Comparison of sensory characteristics of green tea in Thai Nguyen and Phu Tho, Vietnam

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Abstract

Green tea is a popular consumption product in Vietnam. Especially, tea which origins from Tan Cuong, Thai Nguyen has been known for long by its better quality than those coming from other regions on the country. The study aims at comparing and finding out if the difference between tea in Thai Nguyen and Phu Tho can be figured by sensory tasting.

Two products picked from Tan Cuong, Thai Nguyen province and two others from Phu Ho district, Phu Tho are were evaluated by a panel of twelve judges (eleven women and one man) who was set from a group of thirty eight peoples, had completed a general training and sensory tasting on tea. The experiment on dry tea (eleven descriptors) was carried out separately of the experiment on brewed tea (twenty-one descriptors) and brewed leaf (five descriptors). All attributes are made notes on the sensory unstructured intensity scale.

Statistic analyses have shown typical differences by region among all of trees groups of attributes: dry leaf (10/11 attributes), liquor (6/21 attributes) and brewed leaf (5/5 attributes).

Keywords   green tea, sensory analysis

1. Introduction

Green tea since the early years, is the most popular beverage in Vietnam, the third largest green tea production in the world (after China and Japan)

Though green tea was just cultivated and exploited in Tan Cuong, Thai Nguyen in the last hundred years, its products were highly appreciated and much favorite [1, 2]. Development of productivity and quality in Tan Cuong tea region these days are derived from local tea variety (Trung Du) and acclimation tea varieties which mainly origin from other regions in the country, except the two - Kim Tuyen tea variety which were imported from Taiwan and LDP1, which is hybrid tea between mother plant Dai Bach Tra (China) and PH1 father plant (India), a product of the Northern mountainous agriculture and forestry science institute.

The goal of study is finding out the regional difference on both varieties Kim Tuyen and LDP1. However, in the context of this article, we showed only the result for Kim Tuyen variety.

2. Material and method

Four Kim Tuyen dry tea products, two of which from Tan Cuong marked as TKH1 (A), TKH2 (B) and two other of which from Phu Ho, marked sequentially as PKH1(A), PKH2 (B) were chose. These are said to be the best of tea products in the research regions. Products are harvested at a regulated level: one bud and two leaves picked at same harvesting time respectively (around Oct.2012).

Tea brewing method took place in compliance with standards of TCVN 5086-90 or ISO 3103-1980. An amount of 2.8g tea leaves was put in to a 140ml brewing cup. Boiled water from instant electric

kettle was poured on to tea leaves (water temperature in the infuser is about 93°C), and started timing. After six minutes, tea liqueur was poured in to tasting cups. Tea liquor temperature in tasting cup is about 70°C.

Thirty eight people, who enrolled on panel of beginning judges, took two basis tests about smell, taste and color. Twelve people having the best results were chosen to be judges.

After referred from standards of TCVN 3218-1993, 10 TCN 258 – 96, ISO 6078-1982 and others researchers about green tea attributes such as Ellys H. [3], Lee J. and Chambers D.H. [4] …, the tea attributes were approved by internal judges and final evaluated judges. Table 1 below is collection of final attributes for sensory green tea evaluation which we used.

Table 1: Attributes for sensory green tea evaluation

No	Dry Leaf		Liquor			Infused leaf
	Appearance	Color	Appearance	Smell	Taste	
1	Crepy	Green	Clarity	Jasmine-like	Astringent	Bright
2	Length	Black	Bright	Rosy-like	Bitter	Green
3	Wiry	Brown	Body	Green herb-like	Sweet	Coppery
4	Leafy	Silver	Green	Young green rice	Umami	Soft
5	Blister		Yellow	Flavour	Recurring sweetness	Grade
6	Fibrous			New (><mouldy)	Less sweetness after tasting	
7	Down			Sour		
8				Fermented		
9				Smoky		
10				Over-fired		

In training process, panelists were introduced and trained with the products and references for each attributes. After being trained in 20 hours, panelists attended to taste and noted attributes of dry leaf, liquor and infused leaf on 10cm unstructured intensity scale.

Results were Anova analyzed on Statistica software and PCA on SPAD software.

3. Results and discussion

3.1. Dry leaf

Average value of dry leaf characteristics and their order of evaluation from low to high were displayed in table 2. Small letters on right top of average numbers shown result of Tukey analysis (α=0.05) under a regulation that products were marked by a letter means belong to a same group.

Table 2: Average value of dry tea attributes

No	Attribute	TKH1 (A)	TKH2 (B)	PKH1 (C)	PKH2 (D)	Order of evaluation
1	Green	5.98^b	5.43^b	2.23^a	1.68^a	DCBA*
2	Black	6.90^b	5.97^b	2.43^a	2.59^a	CDBA*
3	Brown	2.38^a	3.51^b	7.51^c	7.85^c	ABCD*
4	Silver	6.54^b	6.24^b	3.18^a	2.05^a	DCBA*
5	Down	8.42^c	5.53^b	3.02^a	1.56^a	DCBA*
6	Fibrous	1.54^b	1.93^b	8.24^a	8.48^a	ABCD*
7	Leafy	1.59^a	3.00^b	8.15^c	8.28^c	ABCD*

8	Crepy	6.87[c]	4.67[b]	2.69[a]	2.04[a]	DCBA[*]
9	Wiry	6.78[c]	5.53[b]	1.72[a]	1.68[a]	DCBA[*]
10	Blister	1.84[a]	2.97[a]	6.14[b]	4.57[b]	ABDC[*]
11	Length	6.60[b]	2.87[a]	8.54[c]	5.98[b]	BDAC

The table shows clearly differences of ten among eleven attributes: *brown, black, green, silver, down, leafy, crepy, wiry* and *blister*. Differences between two product groups of Tan Cuong and Phu Ho (AB is bigger or smaller together in compare to CD) can be seen obviously by observing average value. For example, on *Green* attribute, Phu Tho tea products have average value at 1.68-2.23, while Tan Cuong tea products have average value at 5.43-5.98. *Length* average value of products were crisps-crossed, explained by no scheming research about length. In addition, length attribute is easy to change after a transportation process. Length scale was evaluated as 10 equal to 3 cm and 0 equal to 0.5 cm.

Therefore, at a same picking level (one bud and two leaves), Tan Cuong brought back a product which has more silver, greener, blacker, more wiryer, more crepy, more down, but less brown, less leafy, less fibrous, less blister. According to green tea standards (stand green tea is black green, less leafy, less fibrous and more snow (TCVN 3218:1993)), the Tan Cuong tea have more good advantages, which caused by the differences of geography, of climate or also of cultivation plan and transforming method. Some researchers had shows that production material (fertilizer) were invested many more in Tan Cuong tea regions [5, 6].

Figure below show results of PCA analysis of dry tea attributes and position of products on axis 1 (61.19% information ratio) and axis 2 (9.6% information ratio). Axis 1 shows attributes such as *green, silver, down, crepy, black, brown, fibrous, leafy*. Among those, *yellow, fibrous, leafy* are on opposite directions with others. These are attributes in order to distinguish products of Tan Cuong and Phu Ho. Four products lie on four different quarters. Products of Tan Cuong lie far from Phu Ho, it shows that the differences between two regions lying on attribute such as green, silver, down, crepy, black, brown, fibrous, leafy.
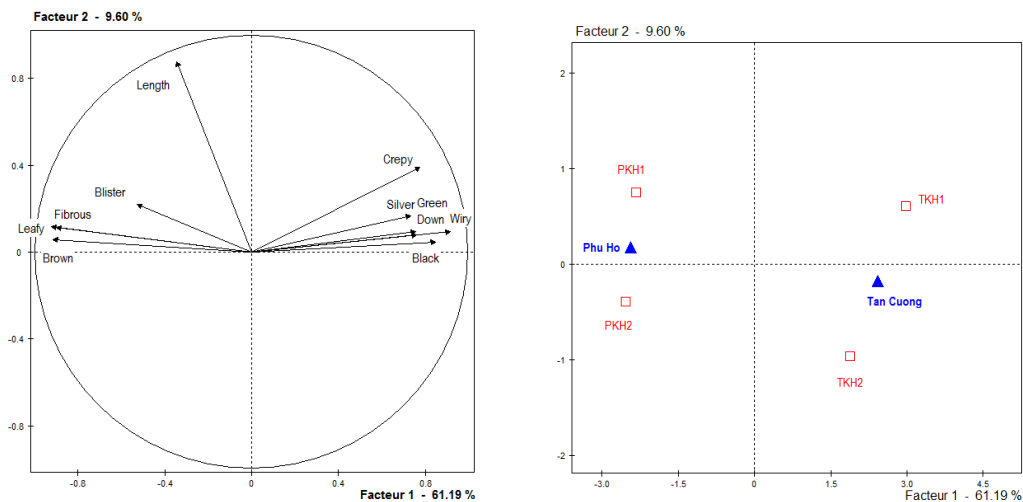

Figure 1: PCA analysis on dry tea

3.2. Brewed tea

3.2.1. Color and appearance

Below the similar structure as table 2, table 3 show the results of ANOVA analysis on attributes of color and appearance of liquor. The result wouldn't differentiate the tea between Tan Cuong and Phu Tho, even though the difference between products exists.

Table 2: Average values of color and appearance attributes of brewed tea

No	Attribute	TKH1 (A)	TKH2 (B)	PKH1 (C)	PKH2 (D)	Order of evaluation
1	Clarity	5.58^a	6.10^{ab}	6.94^b	5.88^{ab}	ADBC
2	Bright	6.36^b	6.06^b	7.05^b	3.80^a	DBAC
3	Body	4.29^a	5.38^{ab}	4.43^a	6.12^b	ACBD
4	Green	3.55^a	6.02^c	4.62^b	8.12^d	ACBD
5	Yellow	6.4^a	5.80^a	6.10^a	2.67^b	DBCA

3.2.2. Arome

Observation ANOVA in table 4, we see only the regional difference on 6 attributes: *Sour, Fermented, New, Flavour, Rosy-like* and *Young green rice*.

Table 3: Average values of aroma attributes of brewed tea

No	Attribute	TKH1 (A)	TKH2 (B)	PKH1 (C)	PKH2 (D)	Order of evaluation
1	Sour	3.75^{ab}	2.96^a	3.91^{ab}	4.36^b	BACD[*]
2	Over-fired	1.89^a	2.47^a	1.77^a	2.36^a	CADB
3	Smoky	2.95^a	2.15^a	3.23^a	2.85^a	BDAC
4	New (><mouldy)	5.36^{ab}	5.71^b	4.41^{ab}	4.11^a	DCAB[*]
5	Flavour	5.07^{bc}	5.58^c	3.98^{ab}	3.00^a	DCAB[*]
6	Jasmine-like	3.15^a	3.16^a	2.82^a	3.27^a	CABD
7	Rosy-like	1.69^a	1.84^{ab}	2.97^b	4.52^c	ABCD[*]
8	Young green rice	3.85^b	5.50^c	2.85^{ab}	2.17^a	DCAB[*]
9	Green herb-like	3.5^a	3.28^b	3.75^a	3.25^a	DBAC
10	Fermented	2.02^{ab}	1.31^a	2.71^{ab}	3.12^b	BACD[*]

The most different are shown between rose and young green rice scent. Tan Cuong tea's rose scent are weaker but *young green rice* scent are stronger. This brought in proposal that Tan Cuong teas are processed at higher temperature in compare to Phu Ho. This processing at high temperature create *young green rice* scent, but also reduce flowery in tea (and to Kim Tuyen tea, the most specific flower scent is *rosy-like*)

With the attributes *Sour, Fermented, New*, and *Flavour*, products of two regions are distributed on two sides, though media products are not discriminated in term of statistics. For example, new tea aroma, PKH1(4.41) belong to 2 groups a (PKH1:4.11) and b (TKH2: 5.71). Regional differences require more experiments upon increasing number of sample to restring then. However upon those experiments that took place, Tan Cuong has a higher trend about *New, Flavour* and a lower trend about *Sour* and *Fermented*.

Thus, in conclusion, theses differentials aroma attributes such as *Sour, Fermented, New, Flavour, Rosy-like* and *Young Green Rice*, is the distinguishing characteristics of the tea Tan Cuong, which express the difference in production technology, also in quality intrinsic of tea leaf.

3.2.3. Taste

Among taste attributes, the most related to geography origin and tea grade [7] is hardly differentiated by Anova analysis. However, PCA results show that Tan Cuong tea has a higher trend on astringent, bitter and umami (*Figure 2*). The difficulties of regional differentiation in taste attributes could be caused by polyphenol compounds, causing bitter and astringent (which are not favorable by consumer) in green tea. Indeed, this compound is difficult to evaluate on sensory analysis, especially when number sample are many [8]. This situation allow an understanding for the confusion of origins of tea product in the market, as the regional related attributes is very hard to distinguish, especially to mass consumers.

Table 4: Average values of taste attributes of brewed tea

No	Attribute	TKH1 (A)	TKH2 (B)	PKH1 (C)	PKH2 (D)	Order of evaluation
1	Astringent	4.25^a	3.26^a	3.5^a	3.53^a	BCDA
2	Bitter	5.50^a	4.66^a	5.03^a	5.10^a	BCDA
3	Sweet	4.38^a	4.48^b	4.41^a	4.15^a	DACB
4	Umami	3.58^{ab}	4.15^b	3.01^a	3.68^{ab}	CADB
5	Recurring Sweetness	4.34^a	4.13^a	4.29^a	4.29^a	BCDA
6	Less sweetness after tasting	3.85^a	4.52^a	3.44^a	4.13^a	CADB

In summary, we do analysis PCA for all characteristics group: color and appearance, aroma and taste. PCA results including all attributes of liqueur are shown on below diagram. Axis 1 shows 16% information ratio is linked with attributes: *Rose-like, Over-fired, Fermented, Bright, Sour*. Axis 2 with 14% information ratio show information of attributes: *Flavour, New, Green herb-like, Young Green Rice, Astringent, Bitter* and *Umami*. Products, thought are not divided in to two different regions, Tan Cuong products are close to each other and tend to be nearly to Axis 2. It means that Tan Cuong tea products have higher intensity of attributes *Flavour, New, Green herb-like, Young green rice, Astringent, Bitter* and *Umami*.
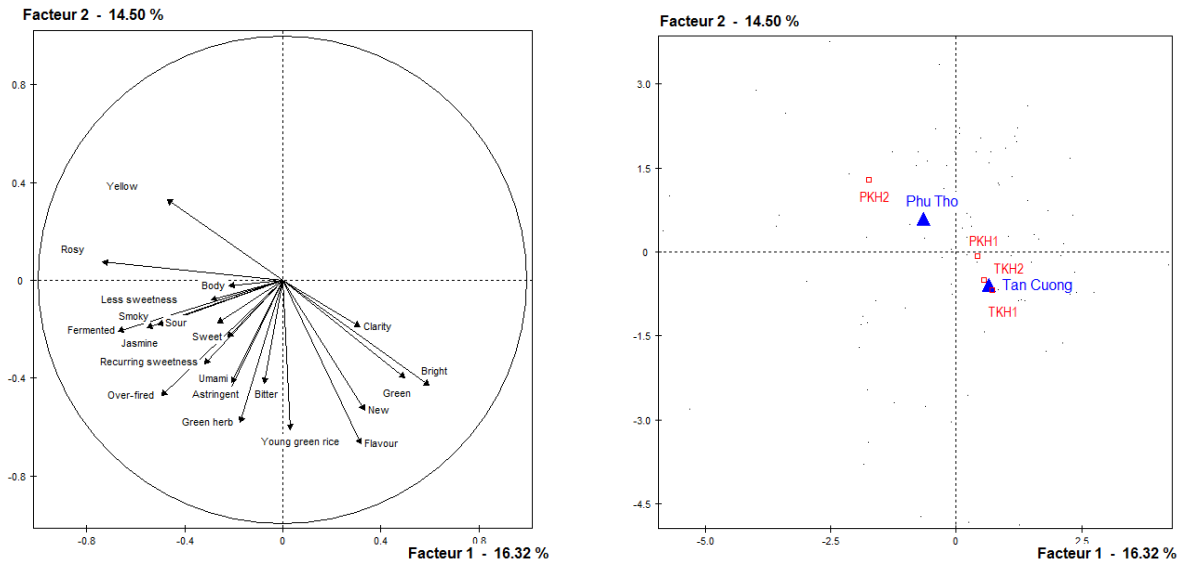
Figure 2: PCA analysis on brewed tea

PKH2 products lies differentially and was characterized by *Yellow*, meanwhile other product TKH1, TKH2 and PKH1 are nearer about *Green* and *Bright*. Besides, appearance and color of green tea are affected mainly by technology process. PKH1 products have a defining characteristic of color and appearance closer to Tan Cuong products, which gives out a proposal that Phu Tho tea also have a good production procedure to reach a similar quality of Tan Cuong product in terms of color and appearance.

3.3. Brewed leafs

Similarly, we did analysis brewed leaf on the attributes *Coppery, Soft, Bright, Green, Grade*. Results show Tan Cuong tea has lower intensity of copper color, leaf are smaller however has a higher intensity of bright, green and soft in compare to Phu Tho tea. This result is equal to results of experiments which has been taken place on dry tea of previous parts.

Table 5: Average values of attributes of brewed leaf

No	Attribute	TKH1 (A)	TKH2 (B)	PKH1 (C)	PKH2 (D)	Order of evaluation
1	Coppery	1.52^a	1.77^a	3.26^b	4.47^c	ABCD[*]
2	Soft	6.72^b	6.90^b	3.84^a	2.95^a	DCAB[*]
3	Bright	6.11^a	5.38^a	5.23^{ab}	3.90^b	DCBA[*]
4	Green	6.86^a	6.49^a	5.05^c	3.07^b	DCBA[*]
5	Grade	4.19^c	2.69^b	7.22^a	6.85^a	BADC[*]

4. Conclusion and recommendation

Hence upon observation of dry tea, tea infusion and infused leaf, Tan Cuong tea products are different significantly from Phu Ho tea products.

Observation below PCA analysis of all attributes, we see – axis 1 shows 27.48% information ratio, reflect majority of attributes of dry tea and infused leaf, axis 2 shows 9.66 information ratio, replect attributes of aroma and taste.
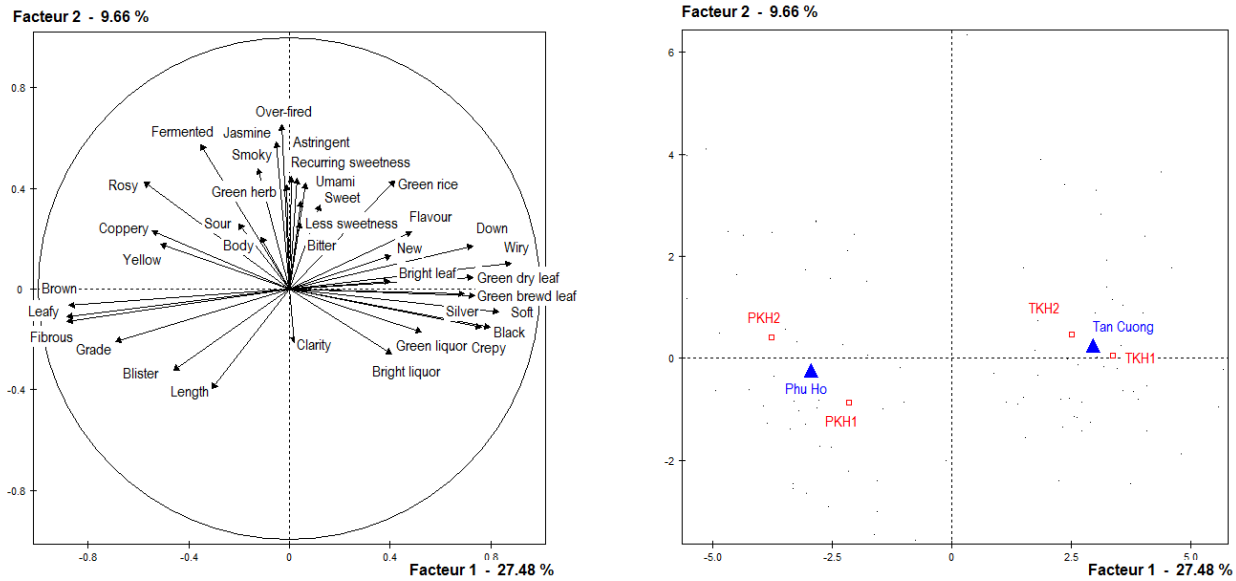

Figure 3: Synthetic PCA analysis on dry tea, brewed tea and brewed leaf

Experiments shows availability of differentiation of products of Kim Tuyen tea of Tan Cuong and Phu Ho products on almost of attributes of dry tea and brewed leaf. At a same picking level (one bud, two leave), Tan Cuong tea has a better evaluation than Phu Ho one's. However larger experiments are needed, with a bigger number of products and giving out a great significant affirmation about regional difference.

To tea infusion, Tan Cuong and Phu Ho tea are discriminated on attributes *Sour, Fermented, New, Flavour, Rosy-like* and *Young green rice*. Of a same type (one bud, two leave) tea, Tan Cuong tea was well-cultivated in order to give a better flavour. La transportation of fresh tea leaf in Tan Cuong is better so that tea will be less fermented. And in terms of processing, Tan Cuong has a specific way of processing, which is use higher firing in order make a stronger scent of young green rice but weakening scent of rose in compare to Phu Ho tea.

In general, the study has shown difference of processing technological between two regions, but those inherent differences were not shown profoundly. We recommend analysis at professional judges to make a deeper study on these attributes.

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