International Journal of Multidisciplinary Research and Development

Volume :2, Issue :4, 366-369
April 2015
www.allsubjectjournal.com
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 3.762

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The change ability of the teaflavans and tearubigines in the production of georgian black tea

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Abstract
The nature of transformation of teaflavans and tearubigins of Georgian black tea during fermentation was investigated. To evaluate the control of the fermentation process the methods of depth of oxidation of phenol compounds and the index of teaflavans / tearubigins are considered.
It is shown that in the depth of oxidation of phenol substances the maxima of intensity of the color of infusion observed in the fermentation of semi-manufactured goods at fermentation of the leaf during 150-180 min - for the first fraction of the first twisting and 180-210 min - for the third fraction of the third twisting. With increasing duration of fermentation increases the content of teaflavans and tearubigins and reaches maximum over 3 hours.
The ratio of absorbance of optical density E380 / E460 at a wave length of 380 nm for teaflavans and tearubigins are respectively 1.7-2.3 and for the first fraction - 1,9-5,5 - for the 1st fraction of the first twisting and 1.7-2.5 and 2,8-8,0 – for the third fraction to the third twisting.
The optimum duration of fermentation corresponding to the maximum percentages of teaflavans and tearubigins and minimum values of their relations, respectively, 1 :(8,38-8,87) - for the first fraction and 1 :(7,90-8,04) - for the third fraction .
Both methods of control of the fermentation process of tea considered by us can be a supplement to the organoleptic methods of estimation of black tea.

Keywords: black tea, fermentation, teaflavine and tearubigine, semi-finished product, the intensity of the infusion, organoleptic evaluation.

1. Introduction
Formation of quality of tea as a tasty product occurs during biochemical reactions occurring in tea leaves as a result of (ferment) enzymatic oxidation of the extractive complex. An important part of extractives substances of both a tea leaf, and ready- made tea is a complex of phenol compounds, or so-called tea tannin, from the depth of oxidation of which depends not only the organoleptic quality indicators, but also the physiological value of the drink. Biological conversion of phenol compounds is the basis of technology for production of fermented products (black, red and yellow tea).
Despite the fact that the production of fermented tea, specifically the black one, has a sufficiently large history, the nature of the basic compounds of semi-finished products and the ready product –polyphenols, are not yet fully established. All studies on these compounds were based either on the raw material, or on their quantitative conversion during processing.
Proceeding from this, there was a misconception about getting black tea only on the basis of quantitative transformations, while obviously it is clear a very big difference between raw materials and finished products. From this it follows that the production of black tea is mainly based not on the quantitative but on qualitative variability of tannins.
The study of nature of poly-phenol compounds of finished products of black tea began relatively recently. The main problem was to elucidate the nature of the products obtained as a result of transformations containing catechins in tea leaves and their influence on the quality of the finished product. In this regard it should be noted the works carried out by E. Roberts and his co-workers [1-4], L. Yutaz and G. Branderberg [5], Britton [6].
They also proved that saturation and color of the infusion of black tea are caused almost exclusively by two groups of substances of poly-phenol nature: teaflavane (TF) and tearubigine (TR) (Fig. 1 and 2).

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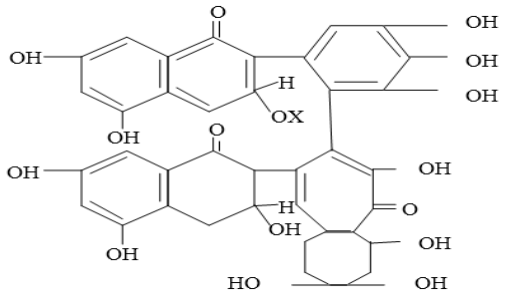

Fig 1: Teaflavan

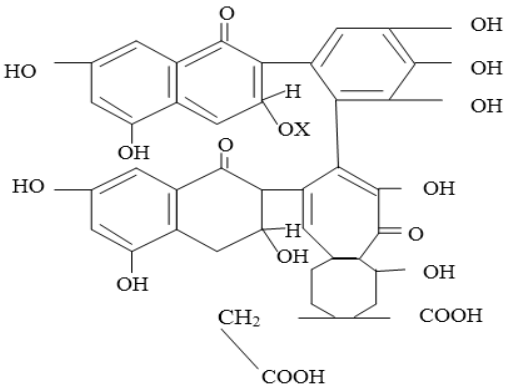

Fig 2: Tearubigineee

The latter especially plays an important role in formation of aroma, taste and staining of tea infusion. They are colored end products of condensation of tea poly-phenols – of gallocatechin gallate and epigallocatechin gallate. During fermentation of tea as the depth of oxidation of phenol substances the amount of thearubigines gradually increases while reducing the content of theaflavanes.

According to the given data in the top-quality Indian black tea the correlation of teaflavanes to tearubigine is 1:10 [8]. For Georgian black tea such data are not available. There is not also firmly established relationship between the depth of oxidation of phenol compounds with organoleptic indices of the finished tea.

Materials and Methods

For material investigation served a graded tea leaf (3-4 sheeted flushes) in July and August picking.

Were studied the samples of semi-finished products of black tea of the 1st fraction twisting and the third fraction of twisting after the 3 rd twisting. Analyses of the first fraction were carried out immediately after the first twisting, and the following - after 2.5 hours and after fermentation - every 30 minutes. The first analysis of the third fraction was carried out after the third twisting and subsequent - every 30 minutes.

The intensity of coloring was measured on a colorimeter-nephelometer Feck-56 at the wave length of 400 nm. It was established that high concentration affects the intensity of the tea extract, and so the extract was diluted with water. 1: (2-4).

Spectral characteristics of infusions of green and fermented tea leaves were taken at intervals of the wavelength from 400 nm to 750 nm for the first fraction of the 1-st twisting and the third fraction of the 3rd twisting on the spectrophotometer SF 4.

Number of the oxidative material was studied by the permanganate method [9] and number estimation (semi-ranking point) of semi-finished black tea - by tasting.

Definitions of teaflavans and tearubigins were performed according to index of optical density of the tea extract at the wave length of 380-460 nm [9]:

For the test tea extract was prepared the extract from 9 g of fermentable tea, which was placed in an Erlenmeyer flask and extracted with 375 ml of boiling distilled water. Extraction was carried out during 10 minutes while maintaining the internal temperature inside the flask not lower than 85 ^{0}C.

Results and Their Discussion

On the basis of the experiments were established:

- maximum absorption of infusion and fermented extracts of green tea leaves are in the near ultraviolet region from 360-380nm, then starting from 400 nm absorbance of the extract is gradually reducing to zero in the near infrared region (700-750nm) (Fig. 3).

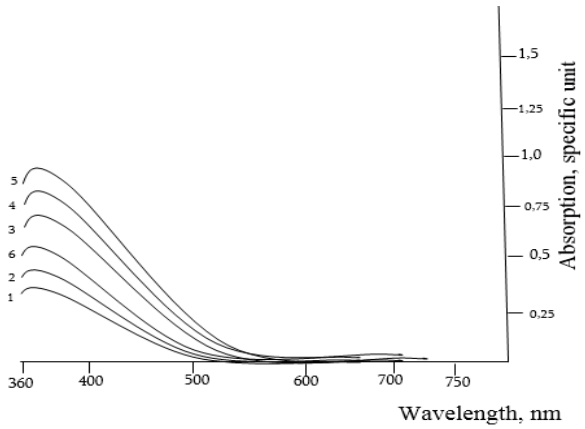

Figure 3. Dependence of absorption is highly fermentable tea leaves. Green leaf (1), the fermentable sheet after 45 minutes (2), 180 m (3), 210 min (4), 240 min (5), 270 min (6)

-as far as continuation of the fermentation process, the color intensity for the first fraction of the first twisting, as well as for the third fraction of the 3rd twisting, increases, and the quantity of generally oxidized material decreases. The intensity of the oxidation process can be judged by the color change of infusion of half-finished tea, reaching its maximum after twisting from the moment of twisting for the first fraction of the 1st twisting through 2.5-3 hours, for the third fraction after third twisting through 3.5-4 hours, then the color intensity for some time remains almost unchanged, and further for the first fraction increases slightly again, and for the third fraction is going down (Tab.1 and 2).

Teas having the best quality are fermented during 150-180 minutes from the start of twisting for the first fraction and 180-210 min - for the third fraction. With these limits of fermentation coincide maxima of coloring intensity and appropriate amounts of generally oxidized materials (Tab. 3 and 4).

Table 1. Changes in the intensity of the half-finished black tea infusion, depending on the duration of fermentation (for the first fraction of the 1st twisting)

#	Fermentation duration, min	Intensity of coloring at dilution of the extract 1: 2 (optical density)	The amount of oxidized material, ml 0,1 N $KMnO_4$ / g of the dry substance
1	Green leaf	0,41	46,0
2	45	0,91	25,6
3	150	1,14	21,2
4	180	1,20	19,8
5	210	1,22	18,8
6	240	1,23	17,0

Table 2. Changes in the intensity of half-finished black tea infusion depending on the duration of fermentation (for the third fraction of the third twisting)

#	Fermentation duration, min	Intensity of coloring at dilution of the extract 1: 2 (optical density)	The amount of oxidized material, ml 0,1 N $KMnO_4$ / g of the dry substance
1	Green leaf	0,41	46,0
2	45	0,80	22,4
3	180	1,03	17,0
4	210	1,12	16,0
5	240	1,12	14,7
6	270	1,04	14,2

Table 3. Dependence of development of infusion color, generally oxidized materials and taster ranking point of half-finished ranking point of black tea for the first fraction of the 1st twist

#	Fermentation duration, min.	The color intensity (optical density)	The amount of the oxidized material, ml 0,1 N $KMnO_4$ / g of dry substance	Ranking point of the half-finished tea		
				Color of infusion	Aroma	Taste
1	0	0	0	–	–	–
2	45	0,50	20,4	Average	2,75	2,75
3	150	0,73	24,8	Strong	3,0	3,0
4	180	0,79	26,2	–	3,0	3,0
5	210	0,81	27,2	Above average	2,75	2,75
6	240	0,81	29,0	Average	2,75	2,75

The relation of the value of optical density E380 / E460 at 380 nm lies for teaflavans within 1,7 ÷ 2,3 for the first fraction and 1,7 ÷ 2,5 for the third fraction. Ratio E380 / E460 for tearubigin within 1,9 ÷ 5,5 of the first fraction and 2,8 ÷ 8 for the third fraction. The maximum value of this relation occurs at the end of the first twist for the 1st fraction and at the end of the third twist for the third fraction, but minimum - after three hours from the start of twisting.

Table 4. Dependence of development of color infusion, generally oxidized materials and half-finished taster ranking point of black tea for the third fraction of the third twisting

#	Fermentation duration, min.	The color intensity (optical density)	The amount of oxidized material, ml 0,1 N $KMnO_4$ / g of the dry substance matter	Ranking point of the half-finished tea		
				Color of infusion	Aroma	Taste
1	0	0	0	–	–	–
2	45	0,39	23,6	Weak	2,25	2,25
3	180	0,62	29,0	Above Average	2,5	2,5
4	210	0,71	30,0	Average	2,5	2,5
5	240	0,71	31,7	Average	2,25	2,25
6	270	0,63	31,8	Below average	2,25	2,25

- With increase of duration of fermentation increases content of teaflavans and tearubugins and reaches its maximum after 3 hours from the moment of the start of twisting after which is marked their going down (Tab. 5 and 6).

Table 5. The dependence of the content of teaflavans and tearubigins and their ratio E380 / E460 with a ranking point of half-finished black tea for the first fraction of the 1st twist

#	Fermentation duration, min.	TF, %	E_{380}/E_{460} for TF	TR, %	E_{380}/E_{460} for TR	TF/TR	Ranking point of the semi-finished tea		
							Color infusion	Aroma	Taste
1	45	0,46	2,23	0,99	5,50	1:2,15	Average	2,75	2,75
2	150	0,62	1,70	5,50	2,35	1:8,87	Strong	3,0	3,0
3	180	0,68	1,20	5,70	1,90	1:8,38	Strong	3,0	3,0
4	210	0,52	2,06	2,20	2,20	1:4,23	Above average	2,75	2,75
5	240	0,36	2,30	1,70	4,40	1:4,72	Average	2,75	2,75

The quality are the best examples of semi-finished tea fermented during 150-180 minutes after twisting from the moment of twisting for the first fraction and 180-210 min - for the third fraction. These limits correspond to the maximum fermentation percentages of teaflavans and tearubigins and minimum values of their relation (1: (8.38-8.87) - for the first fraction and 1: (7.90-8,04 - for the third fraction), i.e. we have considered both methods of control of the fermentation process of tea (depth of oxidation of phenol substances and the indices of relation teaflavans / tearubigins) are well correlated with quality of the finished product.

Table 6. Dependence of the maintenance and teaflavan /tearubigin and their ratio E380 / E460 with a ranking point of half-finished black tea for the third fraction of the third twisting

#	Fermentation Duration, min.	TF, %	E_{380}/E_{460} for TF	TR, %	E_{380}/E_{460} for TR	TF/TR	Ranking point of the semi-finished tea		
							Color infusion	Aroma	Taste
1	45	0,40	2,03	0,77	8,0	1:1,92	Light	2,25	2,25
2	180	0,56	1,80	4,50	2,8	1:8,04	Above average	2,75	2,75
3	210	0,41	2,00	3,24	5,0	1:7,90	Average	2,5	2,5
4	240	0,39	1,70	1,30	5,4	1,3,33	Average	2,25	2,25
5	270	0,38	2,42	1,30	6,4	1:3,42	Below average	2,25	2,25

Conclusions

- There is a direct correlation between the development of the color of infusion during fermentation of the tea leaf, by total oxidation of the material and quality of tea.
- Oxidation products of phenol compounds (teaflavans and tearubigins), conditioning the color and strength of brew tea, undergo quantitative changes during fermentation, and the maxima of their accumulation are in a certain correction to the quality of tea: the smaller the ratio of the optical density of the E360 / E460 for tearubigin the better quality of black tea.
- Relation of teaflavans to tearubigins for best qualitative Georgian tea is on the average 1: (8-9) that corresponds to the optimum of duration of fermentation of 150-180 min for the tea leaf of the first fraction of the 1st twisting and 180-240 min for the third twisting. These factors can be objective in establishing the quality of black tea and addition to the organoleptic evaluation methods.

References

1. Roberts E.A.H. J "Sci. Food and Agric "1958, No 9:381
2. Roberts E.A.H. In "The chemistry of flavonoid Compounds", Pergamon Press 1962:468.
3. Roberts E.A.H.Myers M. J "Sci. Food and Agric. ", 1959, No 10:172.
4. Roberts E.A.H.Myers M. J "Sci. Food and Agric. ", 1959, No. 10:167.
5. Viats L., Branderberger H. J "Chromotography", 1961 No 5:17.
6. Britton T. Biochemistry of natural pigments. Trans. from English. M: 1986 (in Russian).
7. Roberts E. Evaluation of quality teas by chemical analysis. Biochemistry of tea production, v. 9.M. Publishing House of the USSR Academy of Sciences, 1962 :148-157 (in Russian).
8. Pochlebkin V.V. Tea, its types, properties, use .M: 2008 (in Russian).Popov V.R, Shlipakova L.Y. Determination of oxidation products of catechins in black tea infusion. “Biochemistry and advanced technology of the tea production”.M:1966 (in Russian)
9. Melkadze R. Fermentation of tea. Germany-Saarbruken,“Palmarium-publishing”, 2012:90