Beginnings and success in preventing anophelism by means of gambusia fish on the island of Krk in Croatia from 1922 to 1927

Škrobonja, Ante; Materljan, Neven; Škrobonja, Ivana

Source / Izvornik: **Medicinski glasnik Ljekarske komore Zeničko-dobojskog kantona, 2010, 7, 106 - 110**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:184:005655

REVIEW

Beginnings and success in preventing anophelism by means of gambusia fish on the island of Krk in Croatia from 1922 to 1927

Ante Škrobonja[1], Neven Materljan[2], Ivana Škrobonja[3]

[1]Departement for the History of Medicine, Rijeka University School of Medicine, [2]Associate Department for the History of Medicine, Rijeka University School of Medicine, [3]Clinic Hospital Centre Rijeka, Department for Clinical Microbiology; Rijeka, Croatia

ABSTRACT

The introductory part has summarized the role of malaria in the course of history and various attempts of its eradication in Croatia before the World War I. Furthemore, there is a list of activities and results accomplished between 1922 and 1927 on the island of Krk by Dr. Otmar Trausmiller. After a systematic sanitation of all anopheles habitats, primarily natural and artificial bodies of still water, and introduction of imported gambusia to those bodies of water, anopheles was virtually eradicated on the island. What followed was an evident decrease of new malaria incidents, and in the campaign against malaria there was still major concern in the form of chronic patients and intensive quinine therapy. Today, about eighty years after it was introduced to Krk, gambusia still abides in ponds across the island and it represents one of the main factors in the protection against potential revival of indigenous malaria.

Key words: history of medicine, malaria, gambusia fish, eradication, Otmar Trausmiller, the island of Krk, Croatia

Corresponding author:
Ante Škrobonja,
Rijeka University School of Medicine,
Braće Branchetta 20, 51000 Rijeka,
Croatia
Phone: ++385 51 651 165;
Fax: +385 51 651 180;
E-mail: anteskrobonja@yahoo.com

Original submission:
31 July 2009;
Revised submission:
16 September 2009;
Accepted:
30 October 2009

Med Glas Ljek komore Zenicko-doboj kantona 2010; 7(2):106-110

MALARIA IN CROATIA BEFORE WORLD WAR I

Although malaria has been present in Croatia for as long as anyone can remember, particularly in the vicinity of larger rivers and especially in the Croatian Littoral, Istria and Dalmatia, the first written documents on malaria in Croatia date from the 16th century and concern Istria . Before the end of the 16th century, malaria was spread across almost the entire territory of Croatia. The first studies of the disease, as described in "De morbo Naroniano tractatus" (*On the "Neretva disease"*), written by the Paduan professor Giusepe Antonio Pujati, were performed as early as the 18th century (1).

In the western part of Croatia, especially in the Kvarner region, as the public health problem of malaria was present mainly on the islands of Krk, Rab and Pag (2), where an outbreak of epidemic known as Škrljevo disease (at the turn of the 8th and early 19th century), and after its settling (3) remain the leading health problem. However, the mainland, with a few exceptions, was not affected by malaria. On these islands the main malaria mosquito habitats were mostly artificial ponds for cattle watering and lakes in the vicinity of Omišalj on the island of Krk and Velo Blato on Pag. The prevailing type of mosquito was again Anopheles maculipennis, which, apart from the zoophylous type, was also represented by the antropophylous type Labranchiae. Earlier authors claim that this type of malaria was usually a benign tertiary infection (4).

Malaria, which was present endemically near rivers, swamps (particularly near swamps along karst rivers) and ponds, was sometimes a decisive factor in some of the historical events in Istria from the ancient times until the 20th century. The best example is the city of Dvigrad (Ital., *Due Castelli*) that had coped with several epidemics of the plague or similar diseases from the antiquity, but life ceased there in the 18th century, after the adjacent river had changed its course and gave way to fatal swamps (5). On the other hand, many swampy areas were brought to life by the effective land-reclamation and eradication of mosquitoes, as was achieved on the Brijuni Islands thanks to Robert Koch (6).

Although the problem of malaria was more systematically dealt with by the authorities in Dalmatia as early as during providur Dandol's rule (who was a pharmacist by profession) and Napoleon's Illyrian provinces (1808 – 1813) (7), and the first results were achieved, more detailed data on the spread and the character of malaria in Dalmatia date only from 1905, when it was estimated that approximately 80,000 persons infected with malaria lived in the area, and that the prevalence of malaria in certain districts varied between 29% in Knin and 63% in Zadar. After the invitation of the Royal Regency, the Italian malariologist Giovanni Battista Grassi and the German epidemiologist Fritz Richard Schaudin soon came to Dalmatia and prepared and applied "*quinisation*". In 1902., Rudolf Battara eradicated malaria in Nin, Croatian Royal Town. In 1908, under dr. Jakov Gljivanović, 25 doctors and 423 pill distributors were included in the quinisation. They went around villages on a regular basis, distributed pills and monitored their use. Comprehensive assanations of the terrain were also conducted. This soon yielded positive results (8).

Following World War I malaria spread again. Tropical malaria was more widely spread and the number of malaria patients was estimated to reach 150,000. The specific index was also significantly higher and in some areas reached 70 to 90% (9).

DR. OTMAR TRAUSMILER AND GAMBUSIA FISH IN FIGHTING MALARIA ON THE ISLAND OF KRK

A new organised anti-malaria campaign in the Croatian littoral area began after World War I and was lead from two centres: the Institute for the Research and Fighting of Malaria in Trogir and the Public Health Institute in Sušak (10,11). Extensive malariometric surveys and anophelism surveys were conducted. Moreover, many new malaria centres were set up. Systematic assanation in Dalmatia was focused on the melioration of swampy areas and on making wells out of ponds. Anophelism was also successfully combated by applying paraffin and Paris Green. In the Croatian Littoral, particularly on the island of Krk, apart from what was just said about 1924, ponds were stocked with gambusia fish (*Gambusia holbrochi Grd*.) (12).

Gambusia fish live in warm still waters of the central part of the New World. There are two types of these larvivorous small fish, *Gambusia affinis* i *Gambusia holbrochi*.

Gambusia are viviparous, which is a great evolutionaty advantage. A large number of gambusia survive their youth and reach sexual maturity. The females in the aquarium reach sexual maturity at four months of age, and have a brood of 200 young at a time. They multiply during the warm season in temperate climate and have one brood of young every three to six months. In tropical climate, gambusia fish multiply throughout the year. They are not too choosy about their food; however, after it had been noticed that they had a strong affinity for Anopheles larvae that feed on the water surface, there was an attempt of transmitting them to other parts of the world as a means of eradicating Anopheles. This biological method of fighting Anopheles was very successful and appropriate since the living and breeding conditions for this fish were very favourable and the ecological risks minimal (13).

On the largest Croatian island of Krk (406 km^2), known for its endemic malaria from the times of antiquity, the main sources of the disease were many artificial ponds for cattle watering that were virtually infested with Anopheles larvae (4).

In 1923 an extensive and the Sušak Public Health Institute co-ordinated anti-malaria action on the Island of Krk was to be carried by Dr. Otmar Trausmiler. As for the basic hydrotechnical works, Dr. Trausmiler could rely solely on the local labourers, hand tools, and scanty resources. Under such circumstance, Dr. Trausmiler decided to apply a new method of ‘’bio-weaponry’’ by introducing a new, alochtonic species to the island – the tropical Gambusia fish. He would widely report on this idea, its realization as well as the results in his 1927 monography entitled ‘’Malaria on the Island of Krk’’ (Figure 1-3). This work was accompanied by exquisite photographs and drawings, while the results were displayed in tables and graphs and supported by the recent references from the international publications (12).

After he had made a detailed and soundly grounded presentation of the historical and actual circumstance related to malaria on the island, the author elaborated on the project of assanation of all the Anopheles habitats, mainly the natural and artificial still waters and their stocking with the imported Gambusia fish.

Dr. Trausmiler’s presentation of the results opens with the statement that despite the minimum financial support and scanty technical equipment the initial hydrotechnical works had been finished and the conditions set for experimental stocking so that by the end of August 1924 400 *Gambusia holbrochi Grd*. fish from Italy were imported. The fish were dropped into several ponds as soon as they had been brought. Due to the stress they had undergone in transport almost half of the Gambusia fish instantly died. Luckily enough, the remaining Gambusia accommodated fast and well and a large number of them survived the winter 1924/1925 in a new habitat. In May 1925 the first young Gambusia fish were noticed in the fish-stocked ponds and then they were systematically transmitted into other ponds. By the fall 1925 there were 25 newly stocked ponds on the Island of Krk, and fish-stocking was continued with the same intensity. There were at least 1000 to 2000 Gambusia in every fish-stocked pond. The winter 1925/1926 was exceedingly cold so that every pond on the island was covered with

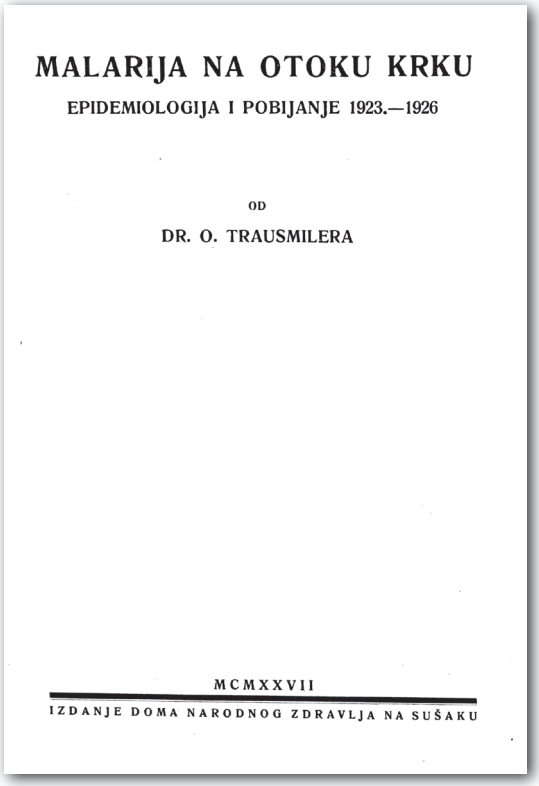
Figure 1. Črna Lokva (Black pond) the first breeding pond for Gambusia fish on the island of Krk (Photo by Dr. O. Trausmiler, 1927) (accepted from: Trausmiler O. Malarija na otoku Krku - epidemiologija i pobijanje 1923.-1926. Sušak: Dom narodnog zdravlja, 1927., p. 76)

Figure 2. Pond with a wall constructed of stone (Photo by Dr. O. Trausmiler, 1927). (accepted from: Trausmiler O. Malarija na otoku Krku epidemiologija i pobijanje 1923.-1926. Sušak: Dom narodnog zdravlja, 1927., p. 77)

ice. The Gambusia fish survived and in the spring 1926 they again started to multiply fast so that Dr. Trausmiler's field-workers proceeded with even more intense fish-stocking of the remaining ponds on the island. Dr Trausmiler pinpoints the first positive effects: the Anopheles larvae vanished from the ponds whose edges were walled, cleaned of water plants, and stocked with Gambusia fish. The fish that were dropped into ponds in springtime would multiply until summer and eat all the Anopheles and Culex larvae. A considerable decrease in the incidence of the new cases of malaria was soon registered. The chronic malaria patients anf the intensive quinine therapy thus became a priority of the anti-malaria campaign.

DISCUSSION

Thanks to the introduction of Gambusia fish to the Island of Krk, the two traditional methods of the Anopheles larvae eradication have been abandoned – relatively expensive paraffin, and Paris Green, effective in certain conditions alone. Spilt onto the pool surface, paraffin would mechanically smother the Anopheles larvae, and would evaporate in a couple of days, which would make ponds usable for cattle watering again. The less expensive Paris Green was a powder insecticide blend of arsenic and copper. Prior to application, Paris Green was to be mixed with gravel dust. Since the latter was scarce on the Island of Krk, it was replaced by sifted ash. In order to apply Paris Green, there should have been no wind to ripple the water surface; as it was often windy on the island of Krk, Paris Green could be rarely applied.


MALARIJA NA OTOKU KRKU

EPIDEMIOLOGIJA I POBIJANJE 1923.—1926

OD

DR. O. TRAUSMILERA

MCMXXVII

IZDANJE DOMA NARODNOG ZDRAVLJA NA SUŠAKU

Figure 3. Coverpage of Trausmiler's book "Malaria on the Island of Krk: Epidemiology and melioration, 1923.-1926." from 1927. (accepted from: Trausmiler O. Malarija na otoku Krku -epidemiologija i pobijanje 1923.-1926. Sušak: Dom narodnog zdravlja, 1927.)

In contrast to these methods, Gambusia fish served as an effective non-toxic and inexpensive biological means against Anopheles larvae. It was enough to catch Gambusia fish with an improvised fishing net, transport them in a bucket or any other vessel and drop them into an Anopheles larvae infected pond; moreover, Gambusia fish made a permanent larvicidial means that did not endanger natural balance. The ponds were mainly artificial cattle watering places without traditional aquatic life; therefore, the use of Gambusia fish as a larvicidal means in this case meant no threat to the local aquatic life.This is even more important because the imprudent introduction of Gambusia fish and its residence in larger water bodies have brought about dramatic changes of eco-systems, especially those of running waters in various parts of the world. It has brought on the decrease in number and a permanent threat to the survival of local invertebrates, fishes, and amphibians. It has been established lately that the dropping of Gambusia fish into some natural ponds and small lakes in California has brought on a considerable decrease in number of the endemic fairy shrimp (*Linderiella occidentalis*) (13), while in New Zealand Gambusia fish represents a threat to the endemic fish of dwarf inganga (*Galaxias gracilis*) (14).

Although Gambusia fish were not used in the continental but solely Mediterrannean part of Croatia, they vastly contributed to the eradication of malaria in Croatia. The most successful of the methods used after World War II was the action started in 1950 using the concept of prof. Branko Richter from the School of Public Health "Andrija Štampar" in Zagreb, based on the application of the new chemical DDT, followed by other new insecticides in all endemic areas. This, along

with the systematic assanation of the terrain and the improved social and economic conditions of the people, finally resulted in uprooting malaria in Croatia. The last indigenous cases of malaria infections were registered in 1958 and WHO in 1964 officially declared that malaria in Croatia was eradicated. Despite the setbacks, up until 1969, when the global eradication policy was finally abandoned, the following European countries had managed to completely eradicate endemic malaria by interrupting transmission: Hungary, Bulgaria, Romania, Spain, Poland, Italy, Netherlands, Portugal and former Yugoslavia (15,16).

In conclusion, today, eighty years after the introduction of Gambusia fish to the Island of Krk, they still live in the ponds across the island. They probably make their 200th generation. Gambusia fish still tirelessly devour mosquito larvae and thus reduce the number of Anopheles and Culex on the island. Entirely acclimatized and domesticated, these tropical fish represent a contingent and precious larvicidal means in the hands of experts.

ACKNOWLEDGEMENTS/DISCLOSURES

Competing interests: none declared.

REFERENCES

1. Gregurić Gračner G, Vučevac Bajt V. History of Eradication of malaria in Croatia. Orvostort Kozl 2002;47:145-55.
2. Azman J, Muzur A, Frković V, Pavletic H, Prunk A, Skrobonja A. Public health problems in the medieval statutes of Vinodol, Vrbnik and Senj (West Croatia). J Public Health (Oxf) 2006; 28:166-7.
3. Muzur A, Škrobonja A. Škrljevo disease: Between myth an reality. Croat Med J 2004; 45:428-31.
4. Cubich GB. Notizie naturali e storiche sull'isola di Veglia. Trieste: Stabilimento tipografico Appolonio & Caprin, 1874-75.
5. Čehić M, Karabajić M. Dvigrad – simbol medicinske nemoći. U: Rašajski R. urednik. Zbornik 2. naučnog kongresa. Vršac: Naučno društvo za historiju zdravstvene kulture Jugoslavije, 1970., pp. 181-5.
6. Fatović-Ferenčić S. Brijuni Archipelago: story of Kupelwieser, Koch and the Cultivation of 14 islands. Croat Med J 2006; 47:369-71.
7. Fisković C. Zdravstvene prilike u Splitu krajem XVIII. i prvih godina XIX. stoljeća. U: Grmek M.D., Dujmušić S, urednici. Iz hrvatske medicinske prošlosti. Zagreb: Zbor liječnika Hrvatske, 1954, pp. 238-54.
8. Nežić E. Historija endemske malarije u Dalmaciji do 1923. godine. U: Zbornik. Prvi simpozij o historiji mikrobiologije i imunologije u Hrvatskoj do 1926. godine. Zagreb: JAZU, 1973., pp. 71-80.
9. Simić C. Malarija. Beograd-Zagreb: Medicinska knjiga, 1948., pp. 237-42.
10. Emili H. Razvoj preventivne zdravstvene službe na sjevernojadranskoj obali od otvaranja Doma narodnog zdravlja u Sušaku do početka II svjetskog rata – 1926. do 1941. Liječ Vjesn 1988; 110:118-24.
11. Bakašun V, Alebić-Juretić A. Sto godina preventivne medicine na Riječkom području. Liječ Vjesn 2002; 124:380-9.
12. Trausmiler O. Malarija na otoku Krku epidemiologija i pobijanje 1923.-1926. Sušak: Dom narodnog zdravlja, 1927.
13. Duryea R, Donnelly J, Guthrie D, Claudia O'malley C, Romanowski M, Schmidt R. *Gambusia Affinis* effectiveness in New Jersey Mosquito Control. Proceedings of the Eighty-Third Annual Meeting of the New Jersey Mosquito Control Association, Inc. 1996, pp 95-102. [Online] http://www.rci.rutgers.edu/~insects/gamb2.htm (23 September 2009).
14. Rowe D. Manegement trials to restore dwarf inganga show mosquitofish a threat to native fish. Water and Atmosphere 1998; 6:10-12
15. Richter B. Osvrt na dosadašnji rad antimalarične službe i njezine zadatke u 1950. godini. Higijena 1950; 4:299-311.
16. Richter B. Doprinos Jugoslavije u konceptu eradikacije malarije U: Angelovski A, urednik. Eradikacija na malarijata vo Jugoslavija. Skopje: Makedonsko lekarsko društvo, 1973., pp. 43-9.