

THE UK
TEA ACADEMY



THE ULTIMATE
INGREDIENT FOR
THE PERFECT
CUP OF TEA

A White Paper by the UK Tea Academy

INTRODUCTION:

The world of tea-drinking in the UK is changing dramatically, with new flavours, loose leaf and herbal infusions becoming ever more popular. With this increase in variety comes the need to understand how to brew the best cuppa.

Water, which makes up to 99% or more of a cup of tea, is an often-overlooked ingredient that has a huge impact on the taste, aroma and appearance of every cup. Following research of many different teas and many different waters, this paper finally provides the ideal water specification needed to make the best brew.

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The UK Tea Academy

THE NATION'S FAVOURITE DRINK

Tea was first brought to Britain in the middle of the 17th century by the Dutch East India Company. Catherine of Braganza, wife of Charles II, loved tea and, in the 1660s, introduced the ritual of drinking tea to the English Royal Court. As tea was an expensive commodity, the habit was initially only adopted by the aristocracy, but gradually, through the 18th century, the poorer classes also developed a taste for tea.

In the UK today, coffee is catching up with tea. We now drink approximately 95 million cups of coffee per day (www.britishcoffeeassociation.org) compared to over 100 million cups of tea (www.tea.co.uk/about-tea), with 80% of people who visit coffee shops doing so more than once a week.

Nowadays tea is still a favourite in the UK, but the surge in coffee popularity has changed what we consume when we're out and about. According to Allegra's 2019 Project Tea Report, Tea comprises just 4.4% of the average coffee shop sales mix, with an estimated 3.6



million hot tea beverages served in specialist coffee shop environments per week. Coffee shops are the core driver of tea beverage sales on the UK high street. The specialist UK coffee shop segment, comprising branded coffee chains and independent coffee shops, is worth an estimated £6.8 billion and totals 15,201 outlets as of December 2018. Tea beverage sales represent a relatively small proportion of the market, with Allegra estimating revenue of £302 million in 2019, an annual increase of 11.1% (*Allegra, 2019*). So why are coffee shops missing an opportunity by not giving more time and space to the UK's favourite drink – tea?

THE PROBLEM FOR TEA

Forty-two percent of tea drinkers surveyed are more likely to favour tea purchased at independent coffee shops versus branded chains (22%), partly due to the perception that independents offer greater attention to detail in terms of tea preparation and service. It's positive to see that 61% of consumers surveyed indicate better quality beverages would encourage them to drink more tea out-of-home, while an increased menu range would compel 40% to do so.

BRITA, Nov 2018

There is clearly an opportunity for businesses to benefit from this consumer desire for a more premium drink, but the tea leaves and service can only do so much. In order to create the perfect drink that the consumer is seeking, operators must understand the importance of water as an ingredient in tea. Simply put, bad water will equal a bad cup of tea.

The impact of water on the taste and aroma of coffee is widely known in the industry. The Specialty Coffee Association (SCA) has determined standards for the water used to brew coffee, including levels of chlorine, calcium hardness, alkalinity and pH.

WATER AS AN INGREDIENT IN TEA IS JUST AS IMPORTANT BUT UP TO NOW HAS NOT BEEN CONSIDERED IN THE SAME WAY AS THE WATER FOR COFFEE.

If the ideal water is not used, the delicate notes of tea cannot be realised, resulting in a bad experience with even the finest of teas. Sadly, this leads to a lack of consumer confidence as well as misconceptions of how certain teas taste.

A perfect example of this is green tea. It is very common for people to “think” that they do not like green tea, the opinion reached because the tea has been almost certainly made with unfiltered water, at the wrong temperature and over brewed. The entire flavour profile is altered, often leaving the tea bitter and undrinkable. Brew a green tea correctly and the entire experience is worlds apart in comparison.

This report highlights the key ingredients of water which impact the brewing process of tea. It will also provide a standard water specification to create the optimal cup of tea.



THE SCIENCE

As we all know, water is made up of Hydrogen (H) and Oxygen (O), giving us the chemical formula H_2O that is widely recognisable. However, water consists of so much more. The fact that it is an excellent solvent means that various substances from the environment are easily dissolved in water, all of which can impact the sensory properties of tea:

1 MINERALS:

Minerals do influence the taste, aroma and turbidity (or cloudiness) of tea. Although mineral levels vary in different tap waters, the most abundant minerals that occur naturally are calcium, magnesium, sodium and potassium, chloride, sulphate and hydrogencarbonate (HCO_3^-). Hydrogencarbonate is responsible for something called **buffer capacity** (otherwise known as alkalinity).

Waters with a low amount of hydrogencarbonate (therefore low buffer capacity) are very sensitive to changes in pH; as the amount of hydrogencarbonate increases (higher buffer capacity), the ability of water to resist changes in pH also increases.

A) BUFFER CAPACITY

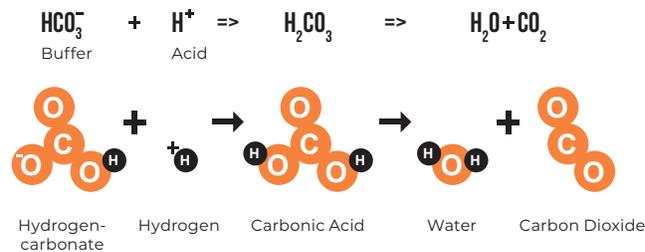
Buffer capacity (or alkalinity) refers to water's ability to keep the pH stable as acids or bases are added. The buffer capacity is caused by hydrogencarbonate (HCO_3^-) and is measured in degrees hardness (dH) or milligrams per litre (mg/l)

The "buffer capacity" of water is also known as the "alkalinity" of the water. This should not be confused with 'basicity', which is an absolute measurement on the pH scale. The buffer capacity or alkalinity of water is the indicator for hydrogencarbonate.

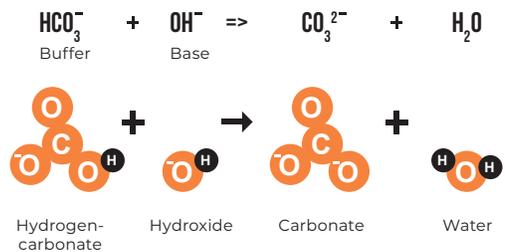
HOW DOES THE BUFFER PREVENT PH CHANGE?

Acids, which would normally cause a decline in pH (a rise in the acidity of the water), are effectively neutralized by the buffer and therefore the pH remains stable. In the same way, when bases are added to water the buffer neutralizes them, preventing a rise in pH. Once the buffering capacity of the water is exhausted, pH will start to change.

IF ACID IS ADDED (H⁺)



IF BASE IS ADDED (OH⁻)



The pH of water has often been determined as having an important impact on the quality and colour of the tea infusion. Contrary to popular belief, the pH of the starting water is of minor importance.

IT IS ACTUALLY THE BUFFER CAPACITY, OR ALKALINITY, THAT IS THE DOMINATING FACTOR

CARBONATE HARDNESS

Carbonate Hardness is the amount of calcium/magnesium that is associated with hydrogencarbonate. In most natural water the total amount of hydrogencarbonate is associated with calcium/magnesium, therefore in these circumstances the terms 'buffer capacity' and 'carbonate hardness' can be used interchangeably.

THE DESIRED RANGE FOR THE TEAS TESTED WAS BETWEEN 2 AND 5 °DH

B) TOTAL HARDNESS

Bivalent Cations like Calcium and Magnesium are responsible for turbidity in tea. The film, or streaking on the tea is actually a complex of calcium or magnesium and polyphenols, which also result in a turbidity, or cloudiness, of the tea. The reactions depend on the time brewed, concentration and pH of the tea.

The concentrations of these cations determine the "total hardness" of water.

The higher the total hardness of water, the more likely the tea will have a cloudy and streaked appearance.

TOTAL HARDNESS OF WATER FOR TEA SHOULD NOT BE HIGHER THAN 9 °DH

2 CHLORINE:

Chlorination is the process of adding chlorine to drinking water to disinfect it and kill germs. Although the level of chlorine in drinking water is very low and not harmful, when combined with organic residues it can change the taste and odour of the water, often making it unpleasant to drink.

Depending on the binding partner, chlorine has different taste qualities and threshold values. When using chlorinated water to brew tea, if the levels of chlorine are high enough that the starting water already smells of chlorine, it is likely that the resulting tea will also have a chlorine-like aftertaste. Importantly, chlorine can also react with the delicate tea aromas. Even if the chlorine levels are low enough that they aren't noticeable in the starting water (i.e. it is under the taste threshold), it is still possible for the interactions to have a significant effect on the aroma profile of the tea.

Boiling in a kettle only removes 5–19% of aqueous chlorine. The remaining chlorine can then interact with tea compounds.

(Bond, Tang, Graham and Templeton, 2015)

IT IS IMPORTANT THAT WATER FOR TEA CONTAINS NO CHLORINE

3 ORGANIC COMPOUNDS:

Volatile organic compounds (VOCs) are chemical substances with either natural or artificial origin. Natural origins can be metabolites of microorganisms like algae. Artificial origins can be industry and agriculture. VOC can dissolve to a certain extent in water but also vaporises into the air. Some of these substances can still be perceptible, even in tiny quantities. Such organic matter in drinking water is very highly controlled and the levels of these substances in drinking water have very strict limit values.

SUBSTANCE	QUALITY	ODOUR THRESHOLD	ORIGIN
Geosmin	Earthy, beetroot-like	4ng/l	Cyanobacteria, actinomycetes
β -Ionone	Violet-like, floral	7 μ g/l	Green algae, cyanobacteria
Benzothiazole	Rubber-like	80 μ g/l	Polyethylene/HDPE pipes
2-Chlorophenol	Medical	0,36 μ g/l	Chlorination of phenols
2, 4, 6-Trichloroanisole	Cork-like, musty	0,03 μ g/l	Methylation of 2, 4, 6-trichlorophenols by biofilms

(M. Antonopoulou a, E. Evgenidou b, D. Lambropoulou b, I. Konstantinou, 2014)

Many of these organic contaminants can arise as off-flavours in tea when they are present in water.

IT IS IMPORTANT THAT WATER FOR TEA CONTAINS NO ODOUR

WATER SPECIFICATION FOR BREWING TEA

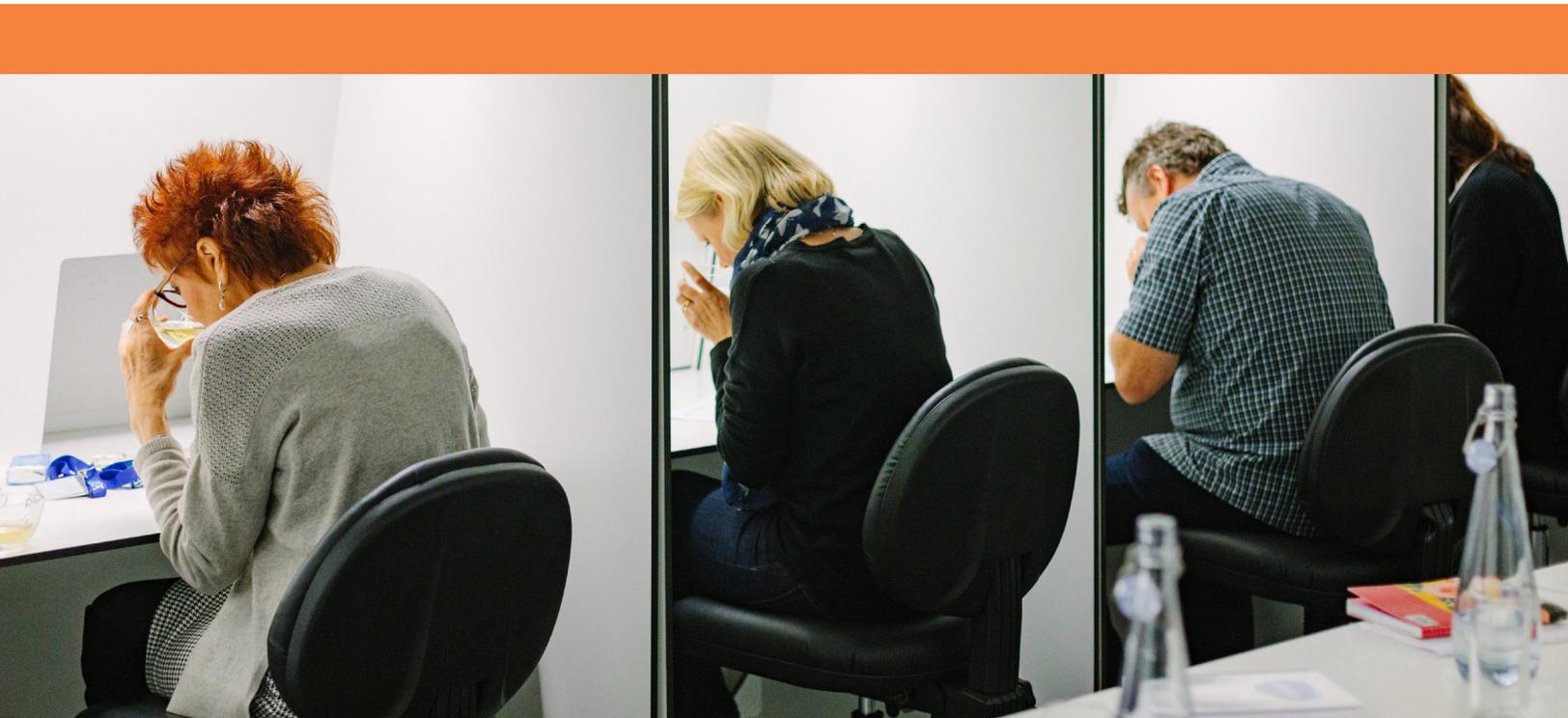
Through our research we have been able to determine the key ingredients of water that impact tea and, most importantly, to define a range that applies to all the types of tea tested. The table below highlights those ingredients that, if present at levels outside the reasonable range, will have a significantly negative impact on the flavour, aroma and look of tea:

PARAMETER	EFFECT ON TEA	TARGET	ADDITIONAL INFO
Chlorine	Changes aroma profile	0 mg/l	-
Odour	Causes off-flavour	None	-
Total hardness	Causes turbidity and tea scum	4° dH	Max. 9° dH
Buffer capacity	Influences pH of tea and therefore taste, colour and turbidity	3° dH	Reasonable Range 2-5° dH

To reach this specification and to ensure consistent quality, the UKTA uses BRITA filters.

In the following section we discuss other factors that impact tea, namely temperature and steep time, and offer recommendations for different types of tea.

If these general guidelines and water specification are followed, you can be confident that the tea you are serving will be of consistently high quality.



OTHER FACTORS THAT IMPACT TEA

HOW MUCH TEA?

The quantity of tea used should be 2.5-3grams to 200ml of water.

If too much tea is used, the brew will be stronger than recommended;
if too little tea is used, the brew will be thin and weak.



TEMPERATURE OF THE WATER

Different teas should be brewed in water at different temperatures. This is because the bitter components in tea (caffeine and polyphenols) are extremely soluble in boiling and very hot water. When we brew tea in boiling water or water at approx. 90 – 95°C, more of the bitter tasting ingredients are drawn out quickly into the water, giving a robust, sometimes quite aggressive brew. This can be fine for strong black teas, dark oolongs, and fermented 'dark teas', but when brewing more delicate teas such as white, yellow, green and the greener jade oolongs, the bitter components can easily overwhelm the subtle sweet and aromatic character of the tea. It is therefore important to reduce the temperature of the water when brewing those more delicate teas. Teas steeped in cold or iced water (a fashionable trend) release more of their sweet ingredients and fewer of the bitter ingredients into the water.

RECOMMENDED BREWING TEMPERATURES



WHITE TEA
80° C



YELLOW TEA
75°-80° C



GREEN TEA
70° C



OOLONG TEA
90° C



BLACK TEA
95° -98° C



DARK TEA (E.G. PUERH)
95°-98° C

STEEP TIME

Different teas need different steep times. The longer a tea is steeped, the higher the level of the tea's bitter components (caffeine and polyphenols) released into the water will be.



WHITE TEA:
5 MINUTES PLUS



YELLOW TEA:
2-3 MINUTES



GREEN TEA
CHINESE:
2-3 MINUTES
JAPANESE:
0.5-1.5 MINUTES



OOLONG TEA:
3 MINUTES



BLACK TEA
SMALL PARTICLES:
1.5-2 MINUTES
MEDIUM LEAF:
2-3 MINUTES
LARGE LEAF:
3-5 MINUTES



DARK TEA
2-3 MINUTES

At the end of the recommended steep time, ALWAYS separate the leaf from the liquor to prevent the tea liquor from continuing to brew and thus causing it to become too strong, too bitter and very unpleasant.

CONCLUSION

The predicted growth in the out of home tea sector offers a huge opportunity to operators. Consumers are used to brewing their own tea at home and expect even better when buying in the high street, hence the need for operators to fully understand what is required to brew a quality cup. And with 60% of consumers typically making additional food purchases alongside their tea, the opportunity doesn't end there.

We have highlighted the important factors in tea brewing, from temperature of the water, brewing time for each tea, as well as the ingredients of the water used to make the tea.

We have often speculated that each different variety of tea requires a different make-up of water to draw the full taste and aroma from the tea leaves.

Through this research and testing, we have managed to create a water specification with a range that works for all types of tea tested, meaning that making quality tea does not have to be hard work.

This water can be achieved through various means. The UKTA uses BRITA filters to achieve these water standards in our training classes to ensure consistent quality.

By using this specification and ensuring staff are trained in how to make different varieties of tea, operators have the opportunity to meet the quality standards consumers desire and subsequently increase their business.

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UK Tea Academy
Director of Studies
World Tea Awards 'Best Tea Educator' 2014

Tim Sturk
UK Tea Academy
Training Director
Licensed Q Grader



Mao Jian Green Tea tested with 5 waters of differing buffer capacities

GLOSSARY:

Acid: a molecule or other species which can donate a proton or accept an electron pair in reactions. Acids have a pH of less than 7

Alkalinity: A chemical measurement of a water's ability to neutralize acids. Alkalinity is also a measure of a water's buffering capacity or its ability to resist changes in pH upon the addition of acids or bases

Base: a substance capable of reacting with an acid to form a salt and water, or (more broadly) of accepting or neutralizing hydrogen ions. Bases have a pH of more than 7

dH: Degrees hardness – a measure of the hardness of water

Bivalent/Divalent Cation: A divalent cation is a cation with valence of 2+. This type of ion may form two chemical bonds with anions. Also known as a bivalent cation.

pH: A measure of hydrogen ion concentration, a measure of the acidity or alkalinity of water soluble substances (pH stands for 'potential of Hydrogen'). A pH value is a number from 1 to 14, with 7 as the middle (neutral) point. Values below 7 indicate acidity which increases as the number decreases, 1 being the most acidic

Valence: A whole number that represents the ability of an atom or group of atoms to combine with other atoms or groups of atoms. The valence is determined by the number of electrons that an atom can lose, add or share.

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