The Nutritional Profile and Flavor of 17th Century Shipboard Salted Beef

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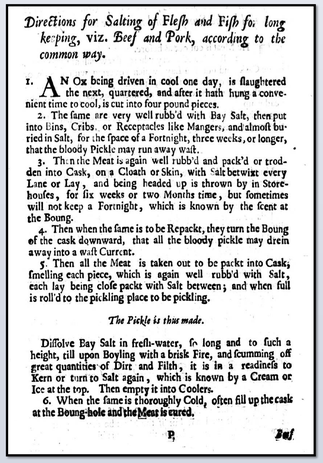
Aggie Research Program

INTRODUCTION

Historical documents note the condition of provisions aboard ships during the Age of Sail; however, the microbiological makeup and laboratory analyses regarding the nutrition and flavor of the foods have never been studied until now. The aim of this study is to examine how the sailors' diet, specifically their staple of salted beef, would have tasted and effected their health, via experimental archaeology and gas chromatography-mass spectrometry.

METHODOLOGY & SOURCES

A grass-fed, antibiotic-free, steer from Houston County Farms was slaughtered on August 4, 2017 and butchered on August 5, 2017 into approximately 4 pound pieces. The butchering was done by Calvin Medders and the Ship Biscuit & Salted Beef (SBSB) team following faunal remains analysis from 17th-century wrecks and historical documents. The pieces were salted and brined using John Collins' 1682 discourse, *Salt and Fishery*, that includes several salting and brining recipes, and placed in a wooden barrel (see **Figure 1**). The barrel was loaded onto *Elissa*, the 19th century tall ship docked at Galveston on August 19, 2017 (see **Figure 2** and **Figure 3**).



Directions for Salting of Flesh and Fish for long keeping, viz. Beef and Pork, according to the common way.

1. AN Ox being driven in cool one day, is slaughtered the next, quartered, and after it hath hung a convenient time to cool, is cut into four pound pieces.
2. The same are very well rubb'd with Bay Salt, then put into Tins, Cribs, or Receptacles like Mangers, and almost buried in Salt, for the space of a Fortnight, three weeks, or longer, that the bloody Pickle may run away with.
3. Then the Meat is again well rubb'd and pack'd or trodden into Cask, on a Cloath or Skin, with Salt betwixt every Lane or Lay, and being headed up is thrown by in Storehouses, for six weeks or two Months time, but sometimes will not keep a Fornight, which is known by the scent at the Boung.
4. Then when the same is to be Repackt, they turn the Boung of the cask downward, that all the bloody pickle may drein away into a waft Current.
5. Then all the Meat is taken out to be packt into Cask, smelling each piece, which is again well rubb'd with Salt, each lay being clofe packt with Salt between; and when full is roll'd to the pickling place to be pickling.

The Pickle is thus made.

Diffolve 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.

P. *Buf*

Figure 1. A folio from John Collins' *Salt and Fishery*, describing a recipe for meat preservation.

Figure 2. The arrangement and monitoring of the barrels on *Elissa*. (Photo taken by Grace Tsai).

Figure 3. 19th-century tallship *Elissa*.

Samples of the food items were collected regularly for analysis via Gas Chromatography-Mass Spectrometry (GC/MS) to create a flavor and chemical profile of the volatile compounds (see **Figure 4**).

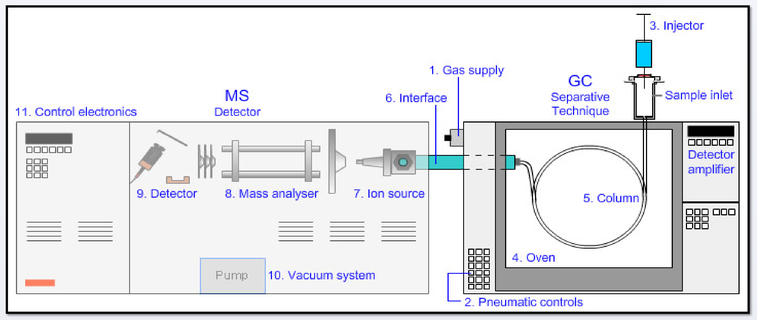


Figure 4. A diagram of the Gas Chromatography-Mass Spectrometry apparatus (CHROMacademy).

RESULTS

GCMS Analysis

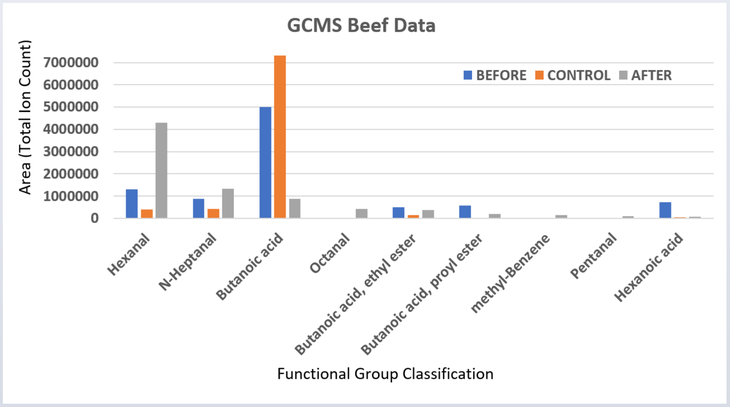


Figure 5. Volatile compounds found in the salted beef. "Before" refers to the beef collected the first day on *Elissa*, "Control" is the beef sample kept in an air-conditioned, non-shipboard environment, collected at the end of the experiment, and "After" is the beef on *Elissa* at the end of the experiment approximately 2 months later.[1]

Flavor Profile

COMPOUND	FLAVOR AROMAS
Hexanal	Green, grassy, fatty
N-Heptanal	Green, fatty, oily
Butanoic acid	Rancid
Nonanal	Tallowy, Fatty
Butanoic acid, ethyl ester	Rancid
Butanoic acid, propyl ester	Rancid
Pentanal	Pungent
Hexanoic acid	Sweaty

Figure 6. The flavor aromas for each of the chemicals found in the beef.[2]

CONCLUSION & NEXT STEPS

During the 17th century, specific methods were used to prepare, cook, and preserve food on board ships. The replicated salted beef from the SBSB Research Project contained several volatile compounds that include rancid, pungent, and sweaty aromas.[2]

Although considered unsanitary in modern Western society, the state of the beef could possibly contribute to the hygiene hypothesis, because meat degradation is correlated to microbiological action. The microbes on the beef could have caused the production or absence of cytokines, which influenced the development of T-helper cells. The development of these cells is consistent with increased tolerance and the overall protection against a wide variety of microbes, creating a stronger immune system. [3]

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ACKNOWLEDGMENTS

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