Microbes In French Bay Salt Used in Replicated 17th-Century Food

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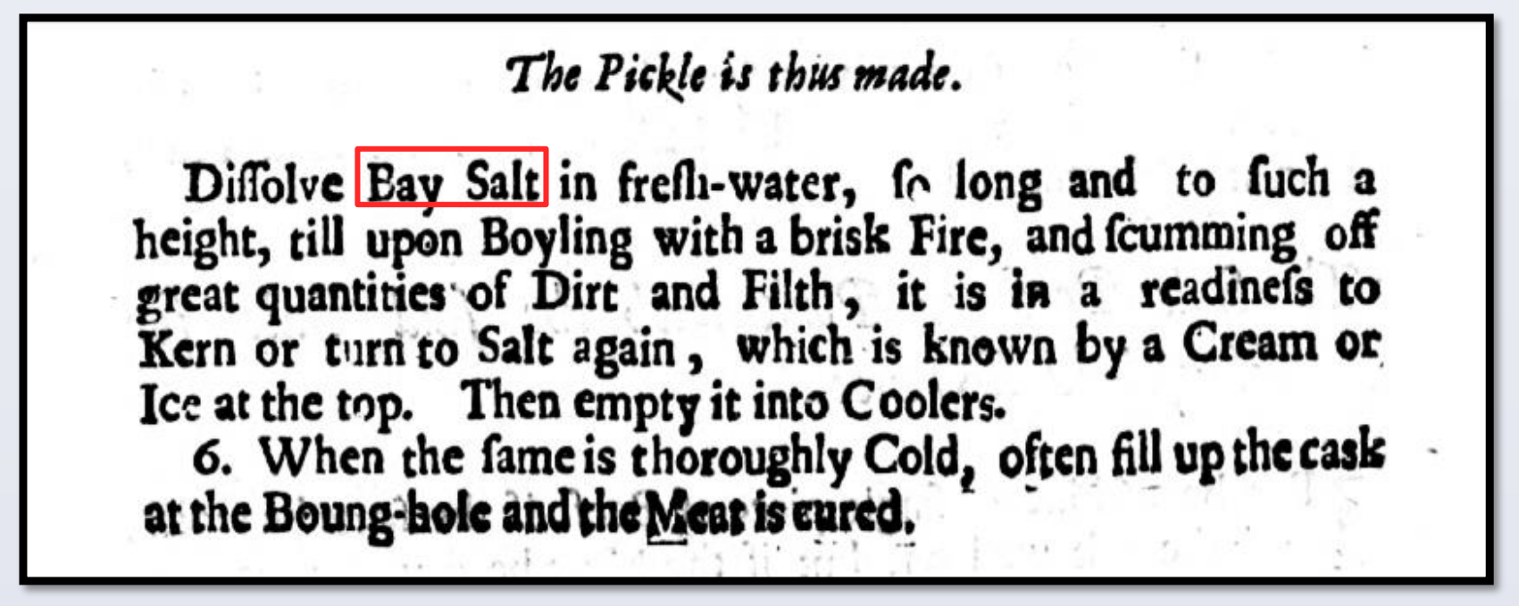
INTRODUCTION

Salt curing is a preservation technique used to protect foods from microbiological spoilage. This technique utilizes salt as the primary preservation agent that works by reducing the water activity (a_w) in foods.[1] Through osmosis, water flows from an area of low salt concentration (inside food) to high salt concentration (outside food). As a result, salt from outside of the food is dissolved and is able to penetrate the food and slow down the growth of microbes within perishable items.

The aim of this poster is to examine the microbes found in the French "bay salt" used to preserve the shipboard provisions (beef, pork, and cod) from the Ship Biscuit & Salted Beef Research Project (SBSB), a study that aims to understand the diet and health of English sailors during the 17th century.



The Pickle is thus made.

Diſſolve Bay Salt in freſh-water, ſo long and to ſuch a height, till upon Boyling with a brisk Fire, and ſcumming off great quantities of Dirt and Filth, it is in a readineſs to Kern or turn to Salt again, which is known by a Cream or Ice at the top. Then empty it into Coolers.

6. When the ſame is thoroughly Cold, often fill up the cask at the Boung-hole and the Meat is cured.

Figure 1. An excerpt from John Collins' 1682 treatise that specifies the use of bay salt for brine used in meat preservation.

HYPOTHESIS

French bay salt is unique because it is collected in *marais salants* (salt marshes) and is unprocessed.[2] The bay salt in the SBSB Project came from the coast of Guérande, France.

The replicated shipboard food preserved in French bay salt are expected to contain the halophilic bacteria: *Haloarcula*, *Halomicrobium*, and *Halobacterium*, and appear as non-pigmented, transparent colonies, and smaller red and orange pigmented colonies. They are hypothesized to be present as these halophilic microbes also play an important role in salt crystallization, because it has been found that their metabolism helps build bio-mineral assemblages.[3]

MATERIALS & METHODS

- French bay salt is plated onto differential and selective media including Blood Agar (BA), MacConkey Plain Agar (MacP), and Mannitol Salt Agar (MSA) to 5 serial dilutions
- Microbial colonies are isolated
- DNA extraction, polymerase chain reaction, and 16s rRNA sequencing is conducted
- Microbes are identified and characterized

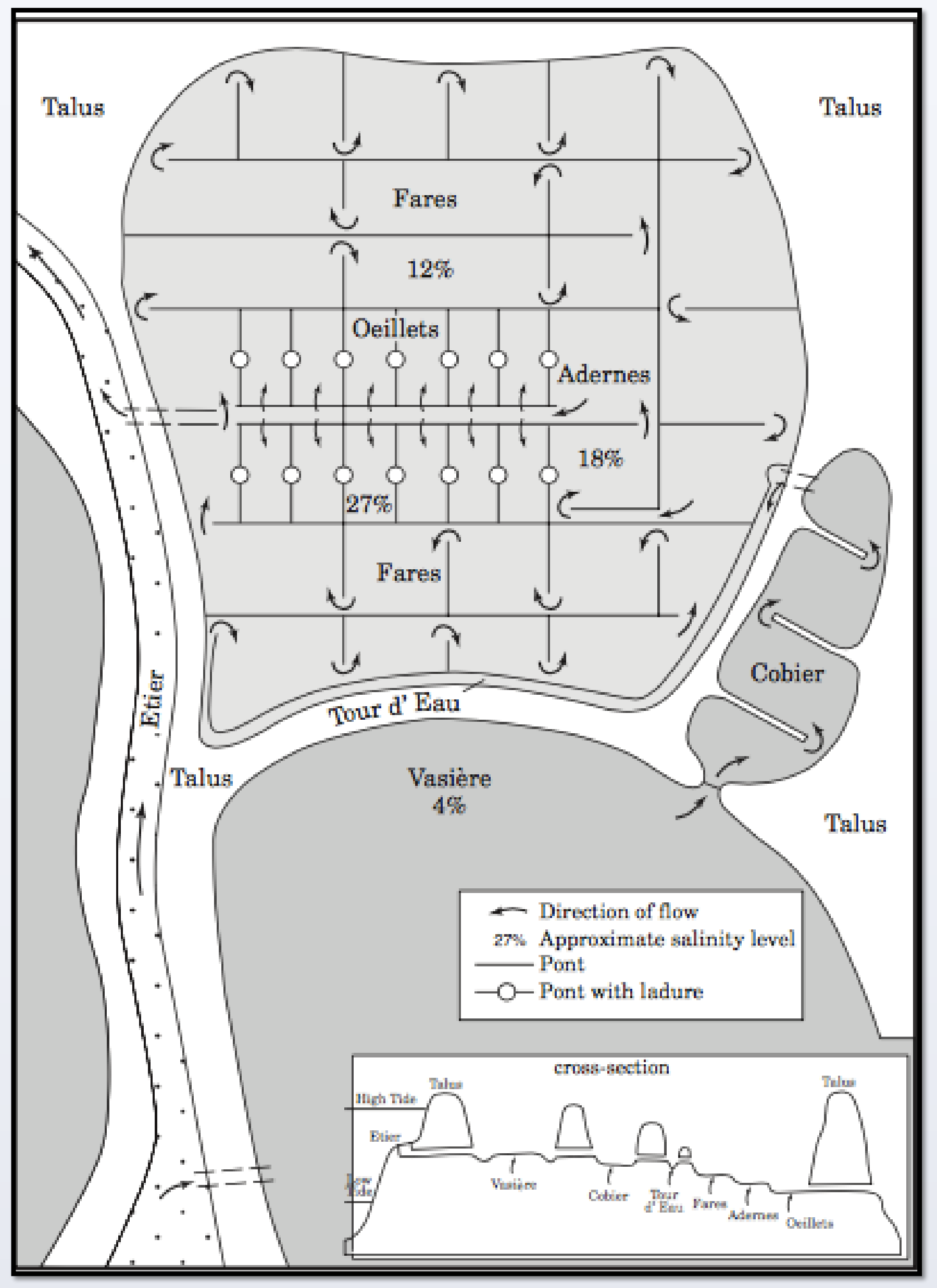


Figure 2. (top left) The structure of *saline* harvesting in Guérande, France.

Figure 3. (top right) Barrels aboard *Elissa* on exhibit.

Figure 4. (bottom right). Salted beef being dry-cured with bay salt

RESULTS

Average Microbial Count on French Bay Salt

	Blood Agar	MacConkey Plain Agar	Mannitol Salt Agar
10^{-1}	5	0	184/214*
10^{-2}	4	0	96/14*
10^{-3}	0	0	12/17*
10^{-4}	0	0	12/0*
10^{-5}	0	0	0

Table 1. Averages of microbial counts on Blood Agar, MacConkey Plain Agar, and Mannitol Salt Agar (*Yellow colonies/Pink colonies) at various dilutions obtained from French bay salt.

- MSA showed the most abundant and diverse growth and showed both positive and negative mannitol fermentation
- The growth on the MSA plates also indicate that they are likely halophilic or halotolerant bacteria due to their ability to grow in a high salt environment.
- MacConkey Plain plates for the bay salt contained no growth
- The blood agar plates for all counts indicated little to no growth

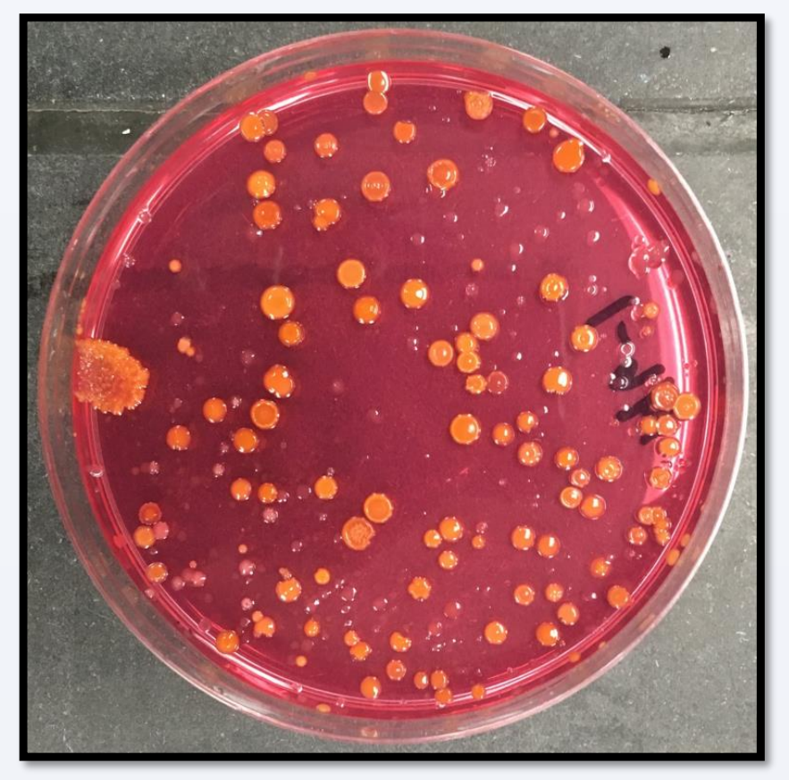


Figure 5. Orange-pigmented bacterial growth on a Mannitol Salt Agar.

Figure 6. Several different microbes growing on Blood Agar.

CONCLUSIONS & NEXT STEPS

Microbial analysis shows growth of halophilic microbes. Due to the high salinity environment of the salted shipboard foods, the observed bacteria were able to maintain a cytoplasm that was at least isosmotic to the brine, a basic property for all halophilic bacteria.[4] Further 16s rRNA sequencing is underway to determine the taxa of the bacteria found.[5]

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ACKNOWLEDGEMENTS

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