Context & Objective

Tea drinkers are very sensitive to the taste characteristics of tea. These attributes range across a wide spectrum of flavors, bitterness or “smoothness”. The ranges of taste parameters are more or less linked to tea origin, type, process and steeping time.

Tea, the most popular drink in the world, is exported and imported throughout many countries. The importance of proper labeling related to the country of origin and process technique is needed to define quality.

The Astree Electronic Tongue was used to:

- Discriminate flavored teas: blackberry, peach, lemon, vanilla and mint
- Discriminate the origins: Yunnan, Sencha, Wu Long, Ceylan
- Discriminate teas from various processes: black tea, oolong and green tea
- Measure steeping time: 4, 6 or 8 minutes. Overstepping tea will cause bitterness. With correct steeping, the tannins or natural acids give pleasant flavor to the tea.

This application note represents the results of the four aspects listed above.

ASTREE electronic tongue

The ASTREE Electronic Tongue (fig. 1) is based on liquid sensor array allowing a measurement of potential difference between each sensor and a reference electrode. Each sensor has a specific organic membrane, which interacts with chemicals present in the liquid sample in a specific manner. Recorded data are processed by the software as a global taste fingerprint.

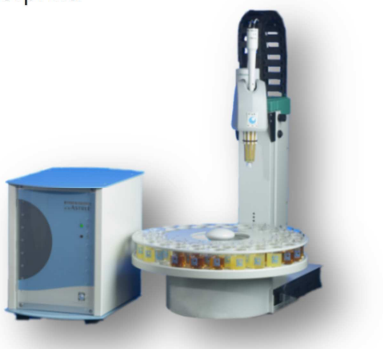


Fig.1: ASTREE Electronic Tongue (Alpha MOS, France)

Experimental Plan

Analytical conditions

Sample volume	100 mL	Temperature	Ambient
Time between 2 analysis	180 sec	Acquisition time	120 sec

Method Repeatability

To determine the repeatability of the method, an RSD has been computed on the measurement for four replicates of a single sample. The results are presented in the table.

Sensor	1	2	3	4	5	6	7
RSD	0.09	0.11	0.12	0.17	0.13	0.21	0.12

Based on the repeatability of the measurement, the method can be considered acceptable for this study.

Sample preparation

The teas are all brewed in hot water for three different lengths of time. The same brand of water (Evian) has been used for all the samples. All teas have been cooled down before the analysis.

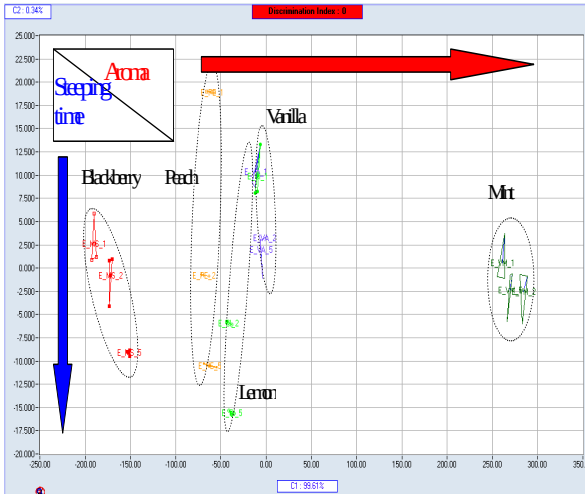
Flavor Types

Samples

Four flavored black teas with different flavors and one green tea have been analyzed at different steeping times:

- Blackberry black tea: 1, 2 and 5 minutes of steeping
- Vanilla black tea: 1, 2 and 5 minutes of steeping
- Lemon black tea: 1, 2 and 5 minutes of steeping
- Peach black tea: 1, 2 and 5 minutes of steeping
- Mint green tea: 1, 2 and 5 minutes of steeping.

Results



All analyses have been represented on a PCA graph:

- The differentiation between the samples is done in function of the flavor on the X-axis and then on the steeping time on the Y-axis.
- Mint tea is different from the other teas. This is due to the fact that the mint tea is a green tea, compared to the other samples that are black teas.
- Within the black teas, peach, vanilla and lemon flavored teas are in the same portion of the graph. The blackberry-flavored tea is noted to be a little bit dissimilar from the others.

Tea origin and process type

Samples

Five Earl Grey teas from different types and origins have been analyzed at different steeping times.

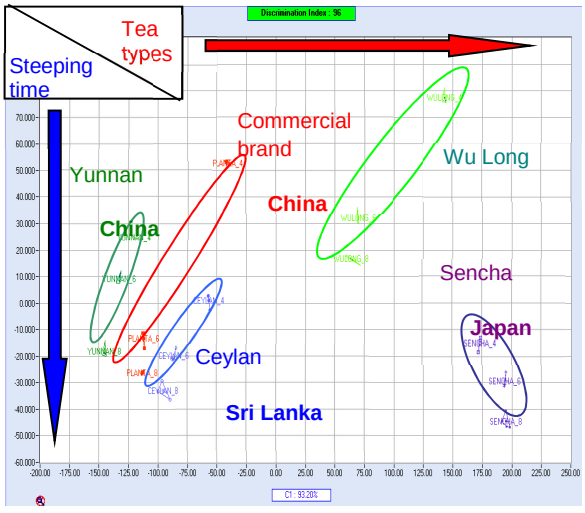
Earl Grey (advised steeping time)	% Earl grey	*Tea Sample Description*	Alpha-MOS Reference
Yunnan*** (4-5 min)	2.5	China Black tea - 4 min. steeping	Yunnan_4
Yunnan***		China Black tea - 6 min. steeping	Yunnan_6
Yunnan***		China Black tea - 8 min. steeping	Yunnan_8
Sencha* (5 min)	3.0	Japanese Green tea - 4 min. steeping	Sencha_4
Sencha*		Japanese Green tea - 6 min. steeping	Sencha_6
Sencha*		Japanese Green tea - 8 min. steeping	Sencha_8
Wu Long** (7 min)	2.8	Taiwan tea - 4 min. steeping	WuLong_4
Wu Long**		Taiwan tea - 6 min. steeping	WuLong_6
Wu Long**		Taiwan tea - 8 min. steeping	WuLong _8
Ceylan*** (5 min)	2.5	Sri Lanka Black tea - 4 min. steeping	Ceylan_4
Ceylan***		Sri Lanka Black tea - 6 min. steeping	Ceylan _6
Ceylan***		Sri Lanka Black tea - 8 min. steeping	Ceylan _8
Commercial brand*** (3-5 min)	8.0	Chinese Black tea (92%) - 4 min. steeping	Planta_4
Commercial brand***		Chinese Black tea (92%) - 6 min steeping	Planta _6
Commercial brand***		Chinese Black tea (92%) - 8 min steeping	Planta _8

*"Green tea": Green tea is produced when the leaves are fired immediately after picking. In Japan, this is done by hand with one pound of leaves being steamed at a time. After steaming for 3 to 5 minutes, the leaves are placed on a heated table and rolled, either by hand or by machine to produce the characteristic curl. The leaves are then placed on paper trays over a charcoal fire for a final drying.

**"Wu Long or Oolong tea": Oolongs, which may be considered the halfway point between green and black teas, are semi fermented. After rolling, the tea is allowed to ferment only until the edges of the leaves start to turn brown. Then the leaves have reached a precise stage in the natural fermentation and capture the unique fragrance and interesting character associated with Oolong tea.

***"Black tea": the first step in the process of making black tea is called "withering". The leaves are spread on trays called "tats" and as the leaves dry they lose moisture and begin to wilt. The average wilting time is eighteen hours. The next step is rolling. The rolling process, which is usually done by machine, twists the leaf and bruises it, thus encouraging fermentation. The oxidation process begins, turning the leaf from green to coppery brown. When the rolling is completed, the sifting process begins. This process cools and aerates the leaves, separating leaves of similar size, which will thus ferment at a similar rate. As the oxidation continues, the leaf turns even darker in color and the recognizable tea odor develops. When the leaf has fermented to the desired level, it is fired to stop fermentation and destroy bacteria. After firing, the tea is spread out to cool, then graded and sorted.

Results



All analyses have been presented on a PCA graph:

- Three main groups can be defined:
  - The black teas (Yunnan, Ceylan and a commercial brand)
  - The Wu long
  - The green tea
- Wu long is the half way point between the green and black tea. The Wu long is correctly located in between the two groups
- For this application the differentiation of the teas does not depend on the percentage of flavor
- The steeping time is a major parameter for the Commercial brand and the Wu long tea, a significant change between 4 and 6 minutes of steeping can be seen.

Conclusion

The Astree is a fast, objective, flexible and cost effective tool that has been used to perform the analysis of the four different teas. The data has demonstrated the repeatability and accuracy of the Astree for:

- Comparing teas from various flavors, origins, processes
- Evaluating the steeping time influence
- The Astree, is an effective tool to control taste characteristics of tea linked to flavor, process or blending. This analyzer provides significant benefits compared to other laboratory systems. Other applications such as bitterness evaluation can be investigated.