

Review Article

Captain Cook's beer: the antiscorbutic use of malt and beer in late 18th century sea voyages

Brett J Stubbs PhD

Southern Cross University, School of Environmental Science and Management, Lismore, Australia

The custom of allowing British seamen the regular use of fermented liquor is an old one. Ale was a standard article of the sea ration as early as the fourteenth century. By the late eighteenth century, beer was considered to be at once a food (a staple beverage and essential part of the sea diet), a luxury (helping to ameliorate the hardship and irregularity of sea life) and a medicine (conducive to health at sea). In particular, beer and its precursors, wort and malt, were administered with the aim of preventing and curing scurvy. This paper examines the use of malt and beer during late eighteenth century British sea voyages, particularly their use as antiscorbutic agents, focusing on James Cook's three voyages during the period 1768-1780. Cook administered sweet wort (an infusion of malt), beer (prepared from an experimental, concentrated malt extract), and spruce beer (prepared mainly from molasses), among many other items, in his attempts to prevent and to cure scurvy. Despite the inconclusive nature of his own experiments, he reported favourably after his second voyage (1772-1775) on the use of wort as an antiscorbutic sea medicine (for which purpose it is now known to be useless). Cook thereby lent credibility to erroneous medical theories about scurvy, helping to perpetuate the use of ineffective treatments and to delay the discovery of a cure for the disorder.

Key words: Captain Cook, scurvy, antiscorbutic agents, malt, beer, fermentation, sea voyages

Introduction

From about the middle of the fifteenth century, sailors from several coastal nations of Western Europe began to make increasingly frequent, long, and audacious sea voyages into unknown parts of the world. These voyages often had commercial motives, but probably were also encouraged by a new spirit of adventure and curiosity. Portuguese sailors rounded the southern cape of Africa in 1487, and established trading colonies in India, Malacca, and Macao by the mid-sixteenth century. The Spanish, pioneering a route around South America and across the Pacific Ocean, established a colony in the Philippines about the same time. Others, especially the Dutch and British, soon launched equally daring voyages, both in the general cause of discovery (for example, Francis Drake's circumnavigation of 1577-80), and specifically to vie for a share of the lucrative trade with Asia (the English and Dutch East India Companies, for example, were established in 1600 and 1602 respectively).

This European maritime expansion was facilitated by technical advances in the design of ships and in methods of navigation, but a simple nutritional disorder, scurvy, became one of its greatest restraints. A modern historian of the disease has written that, excluding 'straightforward famine', 'scurvy is probably the nutritional deficiency disease that has caused most suffering in recorded history'.¹ In the specific context of the British Navy, the disease is said to have caused more losses than enemy action during the eighteenth century,

a period when Britain was frequently at war. Under these circumstances, the search for a cure for scurvy attained greater urgency.

Among those who participated in the fight against scurvy, the English navigator Captain James Cook (1728-1779) became renowned for his success in preventing the occurrence of the disease during long voyages. In 1776 he received the prestigious Sir Godfrey Copley's medal for his research into its prevention during his second voyage from 1772 until 1775, a circumnavigation during which he explored widely in the southern Pacific Ocean. This award was made annually by the Royal Society of London for the year's 'most useful and most successful experimental inquiry'.² Cook described his investigations to Sir John Pringle (1707-1782), President of the Royal Society, in a letter written in March 1776, as preparations were under way for the departure of his third voyage.³ The letter was subsequently published in its *Philosophical Transactions*.⁴ Pringle quoted from the paper

Correspondence address: Dr B Stubbs, School of Environmental Science and Management, Southern Cross University, P.O. Box 157, Lismore, New South Wales, Australia, 2480
Tel: 61 2 66203650; Fax: 61 2 66212669
Email: bstubbs@scu.edu.au
Accepted 23 July 2002

in his address to the Royal Society on 30 November 1776 on the occasion of the award to Cook of Copley's medal.^{2,5,6}

In his letter, Cook attributed his success to a combination of methods, including: close attention to cleanliness on board the ship; by maintaining a plentiful supply of fresh water; by procuring fresh food whenever possible; and by carrying and using a variety of substances which had known or suspected antiscorbutic properties. These substances included such things as sauerkraut (pickled cabbages), salted cabbage, portable broth (a soup, prepared from cattle offal and flavoured with salt and vegetables, then evaporated to hard cakes), salep or saloop (a powder made from dried orchid roots), mustard, marmalade of carrots (carrot juice evaporated to the consistency of treacle), rob of lemon and orange (their juice evaporated to a syrup), and, most relevant here, malt (partly germinated then dried barley), and inspissated juice of wort and beer.^{3,4} These all reflected the Admiralty's concern that to be suitable for use at sea, potential antiscorbutics should be stable, for at least a year and preferably two, and not be unduly bulky.

The variety of substances used, together with the range of procedures, reflected the prevailing ignorance of the actual cause of scurvy, and the variety of opinions about probable cures and preventatives. Although the cause was unknown (and would remain uncertain until the isolation of ascorbic acid in 1932) numerous theories were current, and attachment to one or other of these influenced the treatments that were promoted. One belief was that scurvy was exclusively a disease of the sea, and that only a return to land would effect its cure; 'the very Earth is the first of cures for the Scurvey'. Accordingly, when at sea in 1782 with a crew dying of the disease, Admiral Pasley dug up the garden in which he raised his 'daily Sallad', and used it instead to 'bury as many men as possible, greatly to their Satisfaction'. This 'did wonders', and the men who were 'carried and lifted in and out of it, incapable of moving a Limb', the following day 'walked of themselves'.⁷

It was not only during Cook's second voyage that Admiralty-sponsored experiments were carried out into the prevention and cure of sea scurvy. Various substances were carried and used on his first voyage (*Endeavour*, 1768-1771) on account of their presumed antiscorbutic properties, and investigations continued on the third voyage (1776-1780) during which Cook died (in Hawaii on 14 February 1779). Prior to Cook, the voyages of Byron (1764-1766) and Wallis (1766-1768) had also been used by the Admiralty to test presumed remedies for this increasingly prevalent and troublesome disease.

My purpose is not to treat the subject of scurvy in detail, for there is an extensive body of literature dealing with this topic, notably the works of Carpenter and Cuppage.^{1,8} My more specific aim is to examine the use of beer and its precursors, malt and wort, during Cook's voyages, and to explain the origins of that use, especially in the context of the search for a cure for scurvy. The antiscorbutic use of these substances has been ignored or confused in numerous works on the general topics of scurvy, beer, and maritime history.

The problem with beer

The custom of allowing British seamen the regular use of fermented liquor is an old one. Ale was a standard article of the sea ration as early as the fourteenth century, during the reign of Edward III. Henry VII established a naval brewery at Portsmouth in 1492 to supply his ships with beer. By Cook's time, one gallon of beer per man had become the standard daily allocation.⁹⁻¹¹

The use of beer at sea by this time had developed three main aspects. First, it was used as a food—it was a staple beverage and an essential part of the sea diet. It was also a luxury, helping to ameliorate the hardship and irregularity of sea life. And thirdly, beer was considered as a medicine, conducive to health at sea.

Beer was administered as a cure for numerous medical conditions, including scurvy. Many eighteenth century physicians expressed their belief in the restorative and curative powers of beer. James Lind (1716-1794) in 1753 recommended 'fermented liquors of all sorts' as 'beneficial' in the treatment of the scurvy. He suggested procedures for 'recovering' spoiled beer, wines, and other fermented liquors; 'as these liquors are all of them antiscorbutic, they are well worth preserving'.¹²

Nathaniel Hulme (1732-1807) called beer 'a noble drink for seamen' and noted that 'ships...have been observed to fall into the scurvy much sooner, after this wholesome liquor was expended, than while it was continued to be drunk'.¹³ Sir John Pringle told the Royal Society in 1776 that it had been a 'constant observation, that in long cruises or distant voyages, the scurvy is never seen whilst the small-beer holds out'.²

Gilbert Blane (1749-1834), physician to the West Indies fleet in the early 1780s, said that 'all sorts of fermented liquors, except distilled spirits, are conducive to health at sea'. He had 'no doubt that malt liquor [was] extremely wholesome and antiscorbutic'. Blane considered wine to be 'the most salutary kind of drink next to malt liquor and spruce beer'.¹⁴ Thomas Trotter (1760-1832), physician to the Channel fleet in 1794-1795, introduced the practice of giving malt liquor at Haslar Hospital when he officiated there, and he found porter (a strong beer) 'one of the best ingredients in the diet of a convalescent'; it 'never failed to strengthen them quickly for duty'. As a child, Trotter himself was 'supported entirely' by small beer during a 'low fever'.¹⁵

John Clephane, M.D., physician to the fleet at New York at the beginning of the Seven Years War (1756-1763) furnished the following as proof of the efficacy of beer as a specific remedy for the disease. At the beginning of the war two store ships, *Tortoise* and *Grampus*, sailed for America under the convoy of the frigate *Daedalus*. *Grampus* happened to be supplied with sufficient porter to last the whole passage. The other two ships were supplied only with the common allowance of spirits. The weather was unfavourable and the passage drew out to fourteen weeks. Upon arrival at New York, *Daedalus* sent to hospital 112 men, and *Tortoise* 62, the greater part of whom were in advanced stages of scurvy. *Grampus* sent only 13, none of whom had scurvy.¹⁴ The use

of beer was also promoted by David Macbride, about whom more will be said later.

Beer's limited keeping qualities, and its considerable bulk, unfortunately prevented a sufficient supply of this wholesome beverage being carried to last longer than a very short voyage. Spirits, mainly French brandy and later rum, were used as conscious substitutes for beer after it was depleted.¹⁶ *Endeavour*, when being fitted out for its voyage in 1768, was to be victualled for twelve months, but of beer she was to have only one month's supply, with brandy in lieu of the remainder.¹⁷ Cook's second and third voyages were similarly victualled for twelve months with all items except beer.^{18,19} Provision of spirits as a substitute for beer may have satisfied the sailors' demand for an alcoholic beverage, but not their medicinal needs. As far as scurvy was concerned, Lind believed that distilled spirits such as brandy 'infallibly increased the malady'.¹² Trotter observed that 'changing the beer for grog [diluted spirits], had a quick effect in increasing the number of scurvies'.¹⁵ With our present understanding of the cause of the disease, however, we would recognise that the depletion of the sea stock of beer would coincide with the depletion of bodily reserves of ascorbic acid in the absence of a dietary source.

Dried malt and sweet wort

Besides beer, among the provisions on board *Endeavour* was malt, carried at the request of the Admiralty as a treatment against scurvy.¹⁷ The use of malt for this purpose had been recommended by Dr David Macbride (1726-1778), an Irish physician and medical writer whose theories on the causes of scurvy became among the most influential of the late eighteenth century.

Macbride, who had for a short time been a surgeon in the navy where he had become acquainted with the diseases of seamen, believed scurvy to be a disease of putrefaction. He was struck by the fact that the decay of animal and vegetable matter was accompanied by the evolution of 'fixed air' (later named carbon dioxide). He believed that this fixed air was trapped in healthy, living tissue, and was responsible for its cohesiveness. Conversely, its escape was responsible for the decay of tissue in diseases such as scurvy. He extended the ideas of Pringle, published in 1750, that fermentation, by its production of fixed air, inhibited putrefaction.²⁰ Macbride reasoned that food which fermented rapidly in the digestive tract would be effective in treating or preventing putrefactive disease, by its production of fixed air which would penetrate the alimentary tract and other living tissues.²¹ Incidentally, the putrefactive theory of scurvy was also responsible for the Admiralty's interest in the invention by Joseph Priestley of a method of impregnating water with fixed air—of making soda water—part of a body of work for which Priestley received the Copley medal in 1773.^{18,22}

Macbride's reasoning led him to the idea of giving sweet wort, an infusion of malt, as an antiscorbutic. Beer had long been considered one of the best antiscorbutics, but as it derived all of its fixed air from the malt of which it was made, Macbride inferred that the malt itself would be preferable on

long voyages, because it took up less room than the brewed liquor, and would keep sound longer. The 'alimentary fermentation' of the malt would then produce fixed air and bring about the cure of scurvy.^{2,21}

In 1762 Macbride drew up a proposal for the use of wort in the treatment of scurvy, and this was sent to Pringle and others. Trials were subsequently made of wort on several voyages including on the *Dolphin* under Captain Samuel Wallis during its second circumnavigation in 1766-68, and during Cook's first voyage on the *Endeavour*.^{21,23,24} The Admiralty issued Cook with instructions for the storage and use of the malt. Every day a quantity was ground, mixed with boiling water in the ratio of one to three, then allowed to stand for three or four hours. The resulting wort was then administered at the rate of at least a quart per person per day.²⁵ Although such a great variety of preventatives were used on this voyage that surgeon William Perry was unable to say 'what was most conducive to our preservation from scurvy', he was nevertheless strongly of the opinion that 'malt is the best medicine I know, the inspissated orange and lemon juices not even excepted'.²⁶

During Cook's second voyage, once again dried malt was carried, and wort prepared and issued as a precaution against scurvy. At the conclusion of this voyage Cook reported to the Admiralty Secretary that 'wort made of malt is without doubt one of the best antiscorbutic sea medicines yet found out...'. His praise of the wort was, however, qualified: 'If given in time it would, with proper attention to other things, prevent the scurvy from making any progress, but would seldom be found to cure it'.¹⁸

Cook's high opinion of the wort was upheld by James Patten, the surgeon on *Resolution*, who said of it: 'I have found the wort of the utmost service in all scorbutic cases during the voyage. As many took it by way of prevention, few cases occurred where it had a fair trial; but these, however, I flatter myself, will be sufficient to convince every impartial person, that it is the best remedy hitherto found out for the cure of the sea scurvy'.²

Dried malt was carried and similarly used during the third voyage, but little is said of it in the accounts of that voyage, presumably because its use had become so routine as to be unworthy of mention. As for its actual effectiveness as an antiscorbutic, the wort may have been of some benefit. Germinated barley contains substantial amounts of ascorbic acid, and some of this may have remained in Cook's malt, provided that the drying process was not excessively severe and that the malt remained fresh.¹

Brewing beer at sea

As already mentioned, although beer was a renowned health food and medicine, only very limited supplies could be carried to sea. One solution to this problem was to brew beer during the voyage. Nathaniel Hulme recommended such a course of action to Joseph Banks before the commencement of Cook's first voyage; he provided Banks with a recipe for brewing the beer and a method for preserving yeast at sea.²⁷ Hulme had gained his M.D. at Edinburgh in 1765 with a

thesis on scurvy, a disease with which his naval experience had brought him into contact. In 1768 he published an expanded version of this thesis, with a section entitled 'A proposal for preventing the scurvy in the British navy' in which he advocated the use of orange and lemon juice. This juice was not, however, intended to replace beer, but rather to supplement it. Hulme observed that 'the most healthy part of the sea diet is the drink alone', such as 'sound small beer [which] perhaps, is the best antiscorbutick liquor'. He proposed administering citrus juice by mixing it with the seamen's allowance of drink, whether it be beer, wine, or grog. 'Good sound small beer, [although] an excellent antiscorbutick liquor...is not found sufficient of itself to prevent the disease' so should be 'daily impregnated with...the juice.' Included in Hulme's proposal, a copy of which he provided to Banks before the departure of *Endeavour*, were instructions, based on Macbride's work, for preparing and administering wort; directions for making spruce beer using molasses and leaves or wood shavings from the spruce fir; and directions for brewing a beer with molasses and turpentine, the dried resin of the fir and other coniferous trees.¹³

It is uncertain whether Banks followed Hulme's advice. Cuppage reported that beer had been brewed when *Endeavour* was at Tierra del Fuego in January 1769, but he possibly confused the brewing of beer with the boiling of wild celery into soup for use as an antiscorbutic.⁸ No mention of brewing beer can be found in either Banks's or Cook's journals of the voyage. In the journal of his second voyage, however, Cook refers to 'an experiment made during my former voyage' which did not succeed.²⁸ He was presumably referring to an experiment in the brewing of beer with molasses, for this is the context in which it is mentioned. Malt, however, appears not to have been used for brewing during the first voyage, its use being restricted to the preparation of wort for administration as an antiscorbutic. This is confirmed by Pringle who said that the wort, and the acid juices of lemons and oranges, were dispensed 'only as medicine'.²

Inspissated juice of malt

Interest in brewing at sea was stimulated in October 1771 when the Admiralty received news of a product called 'inspissated juice of malt'. Directions were given for a quantity of this product to be prepared, and for a trial of it to be made for brewing beer at sea on *Resolution* and *Adventure*.¹⁸

Two different kinds of 'inspissated juice' were made; one from wort and one from beer. Both contained hops, which would avoid the inconvenience of sending these to sea. One was fermented, which would overcome the difficulty of always having yeast available during the voyage. The 'juice' was prepared by boiling away most of the water from wort or beer until it was thick and viscous, a process which took a week. The resulting concentrate could then be made into beer at sea simply by mixing it with the necessary quantity of water, with or without yeast as required, and letting it stand for a few days.^{16,18} Given the manner of preparation, it is

improbable that either sort of juice, and especially the juice of beer, would have contained more than negligible amounts of ascorbic acid.

Mathias has treated the subject of beer concentrate in some detail, but principally in the context of extending beer supplies at sea, not of preventing scurvy.¹⁶ Carpenter, who deals with malt and beer in his history of scurvy, makes no mention of inspissated juice.¹ Watt has said that inspissated juice was used on Wallis's *Dolphin* in 1766-68, but he confuses dried malt with the concentrate.²⁹ The first use was undoubtedly on Cook's second voyage.

When *Resolution* and *Adventure* left Plymouth Sound they carried supplies of both the juice of wort and juice of beer. The ships' commanders, Cook and Furneaux, were instructed to make experiments of their efficacy, and Cook was instructed to report on this at the end of the voyage.¹⁸ The beer brewing activities on the second voyage mainly concerned the use of inspissated juice of wort and beer.

The juice had its first use on *Resolution* early in August 1772, in the North Atlantic Ocean. The method employed to produce the beer from the inspissated juice of beer was to mix it with cold water then stop it down. In a few days it would be 'brisk and drinkable'. The inspissated juice of wort required to be fermented with yeast in the usual way of making beer. Cook found, however, that from 'the heat of the weather and the agitation of the ship', both sorts of concentrate fermented uncontrollably in their casks, causing great losses. Further experiments were made after *Resolution* left the Cape of Good Hope in November 1772. The cool southern climate was more favourable for brewing, although here Cook had to recommend the use of warm water, and keeping the mixture in a warm place to maintain fermentation.¹⁸

Reports on the use of various antiscorbutic articles during the second voyage were made by Cook in letters to the Admiralty Secretary and to the Victualling Board in August 1775. Cook was pleased with the beer produced from the inspissated juice in cool and temperate climates, but to be useful in hot climates it needed to be prepared in such a way as to prevent it from fermenting spontaneously in the casks.³⁰ Interestingly, although substantial extracts from both letters were included in Beaglehole's account of Cook's second voyage, the sections dealing with the inspissated juice were omitted.¹⁸

Later, in his letter to Sir John Pringle in March 1776, and in the version of his journal published in 1777, Cook mentioned dried malt, and the use of it to make sweet wort, but said nothing of the inspissated juice, or of brewing beer. He said that he had confined his comments to those articles 'as were found the most useful' as antiscorbutics, which suggests that the juice was not so-considered.^{3,4,31} Nevertheless, Cook was favourably enough impressed to request that supplies be put on board *Resolution* and *Discovery* for his third voyage, for further experiments. This was done, only this time the wort had been more highly hopped before being inspissated, in an attempt to make it stable in hot climates.¹⁹ Despite the trouble taken to prepare further concentrate, and despite the issuing of instructions for its use for making beer,

there is no record in the journals of the third voyage of its use for this purpose. The concentrate is not mentioned in the accounts of any of the four occasions on which beer was brewed during that voyage, some details of which follow.

Sugar beer or malt beer?

Because the antiscorbutic value of beer was held to derive mainly from the fixed air that it contained, it mattered little from the point of view of scurvy what fermentable material was used to prepare the beer. Thus, beers based on molasses and sugar, not malt, were brewed during Cook's second and third voyages and administered in the prevention and the cure of scurvy. Most of these were types of 'spruce beer', which traditionally was prepared from molasses (Table 1).

According to the theories of the time, spruce beer derived its antiscorbutic virtues both from the fixed air produced by the fermentation of the molasses, and from the vegetable matter added to it. The latter might be: either the fresh leaves and other parts of the spruce fir trees; or essence of spruce prepared from these trees; or turpentine. Thus Lind in 1753 wrote that 'a simple decoction of the tops, cones, leaves, or even bark and wood of [pine and fir] trees, is antiscorbutic: but it becomes much more so when fermented, as in making spruce beer; where the molasses contributes...to make it a more suitable medicine'.¹²

Spruce had been used as an antiscorbutic for more than two centuries before Cook's voyages. During his sojourn in Canada in 1535, Jacques Cartier became acquainted with the use of a decoction of the leaves and bark of a certain tree, probably a spruce, to cure an unknown malady which, from his description of it, was certainly scurvy.¹² Cuppage refers to this decoction as 'beer', but it was not fermented so should not be so-called (Cuppage also confuses wort and beer).⁸ Not only in the northern American colonies, but also in several countries of northern Europe, spruce beer became a common

and effective preservative against, and remedy for, scurvy. William Barentz carried casks of it on his voyages in 1594-97.³²

Moreover, beer infused with various herbs was being used as a remedy for scurvy and other complaints in England by the mid-seventeenth century.³³ During his three year period in North America (1729-1731), Bishop Berkeley learned from the Indians the use of 'tar water', prepared by soaking pine tar or some similar resinous product in water. Upon his return to Ireland, Berkeley advocated its use for almost every bodily ailment.^{34,35} Lind recommended adding molasses to tar water and fermenting it in the manner of spruce beer, by which he thought it would 'certainly become much more antiscorbutic'.¹² Both Lind (1753) and Hulme (1768) published descriptions of the preparation and antiscorbutic use of spruce beer, the latter supplying the recipe which Banks took with him on *Endeavour*.

The first clear evidence of brewing spruce beer on Cook's voyages comes in early April 1773 in New Zealand. Here, a beer was brewed using the inspissated juice of wort, but supplemented with molasses. To the mixture was added the leaves and small branches of a tree that Cook described as being similar to the American black spruce. Cook noted that it was not at all necessary to use inspissated juice for the making of this beer. Molasses or sugar would do just as well. He made use of the inspissated juice because he 'had it and could not apply it to a better use and to save sugar and molasses'. Cook wrote at this time that his crew had become 'strong and vigorous' through 'the healthiness of the place, and the fresh provisions it afforded. The beer certainly contributed not a little'. 'There was hardly a man in the ship [*Resolution*] that did not attribute our being so free of the scurvy to the Beer and Vegetables we made use of at New Zealand'.^{18,28}

Table 1. Beer making during Cook's three voyages, 1768-1780

Voyage	Date	Place	Details of brew
I	Unknown (1768-71)	unknown	suggested by Hulme, possibly tried molasses, with spruce leaves or shavings, or turpentine, + yeast
II	Aug. 1772	At sea (Atlantic Ocean)	inspissated juice (1 part in 8-12 of water) +/- yeast
	>Nov. 1772	At sea (Indian/Southern Ocean)	inspissated juice (1:12, 1:16)
	Apr. 1773	New Zealand	inspissated juice + molasses (juice:mol. = 3:1) + 'spruce' + yeast +/- 'tea plant'
III	Feb. 1777	New Zealand	'treacle [molasses] or sugar' + 'spruce'
	Apr. 1778	Nootka Sound	spruce beer. details unknown
	Dec. 1778	Hawaii	sugar cane + hops
	Sep. 1779	Kamchatka	molasses + 'spruce'

Cook's use of molasses to replace a proportion of the inspissated juice in the beer brewed in New Zealand in 1773 seems to have set the scene for brewing activities on his third voyage. No specific reference can be found to the use of inspissated juice for brewing on that voyage. This absence of comment might mean just that its use had become routine, and unworthy of mention, but it more probably means that Cook had ceased to use it in this way.

When *Resolution* and *Discovery* arrived at New Zealand in February 1777, spruce beer was again brewed, both for Samwell, the surgeon's first mate on *Resolution*, recorded that on 13 February the tents were erected on shore, under a 'proper guard of marines', and close to these a brewery was erected 'for making spruce beer both for present use and for a sea stock'. Samwell thought the beer to be 'of infinite use to the ships' companies by keeping them free from the scurvy', which reflected 'great honour on the commander who paid due attention to this important article'.¹⁹

Spruce beer was again brewed in April 1778, at Nootka Sound on the Canadian west coast. Enough beer was brewed on this occasion 'to last the ship's company for two or three months'.¹⁹ Cuppage has written that beer was also brewed at Unalaska Island during Cook's visit early in October 1778, but he confuses the brewing of beer with the drinking of beer brewed elsewhere, probably at Nootka Sound.⁸ When the ships reached Unalaska, Cook recorded that both were free of scurvy, attributing this in part to the spruce beer which was drunk 'every other day'.¹⁹ This journal entry was made on the day on which *Resolution* anchored in Samgoonoodha Harbour, before there had been time to make more beer, so it must refer to beer prepared previously.

Towards the end of November 1778 Hawaii was reached. Here a beer was brewed from a strong decoction of sugar cane. It was flavoured with hops, of which there was a supply on board the ship. This was almost certainly the first, and probably the only beer on Cook's voyages to be made from sugar cane. Also while in Hawaii, William Bayly, astronomer on *Discovery*, made 'exceeding good beer' by boiling in water the swollen underground stem of *Cordyline terminalis*, and allowing the sweet extract to ferment. This appears, however, to have been a private experiment, the product of which was not for general consumption.¹⁹

Spruce beer was brewed again, probably for the last time on the voyage, at the end of September 1779 at Kamchatka, in eastern Siberia. Captain James King recorded that a fortnight's beer was made for the crew using molasses and 'spruce essence' prepared from a small local tree.^{19,36} Upon his return from the third voyage, King attributed 'the superior Healthiness of the People of the *Discovery* over those of the *Resolution* in a great measure to the Beer we brewed'.¹⁶

A summary of the beer brewing which took place during Cook's voyages (including the suggestions made to Banks by Hulme for the first voyage) is given above (Table 1). Although I cannot be certain, it appears that the inspissated juice of malt was not used for beer-making during Cook's third voyage. A partial reason for this could have been the problems experienced in controlling the fermentation which

tended to be over-violent in hot climates. Another reason could be that Cook decided to avoid the difficulty of brewing beer from the concentrate by simply administering it directly as a medicine. It was, however, used for brewing on many voyages after Cook's, and long after 1795 when lemon juice was officially adopted for use against scurvy.

Faith in beer and malt dies hard

Belief in Macbride's putrefactive theory of scurvy began to wane in the early 1780s. That it survived so long was a triumph of theory and authority over practical experience and clinical evidence. Indeed, John Clark had written in 1773 that:

'of late no proposal has inspired greater hopes of success than the malt infusion recommend (sic) by the ingenious Dr Macbride. His theory, concerning the operation of vegetables, and the manner in which they cure the scurvy, is founded upon the most plausible principles, and is supported by seemingly conclusive experiments made *out of the body* (my emphasis)'.

And yet in cases of which he was aware 'in which the wort was tried at sea', it had no effect 'either to remove the disease or to check its progress'.³⁷ Later, even the decline of the theory did not destroy the well-established faith in beer and essence of malt in the prevention and cure of the disease. Their use for this purpose persisted for many years after the last of Cook's voyages, perhaps based upon a belief that they might exert their commonly accepted antiscorbutic effects through some other mechanism than fixed air. Growing evidence of their ineffectiveness, however, did accelerate their replacement with other antiscorbutic medicines, especially lemon juice.

A serious outbreak of scurvy occurred at the siege of Gibraltar in 1780 and extract of malt was used there without success.³⁸ When scurvy was ravaging the crew of HMS *Jupiter* in 1781, the sick were given daily 'one pint of wine, one pint of beer, and as much of the essence of malt made into wort as they choose to drink'. Admiral Pasley noted that: 'In no other ship can they have so many antiscorbutics—yet all does not even cheque that horrid disorder'.⁷ Also in 1781, the English fleet in the West Indies was 'furnished with essence of malt', but Gilbert Blane wrote that in the treatment of scurvy 'its powers were so inconsiderable that some of the surgeons denied that it had any'. In trials that were made in the early stages of the disease, however, it was found 'to have a sensible effect in checking and removing it'. 'In this state of the disease, the articles of lesser powers, such as malt and melasses, may be of service by preventing its farther progress, or the appearance of actual symptoms, and by restoring the constitution'.¹⁴

Governor Phillip in 1787 complained repeatedly about the provisioning of the convict ships being prepared for the voyage to New South Wales, particularly the absence of antiscorbutics for either convicts or marines. He requested that 'essence of malt or some [other] antiscorbutic' be provided.^{39,40} Phillip's request was evidently acceded to, for Surgeon-General White later reported that he had been 'liberally supplied with that powerful antiscorbutic, essence

of malt'. His comments on its effects are somewhat contradictory: when forced to ration water, scurvy 'made its appearance with such hasty and rapid strides, that all attempts to check it [including continuing to administer the essence] proved fruitless', but when the supply of water was replenished replenished, 'the free use of the essence of malt...made in a few days so sudden a change for the better in the poor fellows...that every persons on board was surprised at it'.⁴¹

In 1795, lemon juice was officially adopted for use against scurvy, and in 1798 the Admiralty ordered all issue of essence of malt for this purpose to be discontinued.^{1,16} Even this, however, did not mean an end to the desire to brew beer at sea from malt essence, nor to the belief that beer was a useful antiscorbutic, albeit a lesser one, it was now conceded, than lemon juice. In 1806 Sir John Dalrymple (1726-1810) and John Crooks, an Edinburgh chemist, presented a memorial to Sir Thomas Maitland, the Earl of Lauderdale, 'concerning beer to be made at sea' on the occasion of his preparing to sail for India to take up the position there of commander-in-chief. Beer made at sea would 'always come to the relief of the seamen...when their own beer is done', the memorialists asserted.^{42,43}

Dalrymple had some involvement in the manufacture of essence of malt in the 1790s.¹⁶ In his 1806 memorial, he cited Pringle's 1776 discourse to the Royal Society, and urged that beer was better than just wort as 'worts do not contain one fourth part of the fixed air that is in beer', as 'fixed air' is created by the fermentation of the wort to beer. Although not specifically referring to scurvy, he said that fixed air prevented 'the bad effect of salt meat, strong spirits, and sea air'. Dalrymple's beer would be made from cold water, not boiled water, in the common casks of the ship, without the apparatus of a brewery. Two types of beer could be made in this way: one from essence of malt, and one from molasses or sugar.⁴² It is not known whether Dalrymple's suggestions were taken up, but even if not, they are evidence of the persistence of the ideas about scurvy and fermentation promoted by Macbride and Pringle.

Even more remarkably, in 1832, during a survey of the west coast of Africa, Captain Belcher of HMS *Aetna* brewed beer from essence of malt and hops, and reported that it was the only thing 'which appeared materially to check' the scurvy. In addition, Belcher believed that 'a general issue of this on the coast of Africa would be very salutary, and have the effect especially of keeping up the constitutions of men subjected to heavy labour in boats'.⁴⁴ Thus, the belief in beer and essence of malt as effective agents in the prevention and cure of scurvy died hard indeed.

Conclusion: Cook's legacy

Cook has been criticised for his role in promoting the antiscorbutic use of malt, wort, and beer. Despite his unprecedented success in maintaining the health of his crew during his three long voyages, and the recognition he received from the Royal Society, as a scientific experiment Cook's work

was seriously flawed. Such a variety of substances and procedures had been used simultaneously during the voyages that it was impossible to know which were effective in treating scurvy, and which were not.

Cook's report from the second voyage suggests that he was blindly supportive of Macbride's theories, perhaps out of devotion to Pringle. At very least he was confused about the effects of the various substances that he had used and was led by the authority of these scientists into attributing unwarranted success to the use of wort. Guthrie and Meiklejohn have called this 'a remarkable example of a great man's inability to discriminate between essential and contributory factors'.⁴⁵ Stewart called it a 'lack of understanding and blind devotion to mistaken theories [which] perpetuated the use of so-called antiscorbutics which were in fact quite ineffective'.⁴⁶

There is indeed evidence that others were influenced by Cook's support for the use of wort and beer. The Spanish navigator Alexandro Malaspina, in his five year expedition from 1789 until 1784, used malt as an antiscorbutic, his belief in its virtues having been acquired from reading Cook's favourable opinion of it.⁴⁷ Spruce beer was brewed in New Zealand in 1791 to Cook's recipe during the voyage around the world of Captain George Vancouver, who had sailed with Cook on his second and third voyages.⁴⁸

Cook's critics, however, place too much emphasis on his influence, and underestimate that of Macbride and Pringle, and even such as Lind, Trotter, and Hulme, who at one time or another all promoted the antiscorbutic use of malt and beer, and themselves influenced Cook's thinking. Indeed, in the absence of Pringle's promotion of Cook's somewhat ambiguous report in his 1776 address to the Royal Society,^{2,5,6} Cook's praise of wort may have been overlooked, and perhaps equal attention would have been paid to Banks's more scientifically objective thoughts on the topic during the *Endeavour* voyage.²⁷

'Wort was served out almost constantly, of this I drank from a pint or more every evening but all this did not so intirely check the distemper as to prevent my feeling some small effects of it. About a fortnight ago my gums swelld and some small pimples rose in the inside of my mouth which threatned to become ulcers, I then flew to the lemon Juice which had been put up for me according to Dr Hulmes method...The effect of this was surprizing, in less than a week my gums became firm as ever and at this time [April 1769] I am troubled with nothing but a few pimples on my face...'

Banks later gave the opinion that it would be useless to send essence of malt to New South Wales 'as their supply of culinary vegetables must be on the increase, and they must by degrees learn more and more of those which are found wild in the country'.⁴⁹

Sir John Pringle resigned as President of the Royal Society in 1778 and was succeeded by Banks, but Cook could not have known this. He was probably already coming to his own realisation that the wort and malt-beer were not effective antiscorbutics. Evidence for this may be Cook's growing

interest in spruce beer, which he began to brew at the end of the second voyage and appears to have brewed almost exclusively on the third. This may reflect a conscious change of emphasis on Cook's part, away from the use of malt, and towards the various plant materials used to infuse the beer. These materials probably introduced considerable amounts of ascorbic acid into the beer, thus accounting for some of the positive statements about its effects. This may at first have confused the issue further, as these effects might still have been attributed to fermentation and fixed air and thus have supported the antiscorbutic use of beer in general, rather than of the vegetable matter specifically. Ultimately, however, Cook may have begun to trust his own observation and judgement, unpressured by the weight of scientific opinion.

The putrefactive theory of scurvy which was developed and promoted so successfully by David Macbride, dominated attempts to understand and to find cures for scurvy for much of the second half of the eighteenth century. The theory also represented a false lead, however, which probably delayed the discovery of a cure for the disease. It was mainly responsible for the use of unfermented malt as an antiscorbutic. It was also responsible for the interest in brewing beer at sea, and particularly for the development of concentrated wort and beer. The desire to have a continuous supply of beer during a long voyage is insufficient in itself to explain the trouble that was taken, and these activities must be viewed in the context of the more vital task of seeking a cure for scurvy, a disease to which has been attributed greater mortality than 'battles, wrecks, and all casualties of sea life put together'.⁵⁰

Acknowledgements

The following allowed my access to crucial manuscripts and rare books: National Library of Australia, Canberra; National Maritime Museum, Sydney; Mitchell Library, Sydney; Fisher Library, University of Sydney; Brownless Biomedical Library, University of Melbourne; and The British Library, London. I received inspiration and encouragement from the Research Centre for the History of Food and Drink, Adelaide University, South Australia.

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