

PLICOPURPURA PANSA (GOULD, 1853) FROM THE PACIFIC COAST OF MEXICO AND CENTRAL AMERICA: A TRADITIONAL SOURCE OF TYRIAN PURPLE

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ABSTRACT Most marine snails of the families Muricidae and Thaididae, which make up the genera *Murex*, *Thais*, and *Plicopurpura*, produce in the hypobranchial gland (mucus gland) a viscous liquid secretion. The secretion contains, besides mucus and biologically active compounds, minute amounts of chromogens, which develop enzymatically and under the influence of light and oxygen into a purple pigment known as “Tyrian purple,” “Royal purple,” or “Shellfish purple.” Throughout history, humans have used the pigment for various purposes. On the Pacific Coast of Mexico and Central America, for at least 500 y, the dyeing properties of the “snail’s ink” have been known and the pigments used for ceremonial and funeral garments. Here, the muricid *Plicopurpura pansa* (Gould, 1853) is the most exploited, and rarely the thaid *Thais kiosquiformis*. *T. kiosquiformis* has to be killed to obtain a few drops of the secretion from the hypobranchial gland, in contrast to *P. pansa*, which can be “milked” periodically without harming the animal to obtain a few milliliters of mucus containing the “Tyrian purple” precursors. In contrast to the Mediterranean region, where the use of purple from marine snails has long been forgotten and the craft of dyeing today cannot exactly be reconstructed, in remote Pacific regions of Mexico (in the states of Oaxaca and Michoacan) and in the Indian community of the Borucas in Costa Rica, its use continues until the present day on a small-scale and represents the survival of a knowledge of considerable antiquity. However, it is feared that this old tradition will be lost in the near future. The scarcity of the snails, the time, patience, and labor required for collecting them; and the great numbers of them required to dye a small piece of material are the main reasons why cheap, synthetic pigments are today used for dyeing traditional dresses.

KEY WORDS: *Plicopurpura pansa*, purple snail, Tyrian purple

INTRODUCTION

A large number of publications exist about the use of shellfish purple as a dye, mainly describing the source from Mediterranean snail species. Recently described was the source and chemistry of Tyrian purple from the west Pacific marine snail species *Plicopurpura pansa* (Naegel & Cooksey 2002). General references about the use of Shellfish purple are the books by Schweppe (1993) and Cardon (2003).

The majority of purple-producing marine snails belong to the family of Muricidae and most, if not all, produce a colorless secretion in the hypobranchial gland (also called mucus gland), which turns purple on exposure to air and light (Fretter & Graham 1994), giving what is known as “Tyrian purple,” “Royal purple,” or “Shellfish purple.” Mollusk purple as such does not occur in the live animal, but is formed during a sequence of chemical reactions in the presence of oxygen and light from the secretions produced by the animal. As in antiquity in the Old World, the use of muricids for dyeing led also on the Pacific Coast of the Americas to a product of high economic value. However, in contrast to the Mediterranean region, where the use of purple from marine snails has long been forgotten and the craft of dyeing today cannot exactly be reconstructed, in remote Pacific regions of Mexico (in the states of Oaxaca and Michoacan) and in the Indian community of the Borucas in Costa Rica, its use on a small-scale continues until today and represents the survival of a knowledge of considerable age (Turok 1999). As in the Old World, the conservative Indian communities in Mexico are convinced that Tyrian purple possesses properties that cannot be duplicated, apart from the practical advantage that material dyed with purple does not bleach. Cheap and fast synthetic dyes of purple color are today available, but the communities still prefer the expensive snail-purple. The garlic-like smell of material dyed with snail-purple, which aroma fades only after

several washings, is valued as a proof of authenticity (Gerhard 1962). Additionally, in various parts of the Americas, shellfish purple has long been used in the bridal dress of Indian women. Here, we may have an explanation for the great esteem in which shellfish coloring has been held on this continent, and consequently an analogy with the Old World belief that the purple from snails helps a woman to become prolific. There is also the possibility of a similar early idea that dye mollusks give protection from evil spirits or that shellfish colors are in some long-forgotten way connected with power, royalty, and religion (Gerhard 1962, Yoshioka 1974).

The use of muricids for dyeing cotton on the Pacific Coasts of Mexico and of Central America dates at least from Columbian times. Here, mainly *Plicopurpura pansa* (Gould, 1853) is exploited for Tyrian purple production. The carnivorous, gonochoristic marine snail inhabits intertidal rocks exposed to the open sea with high impact waves. The range of *P. pansa* extends at the Pacific from the northwest coast of Mexico (Baja California Sur) (Clench 1947; Keen 1971) to northern Peru (Peña 1970, Paredes et al. 1999). At low tides the mollusk is relatively easily gathered, and it ejects its dye-producing liquid in such a quantity that there is no need to kill the animal to obtain the purple. Furthermore, the dye-producing hypobranchial gland is so active that the snails can be “milked” periodically. The secretion is a milky-white liquid, which turns on exposure to air and light, at first yellow, then greenish, bluish, and finally purple (“Tyrian purple”).

The knowledge about the use of Tyrian purple on the Pacific side of Central America and Mexico before Columbus is very limited. Because of the tropical humid climate, the preservation of textiles is poor, and because the purple from *P. pansa* can be obtained without the need to kill the animal, shellfish middens are not found, as in Mediterranean and South American locations. However, we have written evidence of this ancient industry from several places in Central America, especially from the 17th and 18th centuries.

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HISTORICAL WRITTEN REPORTS ABOUT THE USE OF TYRIAN PURPLE

Possibly the first written report about the traditional use of Tyrian purple in Central America comes from the preacher Thomas Gage of England. Gage writes: "About Chira, Golfo de Salinas and Nicoya [Costa Rica] there are some farms of Spaniards, few and very small Indian towns who are all like slaves used by the Alcalde Major, to make him a kind of thread called pita [pita is made of agave fiber], which is a very rich commodity in Spain, especially of that color wherewith it is dyed in these parts of Nicoya, which is a purple color, for which the Indians are here much charged with work about the seashore, and there to find out certain shells, wherewith they make this purple dye. Purpura is a kind of shell-fish whose usual length of life is seven years. He hides himself about the rising of the Dog-star and so continues for 300 days. It is gathered in the spring time and by a mutual rubbing of one or the other of them together, they yield a kind of thick slime like soft wax, but its famous dye for garments is in the mouth of the fish and the most refined juice is in a white vein. The rest of his body is void and of no use. Your Segovia cloth dyed therewith for the richness of the color is sold at five or six pounds the yard, and used only by the greatest Dons of Spain [most probably Spaniards living in the Americas, since during this time Tyrian Purple was not used any more in Europe] and in ancient times only worn by the noblest Romans and called by the name of Tyrian purple. There are also shells for other colors, which are not known to be so plentiful in any other place as here." (Gage 1655).

Unfortunately, Thomas Gage did not describe in more detail which other gastropods were exploited for their Tyrian purple. The literature reports that related species of muricids produce various shades of purple, depending on the number and concentration of different chromogens, and the quantity of liquid produced varies greatly from one species to the next. Additionally, at certain seasons, the mucus gland (hypobranchial gland) is more active and its secretion is altered (Born 1936; Clench 1947; Gerhard, 1962).

Probably because of the over-exploitation of *P. pansa*, it became in Nicoya increasingly difficult to collect snails for dyeing, which caused increasing tensions between the gold-hungry Spanish magistrate and the indigenous population. The tensions exploded in 1760 in an uprising by the Indians (Fernández-Guardia 1938).

In 1744, during cartographic research, the Spanish scientists Jorge and Antonio Ulloa observed at Santa Elena close to Guayaquil in Ecuador, and also in Nicoya, the production and use of Tyrian purple from marine snails. Antonio Ulloa (1748) reports: "On the coasts belonging to the province of Guayaquil the finest purple is found. The animals from which it is derived are contained in shells, about the size of walnuts, and live on rocks washed by the sea. They contain a juice or humor, which is taken out, and yields the true purple. . . . Cotton, thread, and other delicate materials are dyed with it. It gives a lively and durable color, which does not lose its luster by frequent washing, but is rather improved thereby, and does not fade through long-continued use and exposure. Near the port of Nicoya the same kind of shellfish is found, and used for dyeing cotton. In both places the dyed yarn is used in making ribbons, lace, and other articles, which are afterwards skilfully sewn and embroidered. All such articles are highly prized on account of their fine and rare color. Various processes are used for extracting the juice or humor. Some kill the animal. They take it out of its shell, and having laid it on the back of the hand, press and

squeeze it with a knife from the head to the tail, concentrating the fluid in the "tail", which was finally cut off, the rest of the animal matter being thrown away. They treat in this way a number of animals until they have a sufficient quantity of juice. They then draw through the thread, which they wish to dye, and no more is required. But the dyed threads do not show at once the purple color they should have. This is not perceived until the whole is thoroughly dry. At first the color is milk-white, then it becomes green and finally purple. Others express the juice without killing the animal. They do not take it entirely out of the shell, but only press it as to cause a certain quantity of humor to be ejected, with which the threads are dyed. The shells are then laid again on the stones from which they were taken. They recover, and after some time give a fresh quantity of juice, but not so much as the first time. If the operation is repeated three or four times, the quantity is very small and the animal dies of exhaustion."

Ulloa continues the description of the dyeing activity in Nicoya: "a group of dyers would spend a month working from one bay to the next, and return during the following moon to "milk" the same animals again. One man could dye as much as a quarter of a pound of yarn in a single tide, or in theory 15 pounds a month. However, little work was done for a week or so near new moon, when it was thought that the dye was too thin or too meagre. It was believed that both the weight and color of shellfish-dyed thread varied according to the time of day, and sellers and buyers agreed upon a specific hour for their transactions."

It is not clear why the dyers found it either convenient or necessary to kill the animals to extract their color. *P. pansa* can be milked periodically without harming the animal. Perhaps of over-exploitation this species became rare, and therefore the dyers had to look for another purple-producing snail. The species of dye mollusk used toward the end of 1800 was probably *Thais kiosquiformis*. The animal was pricked with a needle or cactus thorn and then pressed down into his shell until it reluctantly yielded a few drops. The cotton threads were soaked and put into a bowl with more cotton into which the dye penetrated (Gerhard 1962).

About the process of purple dyeing as practiced in more recent times by the indigenous communities of Nicaragua, Squier (1852) gives us the following account: "Some of the cotton fabrics manufactured by the Indians are very durable and woven in tasteful figures and various colors. The color most valued is the Tyrian purple, obtained from the murex shellfish, which is found on the Pacific coast of Nicaragua. This color is produced of any desirable depth and tone, and is permanent, unaffected alike by exposure to the sun and to the action of alkalis. The process of dyeing the thread illustrates the patient assiduity of the Indians. It is taken to the seaside, when a sufficient number of shells are collected, which being dried from the sea water, the work is commenced. Each shell is taken up singly, and a slight pressure upon the valve which closes its mouth forces out a few drops of the coloring fluid, which is then almost destitute of color. In this each thread is dipped singly, and after absorbing enough of the precious liquid is carefully drawn out between the thumb and finger, and laid aside to dry. Whole days and nights are spent in this tedious process, until the work is completed. At first the thread is of a dull blue color, but upon exposure to the atmosphere acquires the desired tint. The fish is not destroyed by the operation, but is returned to the sea, where it lays in a new stock of coloring matter for a future occasion."

Apart from aspects of conservation, the "milking" of snails has the advantage that a dye can be obtained without interfering foreign substances.

TYRIAN PURPLE AS A COLORANT IN THE CODEX NUTTALL

In antiquity and in medieval times, Tyrian purple was used in special manuscripts ("Purple codices") as a priming color of parchments. In addition, in a pre-Columbian Mixtec (Codex Nuttall) manuscript, Tyrian purple was applied from an as-yet undetermined snail source, however not as priming color, but as paint. The Codex Nuttall was produced between 1468 and 1519 and describes the wars of conquest of powerful armies, which came to the south of Mexico. Distinguished ladies dressed in purple skirts, ponchos, and coats are shown stained with the same color, and chiefs wearing a purple apron and headdresses. Additionally in this manuscript, it is shown that purple was probably used as a body colorant for priests (Turok et al. 1988).

TEXTILES DYED WITH TYRIAN PURPLE

Due to the humid tropical climate in Mexico and Central America, the conditions for textile conservation are poor. However, about fifty years ago, Mayan textile fragments sealed in a jar were found in the state of Chiapas, Mexico. One band of textile was painted purple with a brush on both sides, most probably from *P. pansa*. It is not possible to date these textiles accurately, however, it is believed that the association of textiles together with charred human bones found in sealed jars belongs to a period not long before the Spanish conquest, and possibly immediately after it (Johnson 1954).

ABUNDANCE OF PURPLE SNAILS IN THE PAST

Undisputed evidence on the use of Tyrian purple on the Pacific coast of Central America and Mexico before the arrival of Spaniards is missing. During the Spanish time, three regions of shellfish dyeing could be found: Veraguas (Panama), the peninsula of Nicoya (Costa Rica), and Oaxaca (Mexico). However, it is not clear which exact species of purple snail were exploited in these regions, but most probably *P. pansa* and in cases of over-exploitation also *T. kiosquiformis*.

The peninsula of Nicoya (Costa Rica) was the center for purple production, and materials dyed with purple were exported to Guatemala and Panama. The mayor of Nicoya had exclusive rights for gathering and distributing dyed skeins in Central and South America. The over-exploitation of the purple snails resulted in a reduction of the snail population, similar to what had happened centuries earlier with Tyrian purple in the Mediterranean (Turok and Acevedo 2000). For this reason, the purple industry in Nicoya ceased to exist by the end of the 19th century, and not for a scarcity of dyers or a reduced demand for the product.

About 1880, the English chemist Schunck (1880) received from the west coast of Nicaragua cotton yarn dyed with the ink from *P. pansa*. It is interesting to note his remark that the animals were extracted, as in Ecuador 150 y earlier, from their shells by means of a pin or other pointed instrument, and the blood furnished the purple dye. This way of obtaining the "ink" certainly drastically reduced the snail population.

The use of "shellfish dye" in Mexico was at first reported in 1874 by von Martens (1874). He obtained from Tehuantepec (Oaxaca) a purple-dyed skirt and material with woven-in purple stripes. He mentioned that the high value of purple-dyed "enagua" skirts can be explained by the high number of snails needed, which are not numerous there (von Martens, 1898). In 1909, the ethnologist Zelia Nuttall visited Tehuantepec, and she also reported that the population of the purple snails seemed to be over-exploited and

became scarce, in spite of the careful treatment of the snails during the "ink" collection. Fishermen started to collect purple at Huamelula, and due to the rarity of the snails, to fill their orders they were often forced to proceed as far north as Huatulco—about 100 km along the coastline away from Huamelula—or even to Acapulco (more than 500 km along the coastline from Huamelula). Nuttall continues, "The scarcity of the fish (snails), the great numbers of them required to dye a pound of cotton, and the time, patience, and labor required, amply account for the comparatively high price of three to five gold dollars for one hand-woven skirt (1909).

TYRIAN PURPLE USE IN MODERN TIMES

Nuttall (1909) regrets that fewer and fewer purple skirts are ordered every year, and that the younger generation of women favors the imported and cheaper European stuffs. At Tehuantepec, the modern center for using Tyrian purple, in 1908 not more than about 20 purple garments were woven, and Nuttall predicted that not before long the industry will be extinct. Nearly eighty years later, Thompson (1994) observed that "in the early 20th century in Mexico shellfish purple was in much more widespread use than it is now. The beliefs, languages, and crafts of the Mexican Indians are fast disappearing. The progressive "westernization" of rural Mexico has led people in many villages to abandon their traditional textiles and customs, in favor of factory-made cloth and western-style clothes which are readily available everywhere. Cultural and social decay is continuing to the point that the demand for traditional textiles has almost vanished. Weavers in a few villages formerly noted for their excellent textiles have turned to making more "commercial" articles for sale to people such as tourists, outside their culture—a classic manifestation of the "airport art" phenomenon."

Today only in remote Pacific regions of Mexico (in the states of Oaxaca and Michoacan) and in the conservative Indian communities of the Borucas in Costa Rica has the tradition of dyeing material with the colorant of purple snails survived (Turok 1999). The Borucas are still exploiting *P. pansa* and *T. kiosquiformis* in the traditional way and are using the dye to make designs on woven fabrics (Gerhard 1962).

Today it is relatively easy to produce synthetically 6,6'-dibromoindigo; however, the interest in it is so small that it is not produced commercially (Imming et al. 2001). It can be considered that the market for a special color can change decisively, not due to technical or scientific influences, but due to historical and cultural perceptions. Tyrian purple has experienced changes during the centuries, not only in the technical, but also in cultural views. Originally, it was the sign of wealth and dignity, the symbol of the ruling class, and later as a high position in the church; today these perceptions have changed completely.

In recent years, however, with the gaining of importance of natural colors, the commercial exploitation of the purple snail for dyeing kimonos with natural "Tyrian purple" had reached in Mexico such levels as to threaten the survival of the species. In 1988, *P. pansa* had to be declared a species under special protection by the Mexican government (Anonymous 1988, Anonymous 1994).

P. pansa grows astonishingly slowly (Ramírez-Rodríguez & Naegel 2003). An animal with a total shell length of about 3 cm might be three years old, if not older. From snails of less than 2-cm shell length can be obtained 0.5 mL of secretion and from large

animals of 5–6 cm up to 4 mL (Rios-Jara et al. 1994). It has to be kept in mind, however, that of this volume only a minute proportion consists of the dye precursors. For this reason, it does not astonish that the enormous number of at least 1000 animals has to be “milked” to dye sufficient cotton threads for just three traditional skirts. In view of the slow growth of *P. pansa*, the small amount of colorant excreted, and the large number of snails needed for dyeing just one skirt, it was the right decision of the Mexican government to permit only Indian communities the traditional exploitation of *P. pansa* for its pigments and to declare it a species under special protection. One recent interesting development in Mexico has to be mentioned, which protect the purple snail on one side, and on the other side promote the traditional use of Tyrian purple and offer to the traditional dyers and weavers an income. Multidisciplinary groups, including indigenous Mixtec, Naho, and Boruca communities, social and scientific researchers, groups

of dyers and weavers, local, state, and federal authorities, ecologists, fishermen, and the tourism industry have all joined hands formulating an agreement that describes standards for the sustainable use of *P. pansa* and to create a natural protected area with limited access rights to the resource and promoting the snail culture and species conservation for the long-term (Turok and Acevedo 2000).

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