

Inheritance of pigmentation in some freshwater pulmonate snails

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The genetic determination of pigmentation of integument and eyes in *Biomphalaria tenagophila* (Orbigny) and *Planorbarius banaticus* (Lang) was studied using the hybridization method. Studied characters in both species are determined at least by two loci, each being represented by a pair of alleles (in this study — **B-b** and **E-e**). The allele **B** in homozygous state in *B. tenagophila* determinates the formation of black colour of the body whereas the allele **b** — the absence of pigment in integument and red colour of the body due to hemoglobin. There is also a codomination in heterozygotes, these molluscs have brown body. The alleles of the second locus determine presence (**E**) or absence (**e**) of the eye pigment. The genotype **bbE-** determines partial albinism: red body and black eyes. Absence of eye pigment (white eyes) is found only in complete albino specimens (genotype **bb ee**). The allele **B** is suppressor for the recessive allele of the second locus. Manifestation of the first locus in *P. banaticus* is analogous to that described above the second locus affects not only the eye pigmentation but also the body colour. Its dominant allele (**B**) determines an additional pigmentation of dorsal sides of head and foot that is more pronounced in homozygotes. Complete albinism in *P. banaticus* is expressed in the absence of eye pigment, orange-yellow colour of body, decreased viability, and some morphological deviations. The study revealed that the genetic system determining the pigmentation of integument and eyes is basically similar in both species studied but gene effects may be very different. Therefore the N.I.Vavilov's Law of Homological Rows can be only applied to related species.

Наследование пигментации у некоторых пресноводных легочных моллюсков

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Методом гибридизации изучали генетическую обусловленность пигментации кожных покровов и окраски глаз у *Biomphalaria tenagophila* (Orbigny) и *Planorbarius banaticus* (Lang). У обоих видов эти признаки детерминированы как минимум двумя локусами, каждый из которых в изученных популяциях представлен двумя аллелями (здесь **B-b** и **E-e**). У *B. tenagophila* аллель **B** в гомозиготном состоянии обеспечивает развитие интенсивной черной окраски тела, а аллель **b** — отсутствие пигмента в коже и красную окраску тела за счет гемоглобина. У гетерозигот имеет место кодоминирование

— моллюски имеют коричневое тело. Аллели второго локуса определяют наличие (**E**) или отсутствие (**e**) глазного пигмента. Генотипу **bbE**- соответствует частичный альбинизм: красное тело и черные глаза. Отсутствие глазного пигмента (белые глаза) свойственно только полным альбиносам (генотип **bb ee**). Аллель **B** является супрессором по отношению к рецессивному аллелю второго локуса. У *P. banaticus* действие первого локуса аналогичное, но второй локус здесь влияет не только на пигментацию глаз, но и на окраску тела: его доминантный аллель обуславливает дополнительную пигментацию дорсальной стороны головы и ноги, более сильно проявляющуюся у гомозигот. Полный альбинизм у *P. banaticus* выражается в отсутствии глазного пигмента, оранжево-желтой окраске тела, а также подавлении способности к размножению, пониженной жизнеспособности и ряде морфологических изменений. Наше исследование показывает, что генетическая система, определяющая пигментацию покровов и глаз, в главных чертах сходна у обоих изученных видов, но детали проявления действия генов могут быть различны, что ограничивает приложимость закона гомологических рядов Н.И.Вавилова лишь близкими видами.

The pigmentation of integument and eyes are characters with clear genetical determination. Albino specimens are very rarely found in nature but they are widely distributed in aquarium cultures. Knowledge of regularity of inheritance of these characters makes a possibility to evaluate experimentally some peculiarities of pulmonate reproduction: in the first place to estimate the portion of progeny born as a result of self-fertilization. We analyzed the inheritance of pigmentation in *Biomphalaria tenagophila* (Orbigny) (Planorbidae) and *Planorbarius banaticus* (Lang) (Bulinidae). The former species was obtained from aquarium culture, the latter — from ditch in settlement Vyritsa near railway station (about 50 km from Saint-Petersburg) and in marsh-riggen cut-off of the River Khmost' (about 30 km eastwards from Smolensk). The former species was studied in 1979-1981 and the latter — in 1982-1983.

The method of laboratory rearing of both species was basically similar to that used in other freshwater pulmonates [Beriozkina, 1980]. *B. tenagophila* were cultivated in the aquarium or in 0,5-1,0 L jam pots. The bottom of the pots was covered with thin layer of clean sand with 1-2 *Vallisneria spiralis* plants. The pots were filled with dechlorinated water. *P. banaticus* was more demanding of cultural conditions: adult animals could reproduce regularly only in the water volume no less than 1.0-1.5 L per snail and in aquaria with abundant water plants providing high concentration of oxygen. Molluscs of both species were fed (beginning from 10 day age) by dry food for aquarium fishes grinded to powder and dispersed over the water surface. Egg clusters (syncapsules) were removed from the pot walls by a soft brush or sharp scalpel and put into Petri dishes with small amount of water. The temperature in the aquaria was almost constant, 20-24°C.

Four phenotypes were found in *B. tenagophila*. Three of them had pigmented (black) eyes but differed in the body pigmentation: black, brown, and red. In the latter case the integument lacks pigment and the colour is determined by hemoglobin. Molluscs of the fourth phenotype had red body and white pigmentless eyes.

Material on *P. banaticus* from Vyritsa consisted of two phenotypes. Both had pigmented (black) eyes and red body with additional partial pigmentation of integuments of dorsal surfaces of head and foot. Some specimens had these parts strongly pigmented (of brownish-crimson colour), other were weakly pigmented (of crimson colour). All specimens from the Khmost' River had black body and black eyes.

Preliminary laboratory studies demonstrated that the pigmentation of body and eyes appeared in juveniles not simultaneously. The presence or absence of eye pigment becomes evident at the end of embryogenesis the duration of which is about 12-14 days. Specimens of *B. tenagophila* lacking integumentary pigment may be found at the same time. The intensity of colour in pigmented juveniles may be evaluated at 10-14 days after hatching. Evaluation of body colour in *P. banaticus* is usually possible not earlier than 3 weeks after hatching.

Two series of experiments were performed. The first series aimed to evaluate the degree of homozygosity of the material. For this purpose the specimens of each found phenotype were kept in pairs for 2-5 months, and the egg-clusters laid were removed and isolated. Progeny hatched from each cluster was kept in separate aquaria till the phenotype became evident. The parents were regarded heterozygous when F-1 was segregated into different phenotypes. The experiment continued until appearance of F-2, when F-1 had