (20357 μg/100g) was recorded in 2010 (regulatory limit = 80 μg/100g). This trend of toxins level increase can not be statistically validated because harmful algae species which cause PSP toxins accumulation in shellfish comprise only a small component of the phytoplankton community. And responses of harmful algae species to climate change may differ from those of the whole phytoplankton community.

References

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Pathogenic vibrios and marine environmental factors

Fig. 4. Four factors measured in urban estuarian environment (2013-2015). A, Seawater temp.; B, Air temp., C, Salinity; D, pH.

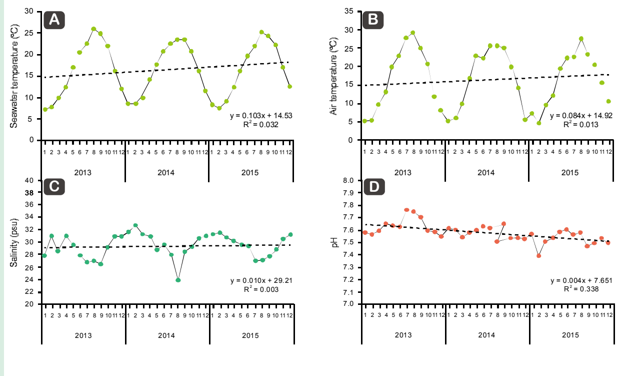

Fig. 5. Vibrios-specific gene detection rate urban estuarian environment (2013-2015, 11 cities). A, *V. parahaemolyticus*; B, *V. vulnificus*.

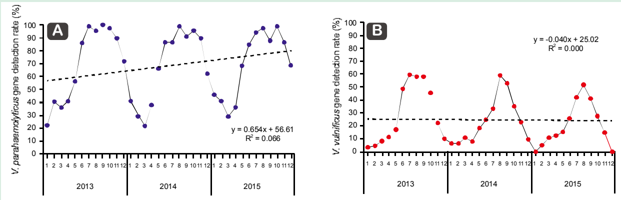

Table 1. The correlation coefficient beween vibrios detection rate and environmental factors

Factors	*V. vulnificus*	*V. parahaemolyticus*
Seawater temp. (°C)	0.91	0.90
Air temp. (°C)	0.87	0.79
Salinity (psu)	-0.83	-0.62
pH	0.44	0.23

Adapted from The relationship of pathogenic Vibrio spp. with marine environmental factors, Korea, 2013-2015 (Centers for Infection Diseases, 2016).

The prevalence of *V. vulnificus* and *V. parahaemolyticus* and their relationship with marine environmental factors were investigated at 11 urban esturian areas.

Seawaters (2200 samples) were collected from three points of each area and four environmental factors (temperature of seawater and atmosphere, salinity and pH) were measured (Fig. 4). And screening of *Vibrio* spp. was performed by PCR to detect species-specific genes (*tlh* and *vvhA*). Three years (2013-2015) of data were analyzed by linear regression to calculate the coefficient of determination.

V. parahaemolyticus (1548 strains, 69.7% detection rate) was the most prevalent species, followed by *V. vulnificus* (568 strains, 25.6% detection rate) (Fig. 5). Among the environmental factors, seawater temperature showed strong correlation with *V. vulnificus* (0.91) and *V. parahaemolyticus* (0.90) (Table 1). Air temperature also correlated with detection rates of both vibrios (0.87 and 0.79) and this result suggested that the growth of vibrios in the stage of seafood processing and handling can be promoted under climate change in particular temperature increase. Risks by time-temperature abuse will be increased and require more efforts in monitoring and screening programs for high-temperature preference pathogens.

And systematic monitoring of pathogenic marine *Vibrio* spp. should be continued for long-term assessment of their risks related to climate changes.

Conclusions

It is prudent of us to say that climate change has implications for food safety. From a marine microbiological perspective, climate change and various factors exacerbate eutrophication causing harmful algal growth. Accumulation of toxins produce by the algae by filter feeders (bivalve molluscan shellfishes) and the consumption of these products may cause human illnesses. And an increase of water temperature promotes the growth of marine pathogens such as vibrios leading to an increased risk relevant to raw consumption of various seafood.

For better understanding and controlling emerging these hazards at all stages of the seafood chain, efforts are required in a number of essential areas such as mathematical modelling, development and application of scientific tool boxes to characterize inter-reactions in microbial communities, systematic surveillance and monitoring for foodborne pathogens, and also reenforced coordination is compulsory among food safety, public health and environmental authorities.

Human and environmental health is inter-dependent and inter-related. Reenforced communication and cooperation among professionals in the world would be significantly valuable for correct evaluation of the impact of global climate change on seafood safety and human and environmental health. As the FAO indicated we need "One Health" concept (Jaykus et al., 2008).

4th International Symposium on the Ocean in a High-CO2 World