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Crude fibre as a parameter in the quality evaluation of tea

Maria Śmiechowska *, Przemysław Dmowski

Department of Commodity and Cargo Sciences, Gdynia Maritime University, Morska Street 83, 81-225 Gdynia, Poland

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Abstract

Tea is one of the oldest beverages known to mankind. Its quality is determined, among other things, by aroma and taste properties. We have paid attention herein to the fact that crude fibre is an important parameter in the quality evaluation of tea and influences its sensory properties. The elucidation of role and meaning of crude fibre in tea is attempted in this paper; therefore its content in tea from various places of origin has been determined. A significant correlation between crude fibre content and tannins content of tea samples was found ($R^2 = 0.72$).

Keywords: Black tea; Crude fibre; Tannins

1. Introduction

Crude fibre in plants originates from certain structural units: cellular walls, sklerenchyma, kolenchyma, and transporting tissues. Young cells have thin cellular walls that become harder as the plant grows and provide the plant with protection from wind, excess transpiration and influence of other undesirable factors (Strasburger, 1962).

Fibre is composed of many different compounds, in particular cellulose, hemicellulose and wood-wool. Most of them are polysaccharides, with the exception of wood-wool, which is a hydrocarbon. The content of crude fibre in young tea leaves is much less than in older ones. The fundamental (and one of the older) definitions of crude fibre states that it is the residue after treating with boiling 0.255 N sulfuric acid and 0.313 N sodium hydroxide (Bartnikowska, 1997).

2. Materials and methods

The study material was tea imported to Poland by sea from China, India and Malawi. The contents of dry mass (ISO 1573-1980) and crude fibre were determined in black tea samples with general method (ISO 5498-1981). First, a sample of tea was boiled in 0.255 M sulfuric acid solution for 30 min, then the insoluble residue was filtered and washed. The obtained substance was subsequently boiled in 0.313 M sodium hydroxide solution, filtered and washed. A sample thus prepared was dried for 2 h in the oven at 130 ± 2 °C. Finally, mass loss was determined after ashing at 350 ± 25 °C. The content of crude fibre in the tea sample was calculated in mass percent relative to the content of dry mass in the product.

The determination of tannins was done by a method based on formation of insoluble tannins salts with copper(II) cation. This includes extraction of tannins with boiling water, followed by precipitation with copper(II) acetate and filtering after 12 h. The final precipitate was dried to constant mass. The content of tannins was calculated from a proportion, considering the quantity of copper taken for analysis and quantity of copper(II)

* Corresponding author.
E-mail address: smiemari@am.gdynia.pl (M. Śmiechowska).

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oxide bound by tannins (Cisowski, Dembińska-Migas, Gill, & Łuczkiewicz, 1995).

3. Results and discussion

The tea imported to Poland is primarily black tea, because the demand for it is the greatest. In the 1990s a change in the structure of tea import occurred. More often, tea from new regions of harvesting, e.g. from Africa, reaches the market, which is determined mainly by economic factors. Tea originating from these new regions is little known. Information about its composition and quality factors is lacking.

One of the parameters described in quality norms is crude fibre content. The content of crude fibre in examined tea samples is shown in Table 1.

Quality requirements for black tea state that crude fibre content should not exceed 16.5% (ISO 3720-1997). From the data collected in Table 1, it appears that, on average, the least crude fibre was contained in tea from China, whereas the highest content of it was found in the raw material from Malawi. Moreover, the content of crude fibre in tea samples from Malawi ranged very dramatically from 5.83% to 43.27% (Fig. 1). Totally, 30% of tea samples from India and Malawi examined in this work did not meet the requirements of the norm and contained more than 16.5% of crude fibre.

Papers concerning the content of crude fibre in tea are rather scarce in the subject literature. It seems, however, that this particular quality parameter allows the determination of tea "age". The younger the leaves tea is made from, the lower is the fibre content. In the so-called leafy teas, a significant content of fibre in the product may show that lower quality material has been used in the production (5th–6th leaf). High content of fibre in the material may also be a result of careless, mechanical harvest of tea, when the yield contains not only leaves but also stems. In turn, in tea produced by the crushing-tearing-curling (CTC) method, it is difficult to determine which leaves on the branch were used in its production, because the CTC technology destroys the structure of the leaf.

In the subject literature, the influence of different factors on the crude fibre content was also examined. Venkatesan and Ganapathy (2004) studied the effect of NK fertilization on the content of crude fibre and other

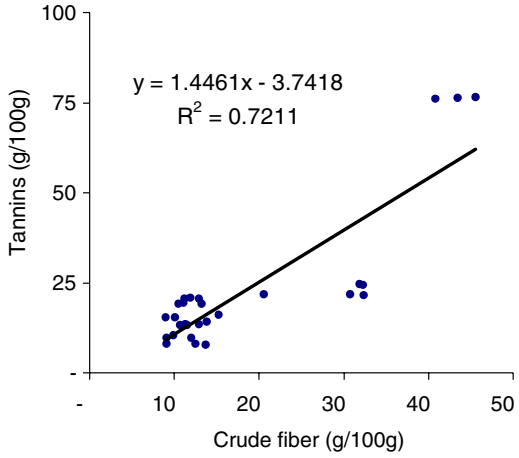

Fig. 1. The relation between crude fibre and tannins content in examined black tea.

parameters. They reported that crude fibre is more abundant in tea supplemented with higher doses of potash: non-fertilized tea contained 15% crude fibre, whereas tea fertilized with 300 kg N and 375 kg K/ha/year contained 15.6% of it. Özdemir, Gökalp, and Nas (1993), in turn, examined the content of crude fibre depending on tea shooting period and processing systems. They showed that Turkish tea contained 12.17–17.19% crude fibre. Black tea, from an early shooting period, contained more fibre than tea from later periods. There was a very significant ($P < 0.01$) correlation ($r = 0.69$) between the fibre content of harvested fresh green tea and processed black tea. They additionally proved that the leaf processing method (traditional, CTC, Rotorvane) influences crude fibre content.

In previous work on the quality of tea from various countries, the authors of this paper found a diversified content of tannins (Śmiechowska, Przybyłowski, Dmowski, & Newerli-Guz, 2003).

In the previous work, the highest quantities of tannins were determined in tea samples from Malawi (32.85%), whereas the lowest were in Chinese tea (7.65%) (Table 2). Although, the content of tannins was low, the infusions were characterized by intense acrid taste, which might be caused by the presence of organic acids and tannin compounds. Tea derived from older leaves is also characterized by strong, acrid, astringent taste.

Table 1
Crude fibre content in black tea (g/100 g)

Country of origin	*n*	Range	$\bar{x} \pm$ SD	Median
China	10	10.96–12.92	11.49 ± 0.89	11.29
India	12	9.56–27.89	15.24 ± 7.91	12.26
Malawi	12	5.83–43.27	21.08 ± 15.70	14.50

n, no. of samples; $\bar{x}$, mean value; SD, standard deviation.

Table 2
Tannin contents in black tea (g/100 g)

Country of origin	n	Range	$\bar{x} \pm$ SD	Median
China	10	0.79–19.4	7.65 ± 5.25	8.04
India	12	7.97–24.4	16.4 ± 6.00	17.3
Malawi	16	12.1–76.5	32.9 ± 20.6	24.0

n, no. of samples; $\bar{x}$, mean value; SD, standard deviation.

A very diverse content of tannins in teas from various places of origin is quoted in the literature. Atoui, Mansouri, Boskou, and Kefalas (2005) determined tannin contents in Ceylon and Chinese tea to be 847 ± 8.89 and 1216 ± 32.0 mg/cup, respectively, expressed as gallic acid, which corresponds to 28.2% and 40.5%, respectively. Feng, Tang, Jiang, and Fan (2002) determined tannin content in tea, by spectrofluorimetry, to be 8.16–15.7%. Yebra, Gallego, and Valcárcel (1995) detected 7.2–16.2% tannins in tea. In teas imported to Poland, the content of tannins ranged from 2.1% to 13.3% (Kudełka, 1996).

No research papers concerning the dependence between crude fibre content and the content of tannins and other compounds in tea were found in the available literature. Statistical analysis showed a significant linear correlation (at $P = 0.05$, $R^2 = 0.7211$) between the content of crude fibre in tea and the content of tannins (Fig. 1).

4. Conclusions

Different contents of crude fibre, ranging from 5.83 to 43.27 g/100 g, were found in teas imported to Poland by sea from China, India and Malawi. It has been shown that the tannin content in tea is statistically significantly dependent on the content of crude fibre. The application of crude fibre content measurement, as a diagnostic factor useful for determining the quality of tea, is proposed, especially for tea derived by the CTC method and for tea adulterated with older leaves and stems. In cut and crushed tea, the determination of its quality may be difficult, but it is, nevertheless, an important factor influencing its price on the market and in trade contracts.

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