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Short Communication

The Rise of Clonal Biotechnological Sericulture

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Abstract

Selected or biologically (gene-) engineered substances from the silkworm can be produced in standardized form all year round by automated bioreactors that are based on genomically stable, easy and indefinitely long with 100% effectiveness reproducible parthenogenetic clones.

INTRODUCTION

Experimental genome (organismic) cloning in the silkworm, *Bombyx mori* L.,which was discovered by the Russian biologist Astaurov in 1936, remains to be in the shadow of animal sex regulation problematics, possibly due to its appellation «artificial parthenogenesis. Rewarded by the Nobel Prize trans-nuclear cloning is the same experimental parthenogenesis, the only difference being that we replace the nucleus of activated egg by the donor's nucleus. Properly speaking, we do not reach genome cloning in this way because the constructed hybrid egg, where donor's nucleus confronts the alien recipient ooplasm, is only partially and roughly imitates the egg that had given, under now unplayable conditions, rise to the donor ontogenesis and to the used donor's nucleus [1,5].

Ontogeny repeatability is the basic principle of genomic (organismic) cloning. Therefore, «paraclones» obtained through the trans-nuclear cloning cannot be used for precise genome copying and hence for successful establishment of clones maintaining identical phenotype (ontogeny) in a series of generations. The use of somatic trans-nuclear paracloning in current biotechnology is also hindered by low efficiency of the procedure and by abnormalities encountered in the surviving individuals [1,3].

Astaurov proved the possibility to regulate meiotic processes in unfertilized (female parthenogenesis), freshly inseminated (male parthenogenesis) egg by specific heat shock treatments, and thus tackled the problem of sex regulation in the silkworm. The all-female progeny obtained in this way from single female imago, genetically and phenotypically iterated mother's ontogenesis and was therefore designated as mother's clone (parthenoclone) [1]. The genomic (organismic) cloning with Astaurov's method is ensured by the absence of crossing-over in the silkworm oogenesis and by thermal suppression of the first (reductional) meiotic division in the treated egg. Due to these phenomena, the whole chromosomal set of the mother remains unchanged and undergoes only equational division, i.e. mitosis. The first and subsequent clonal parthenogenetic generations start their "mitotic" development from the **cellgenome** of the mother-founder. Using his effective method of cloning and exploiting large silkworm germplasm bank available in the USSR, in 1972 Astaurov obtained the first parthenoclone with 100% clonal reproducibility; since then all hereditary factors that have determined its maximal capability of thermal cloning are accumulated and conserved in a single genome. The clone has accomplished by now more than 100 generations and its genetic and phenotypic characteristics remained stable, alike microorganism and cell culture strains, plant clones, clones of unisexual, and some naturally parthenogenetic animals [1,3- 6].

Parthenozygous silkworm population that has been created from Astaurov's clone and different genetic strains is now a unique experimental model for the study of parthenogenesis, genome cloning and their role in the evolution of organisms. It is also the specialized breeding and experimental basis for the clonal biotechnological sericulture. Cloning endows the silkworm with properties of a unique biotechnological reactor with the possibility to **standardize** all traditional and modern gene engineered products obtained from the silkworm. The first transgenic parthenogenetic clones have recently been established. It is pertinent to envisage their quick creation, maintenance and improvement if we take into account and use the steps we found effective at experimental genetic analysis of clonal variability and selection [5, 6]. The results expected are:

1. Setting transgenic clones already in the daughter progeny of the generation produced by the clonal eggs with inserted DNA construct and subsequent insertion, by this way, of genes modifying expression of the target product [5,6].
2. Quick genetic corrections of the obtained clone such as transgene homozygotization and polyploidization without introducing into its genome additional genetic material [2].
3. Temporary parthenocloning from any strains with low or

none cloning ability by transplanting larval ovaries into a reliable parthenoclone [5,6].

4. Production of bivoltine clones or diapause prevention in univoltine clones by the methods compatible with DNA microinjection into the egg after its thermal activation [2,5,6].

5. Certification of the methods used for the identification, isolation and analysis of genes controlling cloning ability [3].

6. Elaboration of the male cloning technique based on the experimentally induced sex reversal in the male germ line [3].

7. Construction of parthenozygotic models for the analysis of genetic, epigenetic and ontogenetic variability with the aim to create stable clone-producers with maximal expression of the desired gene(s) [3].

8. Cytogenetic reactor, based on Astaurov's clone egg cells, that can be launched (activated) in different ways and «uploaded» by gene-engineered, nuclear or cellular material for increasing transgenesis efficiency, for obtaining and study of new transgenic and hybrid forms in the silkworm [4].

9. Optimization and development of robotic cloning and clone rearing [1].

10. Year-round automated production of target materials by transgenic clones reared on artificial diet [6].

The author intends to propose foundation of an international corporation of clonal biotechnological sericulture.

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