Polyploidy in a natural population of mussel, *Mytilus trossulus*

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Abstract

We have analyzed natural polyploidy in a population of *Mytilus trossulus* from Vancouver Island (British Columbia, Canada) by means of cytogenetic techniques. Results obtained are the first reporting on this type of numerical chromosome aberrations in mussels.

Keywords: mussel; *Mytilus trossulus*: polyploidy; chromosome.

The study and detection of natural polyploidy is very scarce in bivalve molluscs. Among the few references about this topic we have found the description of this process indifferent species belonging to genus *Lasaea* (Thiriot-Quiévreux et al. 1989; O Foighil and Thiriot-Quiévreux1991) and in a neoplastic process developed in the clam *Macoma balthica* (Thiriot-Quiévreux and Wolowicz 1996). Elston et al. (1990) related an increase of nuclear DNA content in the mussel *Mytilus trossulus* affected of a neoplasia, too.

In this study, we observed a case of natural polyploidy in the mussel, *M. trossulus*. Samples were collected from Esquimalt Lagoon, Vancouver Island (British Columbia, Canada) during the summers of 1995 and 1996. Once in the laboratory, animals were fed with *Isochrisis sp*. microalgae for ten days and, then, treated for metaphase obtention according to Méndez et al. (1990). This species shows a diploid karyotype 2*n*= 28, constituted by seven metacentric and seven submetacentric chromosome pairs (Fig. 1). In 4 of 168 individuals analyzed, we have detected polyploid metaphases showing a high chromosome number (Fig. 2), which varied from 48 to 92. The modal number showed a value between 74 and 78 chromosomes (Table 1), and it was not the same in each one of the polyploid mussels.

Polyploid metaphases, obtained from gill tissue, showed 1 to 3 large metacentric and 6 large submetacentric chromosomes, a variable number of medium-sized chromosomes (which were characterized according to the centromere position) and small-sized chromosomes whose centromeres were very difficult to visualize. However, in each one of the polyploid cells analyzed, we observed that metaphases always showed the 6 large submetacentric chromosomes (Fig. 2).

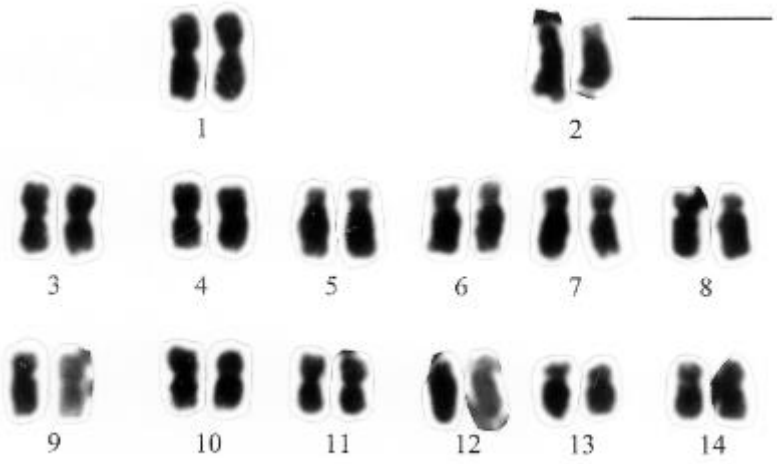

Figure 1. Karyotype of *Mytilus trossulus* showing the seven metacentric (1, 3, 4, 9, 10, 11, 14) and the seven submetacentric chromosome pairs (2, 5, 6, 7, 8, 12, 13).Bar = 5μm

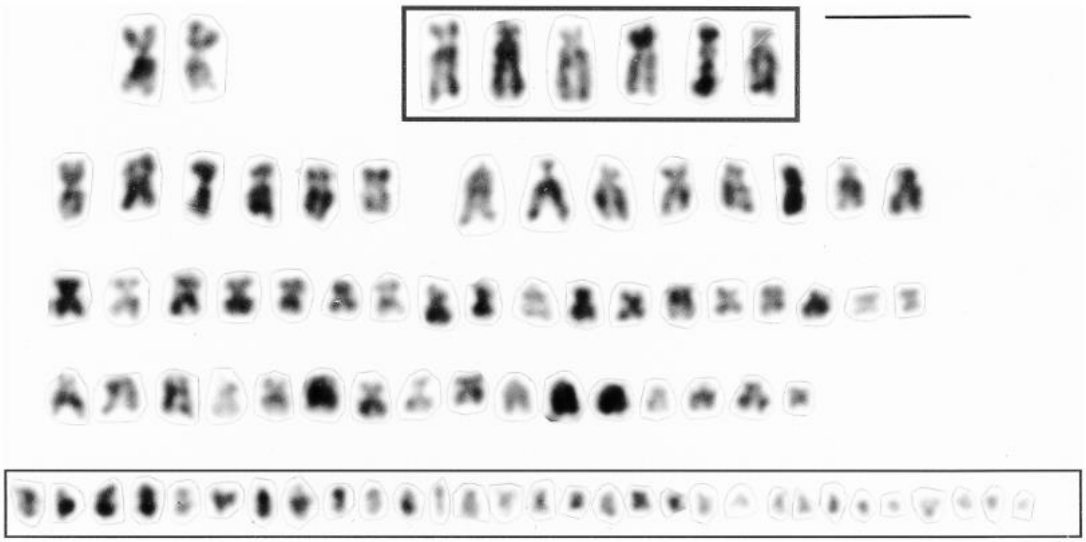

Figure 2. Karyotype of a polyploid cell showing 86 chromosomes. First line, 2 large metacentric and, (in square) the six large submetacentric chromosomes. Second line, 6 medium metacentric and 8 medium submetacentric chromosomes. Third line, 18 medium metacentric chromosomes. Fourth line, 16 medium submetacentric–subtelocentric chromosomes. Fifth line, the small-sized chromosomes whose centromeres were difficult to visualize. Bar = 5μm

The six larger submetacentric chromosomes that appeared in every one of the polyploid metaphases analyzed could suggest that multiple cell replications have taken place. We suppose that along this process, chromosome pair No. 2 is involved, because the morphology and size of this chromosome pair are similar to the morphology and size of the six larger submetacentric ones. In this sense, Moore et al. (1991), analyzing a systemic neoplasia in *Mytilus* sp. mussels, detected the existence of two cellular forms whose DNA contents showed the presence of tetraploid and pentaploid levels. However, in our results these cells appear to be hexaploid.

On the other hand, the proportion of polyploid cells in the 4 affected mussels was different from one individual to another (Table 2); in the other 164 mussels, we did not observe polyploid cells. Thus, whereas

two of the samples showed a proportion of polyploid cells higher than 95%, in the other two it was close to 10%. Furthermore, the mitotic index of unaffected individuals reached maximum values of 0.11%,while the mitotic index of individuals with polyploid metaphases was 0.37%, an increase three times above the normal.

Table 1. Number of metaphases with high number of chromosomes.

	Mussel				
No. chromosomes	1	2	3	4	Total
< 64	2	-	1	-	3
64-68	7	1	8	-	16
69-73	12	2	8	1	23
74-78	7	1	17	2	27
79-83	8	1	12	-	21
> 84	2	-	4	-	6

Table 2. Proportion of polyploid and healthy cells, and total numbers of cells analzyed.

Mussel	% of polyploid cells	% of healthy cells	Total
1	96.67	3.33	150
2	11.11	88.89	63
3	95.22	4.78	586
4	9.38	90.62	32

Along the coasts of British Columbia, blue mussel species frequently develop an illness known as “The Summer Mortality Syndrome” (Bower 1989; Bower et al. 1994). Population monitoring and histological studies allowed us to identify and diagnose it as a haemocytic neoplasia. As pointed out by Elston et al. (1988), the neoplastic hemocytes appear in circulation and rapidly replace the healthy hemocytes, altering the normal physiological processes. The neoplasia is progressive and can be transmitted by cohabitation. Such characteristics could explain the high mortality in these molluscs during the summer months. In this geographic area, mortality can exceed 75% of mussels. Perhaps polyploidy described in this work could be the consequence of a neoplastic process, and it is the first time that it is described in mussel by cytogenetic methodology and chromosome analysis. Further studies must be carried out to investigate if this neoplasia is caused by an infectious agent (virus) or by environmental pollution (Brown et al. 1979; Oprandy et al. 1981; Reinisch et al. 1984). Recently, Krishnakumar et al. (1999) did not find evidence that chemical contaminants induce the development of such a process.

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