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Shelf life stability of Garum, a fish marinate sauce produced with solar heating in Algarve

Margarida C. Vieira[a,b], António Martins†[a], Clarisse Ramalho[a],

Neusa Rodrigues[a], and Rui M. S. Cruz[a,b]

[a]Department of Food Engineering, Institute of Engineering, University of Algarve, Portugal

[b]CIQA-Centre of Investigation in Chemistry of Algarve, University do Algarve, Portugal

OBJECTIVE

The objective of the present work was to study the shelf life of a recipe of a fish sauce Garum originated in the roman empire.

INTRODUCTION

Garum **derives from** ***garos*** **(also** ***garon*****), the fish originally used by the Greeks in about the fifth-century BC to make a sauce of the same name. The sediment that remained behind, after draining the liquid, was called** ***allec*** **(also** ***allex*** **and** ***hallex*****), an appreciated fish paste or delicatess at that time. The brine, itself - the drained water of the fish by the salt was called** ***muria*****, being the fish (tuna, for example) preserved in it.** ***Liquamen*** **(the origin of this name comes from the fact that the small fish liquefy in the pickling brine) was the generic term found for all such fish sauces. Garum is a fish sauce made with fermented fish, salt and water that was used to salt dishes, mainly fish, in the Roman cuisine. The fish sauce was not meant to be used as a sauce on its own.**

Fig. 1- Production plants vestiges ( ) can still be found in a part of the Iberian Peninsula that was called Lusitania in the time of the Roman Empire

It was exported to all places in the Roman Empire as this was considered a luxurious product, being produced mainly in the estuaries of the rivers Tagus, Sado and in the Algarve (1). The largest concentration of vestiges of production plants of garum, are located in the algarvian coast. In Algarve, it was produced in several places and exported to many Mediterranean locations. Exports of garum to Athens in the Vth century B.C. were reported. In the river mouth of Sado, in Troia, a factory of garum was built along 2 Km. In the Atlantic region, production plants remains were found in Póvoa de Varzim, Matosinhos and in the estuary of the river Sado in several places such as Troia, one of the most important fish preservation centers in Hispania.
The ruins of this production plants till now found in the Portuguese territory are composed of tanks where the brine was made to salt the fish and preparation of preserved fish, most of the time brick-built.
The fish preserves were destined to exportation, packed in ceramics amphorae.

Fig. 2 – Garum vessels

The use of Garum disappeared with the end of the Roman Empire, but many fermented fish products survived such as the anchovy paste, our modern allec in Western cuisine and Worcestershire sauce, a recipe that had its origin in the British occupation of India, also with a fermentation of anchovies, onions, shallots, cloves, garlic, vinegar, molasses, chili peppers, soy sauce, pepper, tamarinds, corn syrup and water. However, in the ancient fish sauces of Asia a kind of garum did survive, with a very similar method of production: in Vietnam is known as Nuoc Nam, in Thailand Nam Pla, in Cambodja, Tuk Trey, in Burma, Ngan-pya-yem, Korea, Jeotgal, Laos, Nam Pa and in the Philippines, Patis and Bagoong. Other relatives include the Malaysian shrimp paste belachan and a similar product in Myanmar called nga-pi. In 1908, Kikunae Ikada identified monosodium glutamate as one of the main amino acids present in fermented products and observed its taste-enhancing effect. In fact glutamate is an amino acid that precipitates during fish decay. This product is present in soy sauce and miso products as well as fermented and in stock cubes for soups and sauces. That was probably the main reason of ***Garum*** **being so popular among the Romans.**
Nowadays it is known that fish sauce's final quality depends on five main factors such as fish species, type of salt, fish and salt proportion and other ingredients such as spices and aromatic herbs and fermentation process conditions (2). In fact, this type of fermented products is a result of physical, chemical and microbiological changes, which are responsible for the characteristic appearance and flavor of the final product. These products which usually have long production periods undergo enzymatic proteolytic and lipidic changes (3).

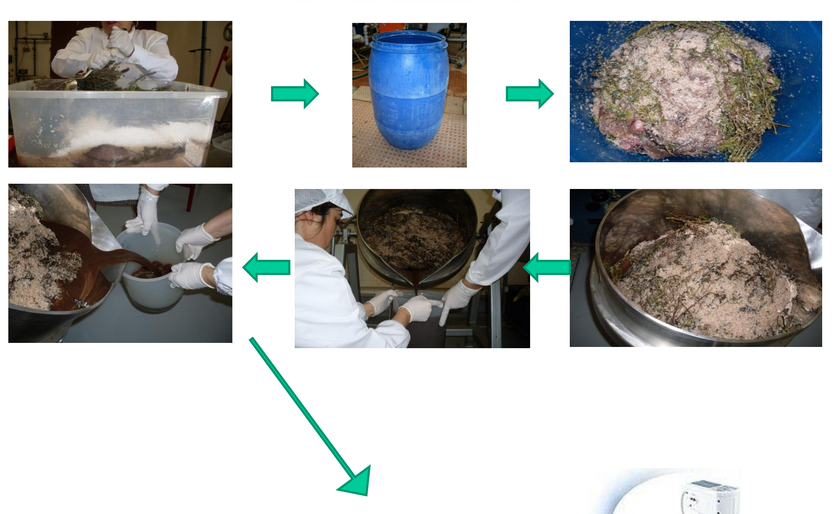
The presence of viscera with high enzyme content, accelerate the process and the high salt concentration should ensure a safe product from the microbiological point of view. The presence of herbs and spices besides flavoring the product may also have antimicrobial properties which can allow the reduction of salt content in the final product without impairing its safety.
Only a few studies are published regarding the production of Garum in the present era.

Fig. 3 – Similar fish sauces that derived from the ancient garum process

The "Confraria do Atum", a recently formed association in Vila Real de Santo António in defense of the development of the red tuna industry, contacted the Department of Food Engineering of the Superior Institute of Engineering of the University of Algarve in order to start recovering the ancestral recipe of ***Garum*** **and updating it to the sensorial, nutritional and safety demands of the actual Food Industry. Their objectives were not only to have a new product but also to add value to part of the 46% (liquid plus scrap) of the tuna fish. They had already a recipe which was used in this piece of work.**

MATERIALS AND METHODS

Garum Processing
A preliminary study of ***Garum*** **production was carried out at the pilot plant of ISE. Tuna viscera mixed with salt and 7 different herbs, oregan, (*Origanum vulgare L.*), mint (Mentha cervina), lavander (*Lavandula officinalis*), thymus (*Thymus vulgaris L.*), mint (*Menta pipperita L.*) and rosemary (*Rosmarinus officinalis L.*), making a layer on the bottom of the container; then a layer of víscera was put down whole and when large in pieces) and over this, a layer of salt two fingers high was added. This procedure was used repeatedly until the container was filled. It rested for seven days in the sun and was then mixed daily for 20 days. After that, part of it became a liquid and the liquid was analysed.**



RESULTS

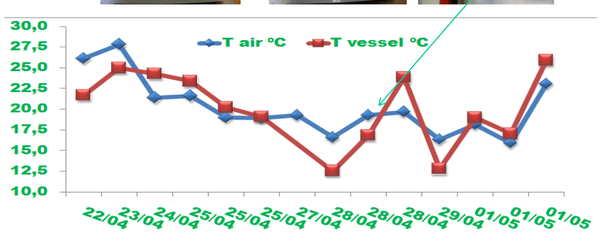


Figure 4– Temperature history during fermentation

Yield

	Raw materials Kg	Final Product Kg	Yield %
Tuna víscera	10		
Salt	10		
Garum		9	49%

pH

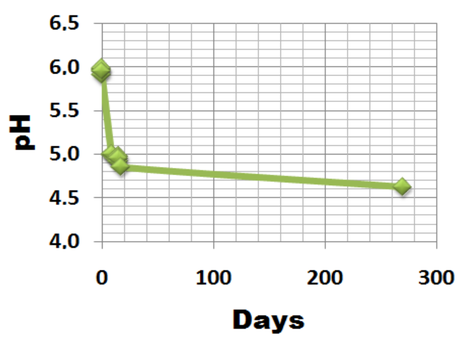


Figure 5– The pH was followed 9 months

Color

L= 29.8 ± 0.2

a= 1.7 ± 0.2

B= 4.4 ± 0.4

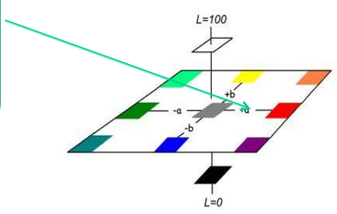


Figure 6 – The pH was followed 6 months

Microbiota

Table 2 - Microbiota in tuna víscera and Garum

	Tuna víscera	Garum Right after processing	Garum 9 months later at environmental Temperature
Moulds and Yeast	Present	Present	Absent
Total Bacteria	1x10^4 C.F.U./ml	1x10^4 C.F.U./ml	8x10 C.F.U/ml
Sulfite-reducing Clostridia	N.d.		1x10 C.F.U./ml

Nacl - 18.86 g/l

CONCLUSION

A nice redish colored salty marinate fish sauce was obtained but the ancient process by itself does not ensure microbial safety of this product for a long shelf life period suggesting a sterilization process right after fermentation.

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