

## ***Microcosmus sabatieri* (Roule, 1885) (Tunicata Ascidiacea), an unusual human food in Kalymnos (Greece, Dodecanese Archipelago)**

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### **SUMMARY**

This contribution introduces the spinialo, a particular food made with the ascide *Microcosmus sabatieri*. (Roule, 1885) (Tunicata Ascidiacea). This marine organism was, and still is, collected by sponge fishermen of Kalymnos (Greece, Dodecanese Archipelago) and packaged to be preserved and consumed on their long fishing boat trips.

### **KEY WORDS**

*Microcosmus sabatieri*, sea squirt, Kalymnos, spinialo, disgusting food.

Received 19.11.2023; accepted 11.02.2024; printed 10.05.2024

### **INTRODUCTION**

The recent COVID-19 pandemic has made the existence of Asian Wet Markets more widely known to the world. In these markets, in addition to seafood (fish, molluscs and crustaceans), animals such as birds (chickens, pheasants), bats, hedgehogs, marmots, rats, frogs and snakes are sold, as well as organs of rabbits and other animals (Grano, 2020; Ralph et al., 2020). In general, it should also be considered that the consumption of particular

foods is dictated both by the availability of local resources and by religious choices. There are many examples around the world of food beliefs and practices based on religion. Muslims fast during Ramadan, believed to be the month in which the Quran, the Islamic holy book, was given by God to the Prophet Muhammad. During this month, Muslims fast during daylight hours, eating and drinking before sunrise and after sunset. Orthodox Jews and some Conservative Jews follow dietary laws, commonly called a kosher diet, which is part of their Jewish scriptures. Dietary laws, which describe the use and preparation of animal foods, are followed for the purpose of spiritual health. Many adepts of Buddhism, Hinduism, and Jainism are vegetarians, in part, due to a doctrine of no offense or nonviolence (Hauck-Lawson, 2004; Larson & Story, 2009). Even in Europe, the Catholic Church has strongly conditioned food choices. The liturgical calendar had made a distinction between fat and lean food in the periods of liturgical prescription and this was true for the people, but above all for the members of the various religious orders where the restrictions were even stronger. Tortoises, for example, were regularly eaten, as being covered in scales; they were similar to fish and therefore could be eaten on so-called “lean” days, representing an excellent alternative in the context of the diet (De Grossi Mazzorin & Minniti, 2000, 2001, 2009; Grano & Alcini, 2019; Grano & Di Giuseppe, 2020).

A very special food whose consumption is not dictated by religion rules but by the use of local resources is represented by spinialo, an ascidian. This particular food had a moment of great visibility through the television show “Bizarre Foods” on the Travel Channel in the United States, which deals with bizarre and disgusting foods from around the world. During an episode dedicated to Greece, this food prepared in Kalymnos was widely discussed. Indeed, in the past this kind of food was closely re-

lated with sponge fishing in the Aegean Sea and is still used today in modern cooking. Sponge fishing is an activity of very ancient origins and practiced throughout the modern era on various Aegean islands. The Dodecanese Archipelago has played an important role in this specialized fishery and some populations have been recognized since the eighteenth century for the exceptional capabilities of their skin-divers (Fourt et al., 2020). The island of Kalymnos in the period from 1800 to 1960 was the undisputed world center of sponge fishing (Bernard, 1972), in the port of Pothia in 1860 there were 370 boats used exclusively for sponge fishing (Fourt et al., 2020). A human food, considered by many to be disgusting, called *spinalo* (φούσκα in Greek), formerly used by sponge anglers in some Dodecanese Islands, is still today of great cultural and gastronomic interest on the island of Kalymnos and in the other Aegean Islands.

## DISCUSSION

In marine ecosystems, ascidians (Phylum: Chordata, Subphylum: Tunicata, Classis: Ascidiacea) are commonly known as sea squirts and they comprise an important group of marine fouling organisms around the world (Pennai & Rothbächer, 2016; Aydin-Onen, 2018). On a global scale, great attention has been given to ascidians due to their nutritive value (Lambert et al., 2016); their ability to produce bioactive compounds, specifically substances which serve as cytotoxic, antibacterial, antipyretic, analgesic, and histamine (Gopalakrishnan et al., 2011), and compounds against various solid-type tumors (Gab-Alla, 2008); and also their use in studies of evolutionary developmental biology (Lemaire, 2011; Aydin-Onen, 2018). *Microcosmus sabatieri* (Roule, 1885), commonly called grooved sea squirt, sea fig, or violet, is a species of tunicates belonging to the family Pyuridae. This solitary ascidian, which lives in the Mediterranean infralittoral zone, on both muddy and rocky bottoms where it forms populations on moderately inclined reefs, lives firmly, attached on various hard substrates and on biogenic detrital substratum down to 200 m depth (Tursi, 1980; Monniot & Monniot, 1987). Unlike the ascidians of the genus *Pyura*, this species does not form dense beds, but it is one of the most conspicuous and abundant megabenthic species in this area (Antoniadou et al., 2006). It reaches large size, sometimes exceeding 20 cm in height, and its wrinkled tunic, characteristic of the family Pyuridae, is often covered by numerous epibiotic organisms, explaining the name of the

genus given by Cuvier in 1815 (*micro* = small and *cosmos* = world) (Monniot, 1965; Voultsiadou et al., 2007). It is widely distributed throughout the Aegean (Koukouras et al., 1995) being one of the most conspicuous and abundant species on rocky cliffs (Antoniadou et al., 2006). The body of an adult sea squirt is quite simple, being essentially a sack with two siphons through which water enters and exits. Water is filtered inside the sack-shaped body where food and oxygen are extracted (Stamatis et al., 2008). It is worth mentioning that *M. sabatieri* has a high filtration rate in comparison to other ascidian species due to its large size and its extensive branchial surface (Fiala-Medioni, 1974). The ascidian *M. sabatieri* is one of the 37 benthic invertebrate species commercially exploited in the Aegean Sea as human food (Chintiroglou et al., 2005). It is a traditional gastronomic delicacy in the South Aegean with a presence on local markets (Antoniadou & Vafidis, 2008) (Fig. 1). It is harvested by diving and randomly collected by various fishing gear from deeper waters. It is commercialized and consumed as fresh or processed product with the name “*spinalo*” referring to the conservation technique of the product in glass bottles



Figure 1. Shop sign in Chorio, Kalymnos Island (Greece).



Figure 2. Glass jars of spinalo in Chorio, Kalymnos Island (Greece).



Figure 3. Glass bottle of spinalo in Chorio, Kalymnos Island (Greece).

(Antoniadou & Vafidis, 2008) (Fig. 2). When cut in half, they reveal a soft, orange-yellow flesh. The strong, bitter taste of the pulp is reminiscent of iodine. Spinalo was originally an angler's dish, eaten by the sponge anglers of Kalymnos who had to preserve their food to last for long sea voyages. Before modern refrigeration arrived on the island, fishermen preserved ascidians meat in empty wine bottles filled with seawater and a drizzle of olive oil. Thanks to the salt in the seawater, a bottle of spinalo could last for months on end. Sometimes the pulp of sea urchins and mussels was also added in this preparation. Marinades are preserved fish and shellfish in a mixture of organic acid and salt. It involves increasing the ionic strength and decreasing the pH. The aim is not only to prevent microorganism growth but also to allow a way of valorisation other than salting for different fishery products (Fuselli et al., 1994). The resulting product has an extended shelf life and characteristic flavour (Stamatis et al., 2008).

Tunicates overall have a high nutritional value (Lee et al., 1995; Odate & Pawlik, 2007; Meenakshi, 2009; Ananthan et al., 2012; Choi et al., 2014; Roje-Busatto & Ujevic, 2014; Gretchen et al., 2016). A number of large solitary ascidians have been analyzed for their nutritive value, showing that they are potentially healthy seafood high in protein and low in calories (Lee et al., 1995; Choi et al., 2006;

Meenakshi, 2009; Tamilselvi et al., 2010; Kang et al., 2011; Ananthan et al., 2012; Lambert et al., 2016). Spinalo demonstrates an exceptional nutritional value in the human diet being rich in minerals (especially iodine, 0.01% dry weight; seawater contains 0.05 ppm iodine or c. 34 million tons; seaweeds of the Laminaria family are able to extract and accumulate up to 0.45% dry weight), vitamins and long-chain n-3 polyunsaturated fatty acids (PUFA) (Stamatis et al., 2004, 2007, 2008; Lyday, 2007). Ascidians have a variety of chemical defenses to protect themselves from predators. These include secondary metabolites and inorganic acids, but may also include heavy metals, as manganese, magnesium, iron, molybdenum, niobium, tantalum, chromium, titanium, and vanadium (Stoecker, 1978, 1980; Odate & Pawlik, 2007). Levels of vanadium and other heavy metals are usually highest in the blood, with elevated concentrations also in the body tissues (Azumi et al., 2007). Tunicates among the family Ascidiidae have the highest vanadium levels but are never eaten; edible species are all stolidobranchs, which have very low levels (Roman et al., 1988). The exceptional water filtration capacity of adult tunicates (Petersen & Riisgård, 1992; Kim & Moon, 1998; Draughon et al., 2010) can sometimes result in the accumulation of pollutants and toxic microorganisms or their byproducts to levels that may be toxic to the tunicate



Figure 4. Menu in a tavern in Emborios, Kalymnos Island (Greece).



Figure 5. Spinialo in a tavern in Melitsachas, Kalymnos Island (Greece).

itself or make their tissues toxic to predators, including man (Sekiguchi et al., 2001; Lafferty et al., 2005; Lopez-Rivera et al., 2009; Echevarria et al., 2012; Rosa et al., 2013; Roje-Busatto & Ujevic, 2014; Lambert et al., 2016). The Commission of the European Communities (Official Journal of the European Communities 2002) set regulations for the maximum levels of marine biotoxins for tunicates intended for immediate human consumption or for further processing before consumption, but many ascidians are collected in the wild by individuals and thus not tested before being eaten.

## CONCLUSIONS

Kalymnos, located in the Dodecanese group of Greek islands in the Southeastern Aegean Sea, is known for its wide range of seafood dishes. A dish from Kalymnos represents not only the island's unique cuisine, but also its rich seafaring tradition: spinialo, a dish of ascidians (fouskes) marinated in a bottles of seawater (Fig. 3). Today there are about 35 vessels belonging to the small-scale artisanal fishery, harvesting and processing *M. sabatieri*, all harboured at Kalymnos. There is no official data on this activity but a mean annual production of 576-768 tons/year is estimated based on data derived

from the Sponge-Fishermen Union of Kalymnos (Stamatis et al., 2008). Even today, the authentic spinialo is produced and packaged in bottles with sea water inside and is occasionally found in small taverns (Figs. 4-5). In addition to Kalymnos, this particular food is also eaten in other Greek islands of the Dodecanese, including Symi and Chalki, islands where sponge fishing has historically been practiced (Bernard, 1976; Baykara Taşkaya, 2022). Unfortunately, it must be recorded that the over harvesting of wild populations of popular edible tunicates has led to reduced numbers and significant ecosystem impacts. In several locations in the Aegean Sea, intense commercial exploitation of *M. sabatieri* reduced numbers to levels that could have cascading effects on the population and on the associated marine community ecosystem (Voultsiadou et al., 2007; Antoniadou & Vafidis, 2008; Lambert et al., 2016).

## ACKNOWLEDGEMENTS

The author wishes to thank Sevasti Zervou (Athens, Greece) and Yannis Bazos (Athens, Greece) for their useful information and a special thanks to Cristina Cattaneo (Rome, Italy) for her constant presence in my life and research.

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