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SHORT COMMUNICATION

KARYOLOGICAL STUDIES IN HYBRIDS OF BELUGA *HUSO HUSO* (L.) AND THE RUSSIAN STURGEON *ACIPENSER GÜLDENSTÄDTI* BRANDT

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This study presents the karyotype analysis of the sturgeon hybrid between the Russian sturgeon *Acipenser güldenstädti* (2n = 250) and beluga *Huso huso* (2n = 118-120) which was recently introduced to Israel as a subject for experimental culturing. The consistent mode of diploid chromosome number of hybrid fish is 181-190. The karyotype is characterized by 78 metacentric and submetacentric, 16 acrocentric (8 of them are relatively large) and about 88 microchromosomes. Our results confirm the intermediate origin of the hybrid between species with (in the family Acipenseridae) a large number of chromosomes and species with about half the number of chromosomes. The presence of numerous microchromosomes and polyploid origin of the family Acipenseridae raises some uncertainty as to whether the hybrid will be completely sterile.

Introduction

All members of the family Acipenseridae are characterized by high-quality meat and eggs which are a delicacy. Under favorable conditions, sturgeons show a rapid weight gain in ponds, cages and basins and within 2-3 years they can attain a body weight of several kilograms. At present this type of rearing of sturgeons is intensively being developed in several European countries, the former Soviet Union, Japan and the USA as an economically important branch of aquaculture.

In the former Soviet Union numerous hybridizations between various acipenserid species have been carried out (Nicolyukin, 1966). Many sturgeon hybrids are fertile, like the intergeneric hybrid between beluga *(Huso huso)* and sterlet *(Acipenser ruthenus)*, called the "bester". This hybrid combined the growth rate of the larger parent (beluga) with the freshwater tolerance of the smaller (sterlet) and proved to be particularly suited for rearing to marketable size (Burtzev, 1972). At present the hybrid between beluga *(H. huso)* and Russian sturgeon *(A. güldenstädti)* is being intensively developed in aquaculture of the former Soviet Union. It may be used both in sea and fresh water due to osmoregulatory tolerance (Burtzev et al., 1989).

The family Acipenseridae may be divided into two groups according to the number of chromosomes and DNA content of the nucleous. One of these groups includes the sturgeons with large numbers of chromosomes (2n = 250), such as the Russian sturgeon *(A. güldenstädti)*, Siberian sturgeon *(A. baeri)*, Amur sturgeon *(A. schrencki)* and Italian sturgeon *(A. naccarii)*. The other group includes beluga *(H. huso)*, great Siberian sturgeon *(H. dauricus)*, sterlet *(A. ruthenus)*, stellate sturgeon *(A. stellatus)*, barbel sturgeon *(A. nudiventris)*, as well as common sturgeon *(A. sturio)*, which have half (2n = 118-120) as many chromosomes in the genome (Serebryakova, 1970; Fontana and Colombo, 1974; Fontana, 1976; Vasiliev, 1985; Arefjev, 1989). The differences between these two groups in the content of DNA per genome and the size of the erythrocytes provide evidence in favor of the hypothesis of the polyploid origin of multichromosome sturgeon species (Fontana, 1976; Kirpichnikov, 1981; Vasiliev, 1985).

Despite that many karyological studies have been carried out in sturgeons, the karyotypes of sturgeon hybrids are not well documented. There are only a few papers on karyological studies in intergeneric hybrids between beluga *(H. huso)* and sterlet *(A. ruthenus;* Ojima et al., 1986; Arefjev, 1989). The karyotypes of these hybrids through three generations do not differ in diploid number (2n = 118-120) from the parental species (Ojima et al., 1986; Arefjev, 1989). A few years ago the first results were published regarding the cytological analysis of hybrids between beluga *(H. huso;* 2n = 118-120) and the Russian sturgeon *(A. güldenstädti;* 2n = 250). It was observed that the hybrid has a non-intermediate chromosome number (2n = 167-169, on the average) and strong destabilization of the karyotype that indicate a high probability of complete sterility (Arefjev and Nikolaev, 1991).

Careful karyological examinations give the most precise results for accurate genetic identifications of the hybrids. Generally, there are definite characteristic chromosomes in the karyotype of each species which allow determination of the genetic origin of a specific individual. In most cases, fish hybrids show an intermediate inheritance in their karyotype characters, poor viability and sterility.

In 1992 a few thousand eggs from the sturgeon hybrid between *H. huso* and *A. güldenstädti* were imported to Israel from Russia for experimental culturing. At present these fish are being reared in the fish farm of Kibbutz Dan. The main purpose of this study was karyological documentation of the origin of this sturgeon hybrid. In addition, cytogenetics of sturgeons is interesting because they are rather primitive fish and their taxonomy is complicated.

Materials and Methods

Hybrid fish were collected at the end of April 1993 from the Kibbutz Dan fish farm. The fish used for karyotyping were 7 months old (50-100 g).

A routine method of chromosome preparation was used (Kligerman and Bloom, 1977). Briefly, the method involved intramuscular injection of 0.5% colchicine 5-8 h prior to dissecting, removal of desired tissue, treatment in hypotonic solution and fixation in 3:1 ethanol:acetic acid. Slides were prepared by dropping a suspension of fixed cells onto a clean microscope slide, air-drying and staining with 10% Giemsa in standard phosphate buffer, pH=6.8, for 15 min. Cells (anterior kidney tissue and gills) with well-spread chromosomes were selected for the study by light microscopy and photographed using high contrast black and white film. Thirty-seven metaphases of 7 individuals were examined.

Results

The consistent mode of diploid number of chromosomes is 181-190. The minimal number is 141-150 and the maximal, 181-190. The average number of chromosomes is 177.1± 2.2. The differences between diploid numbers may be caused by the large number of dot-like microchromosomes, which probably are often lost during preparation, or are due to counting errors.

The metaphase plate and karyogram (2n = 182) are shown in Figs. 1 and 2. The karyotype

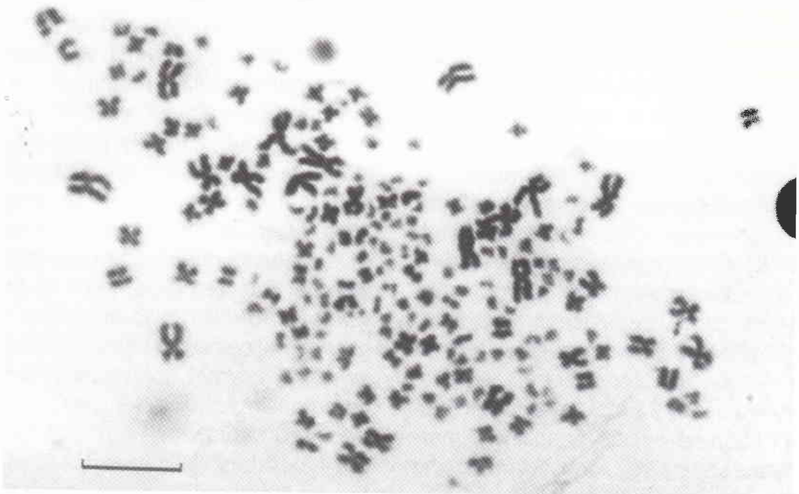

Fig. 1. Metaphase plate of the hybrid between *Huso huso* and *Acipenser güldenstädti;* bar is the equivalent of 10 µk.

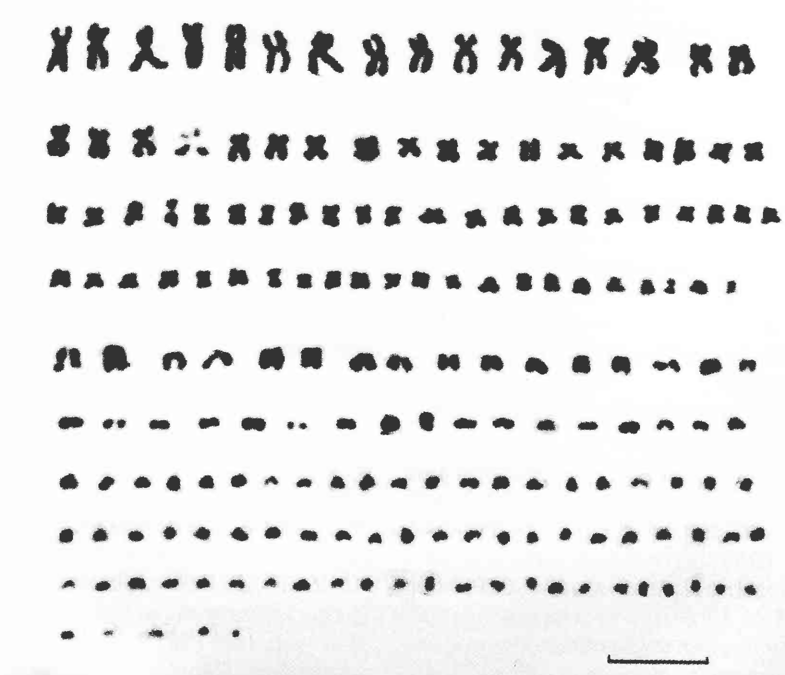

Fig. 2. Karyogram of the hybrid between *Huso huso* and *Acipenser güldenstädti,* 2n = 182; from top, 78 metacentric and submetacentric, 16 acrocentric, and about 88 microchromosomes; bar is the equivalent of 10 µk.

is characterized by 78 metacentric and submetacentric, 16 acrocentric (at least 8 of them are relatively large) and about 88 microchromosomes. The morphological karyotype analysis revealed that three types of chromosomes were present in the hybrids – biarmed (metacentric and submetacentric), uniarmed (acrocentric) and microchromosomes. The length of the smallest microchromosomes is less than 1 μk while the length of the largest ones (biarmed) is about 5 μk. Acrocentric chromosomes form a set in which they smoothly decrease in length and degrade into microchromosomes. The size of the biggest acrocentric chromosomes is about 2.5 μk. They are nearly 2.5-3.5 times larger than the smallest biarmed ones. Variability of morphological types among the biggest biarmed and uniarmed chromosomes was not observed.

Discussion

The results of our investigation show that the hybrid between *H. huso* and *A. güldenstädti* has the consistent mode of diploid number of chromosomes, 181-190. It confirms that this hybrid originated by crossing a species with a large number of chromosomes (2n = 250) and a species with a low number of chromosomes (2n = 118-120). Theoretically, the hybrid between *H. huso* and *A. güldenstädti* should have been intermediate, 2n = 184-185 chromosomes. Our results are very similar to the theoretical ones, especially when the morphological structure of the karyotype is taken into account. The hybrid is characterized by 78 metacentric and submetacentric chromosomes similar to the 80 that is theoretically expected. In addition, according to our data the hybrid karyotype comprises approximately 7-8 relatively large acrocentric chromosomes. This is also in general agreement with the intermediate origin of the hybrid considering that the karyotypes of the parental species have 2 *(H. huso)* and 12 *(A. güldenstädti)* such relatively large acrocentric chromosomes (Fontana and Colombo, 1974; Vasiliev, 1985). Our results are in rather poor agreement with those obtained previously regarding non-intermediate karyotype inheritance and strong disbalancing of genetic apparatus in the hybrid between *H. huso* and *A. güldenstädti* (Arefjev and Nikolaev, 1991).

The family Acipenseridae has a large number of chromosomes and an increased DNA content in the genome. The adaptive value of numerous microchromosomes is unclear, but may represent a mechanism for increasing the chromosomal variability without impairing the integrity of the main genome (Kirpichnikov, 1981). In any case, the presence of numerous microchromosomes, and the polyploid origin of sturgeons raises some uncertainty as to whether the hybrid between *H. huso* and *A. güldenstädti* will be completely sterile. It is known that complete sterility implied by the absence of normal gonad development is uncommon in fish hybrids. Many sturgeon hybrids are fertile when produced and tested in the laboratory (Nikolyukin, 1966). Investigation on the gonadal development of this hybrid and on its fertility/sterility must be conducted.

Acknowledgement

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