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Preliminary quality/price analysis for some green and black tea types

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Abstract

Tea is the second most popular drink in the world, behind water. There is a lot of variety in terms of flavors and this lets the product to be adapted to a wider range of preferences. Thus, the goal of this study was to compare the quality of green and black tea from various firms in relation to the pricing of each product. This study required thorough price monitoring over a period of many months, as well as quality analyses such as relative humidity and ash content. For the gravimetric investigation, four tea types were used, with the first indicating the lowest price and the final being the most expensive. The price rise research was conducted between November 2022 and May 2023, with 28 samples drawn from each variety. All of these tests reveal a link between the price of a product and its quality; thus, when the relative humidity and ash content grew, so did the price, which became obvious over time.

Keywords: relative humidity, ash content, variable prices of tea

1.Introduction

Tea is on of the most widely consumed beverage globally thanks to its universal appeal, affordability, and numerous health benefits. It ranks as the second most popular drink, following water. The tea plant originally hails from Southeast China and gradually expanded its presence to the Indo-Pak subcontinent, Sri Lanka, and eventually into various tropical and sub-tropical regions [14].

Global tea production has experienced a substantial increase in the last twenty years. This can be attributed to various factors, including the growth of the global population, rising societal preference for tea as the beverage of choice, expansion in the tea cultivation area, enhancements in tea plant varieties through selective breeding (cultivars), the adoption of advanced technology, and improved farming practices [12].

China, India, Kenya, and Sri Lanka stand as the world's top four tea-producing nations.

Although China accounts for 28% of global tea production, its share in the international market is 18%, as approximately 70% of the tea it produces is consumed domestically. In the past decade, China has witnessed a notable rise in tea consumption [7].

The industry has created employment opportunities, with as many as 8 million workers employed in China, according to Groosman [6].

Increasing numbers of people are enjoying tea in many different situations from formal meetings to informal gatherings. Various tea varieties are created through different levels of oxidation in the manufacturing process. Black tea undergoes complete oxidation, green tea remains unoxidized, and oolong tea falls in between as semi-oxidized [8]. Individuals of various age groups relish tea as a beverage [16, 20], and approximately two-thirds of the global population partakes in tea consumption in some form as their "morning drink" each day [15].

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Tea's popularity has been on the rise due to increasing consumer awareness of its health benefits and medicinal value, as evidenced by research findings [4, 5, 10, 12, 19].

Consequently, tea is now readily available in most supermarkets, health and natural food stores, pharmacies, large retail chains, as well as in tea and coffee establishments worldwide. New tea brands and tea-related products emerge regularly on a global scale, and pharmaceutical items based on tea continue to be in constant development [15].

Being a biomass primarily composed of lignocellulose, tea residues consist of cellulose, hemicellulose, lignin, polyphenols, proteins, and tannins [1].

The primary bioactive compounds found in tea encompass polyphenols (such as catechins, flavonoids, and proanthocyanidins), methylxanthines, alkaloids (caffeine, theophylline, theobromine), vitamins, minerals, terpenoids, pigments, amino acids, and polysaccharides [17, 18].

In general, based on the level of fermentation and the processing methods, tea can be categorized into non-fermented tea (green tea), lightly fermented tea (white tea), lightly fermented tea (yellow tea), semi-fermented tea (oolong tea), fully fermented tea, and post-fermentation tea (dark tea).

Protein from tea residue and its enzymatic hydrolysate exhibit biological activities, including antioxidative, hypolipidemic, and hypoglycemic properties. These can be utilized in the creation of natural blood pressure-reducing peptides [11]. The dietary fiber in tea residue is abundant in bound polyphenols, the primary constituents of dietary fiber with anti-hyperglycemic properties. Moreover, the synergistic interplay between dietary fiber and bound polyphenols can regulate intestinal dysbiosis by promoting the growth of beneficial bacteria and restraining harmful bacteria. As a result, tea residues can be harnessed in the development of functional foods aimed at reducing blood sugar levels and enhancing digestive health [9, 2].

2.Materials and methods

In order to perform quality as gravimetric indices analysis, we chose four types of green and black tea that were subjected to the study. Teas were numbered as follows: sample 1 - Fares green tea, sample 2 - Dacia Plant slimming tea, sample 3 - Alevia tabieturi, sample 4 - Masala Chai, being numbered in ascending order of market price. Seven samples were taken from each sample, giving a total of 28 samples. For the determination of dry weight, the samples were placed on paper in order to avoid errors and placed in the oven (Sauter model) for one hour. After one hour the samples of the four samples were removed from the oven and weighted again. Determination of relative humidity was carried out using the formula (1).

$$RH(\%) = \frac{(FW-DW)}{DW}\ x\ 100 \qquad (1)$$

Where FW – fresh weight of sample in grams,
DW – dry weigh of sample in grams.

For the determination of ash content, the dried samples were placed in ceramic containers and placed in the calcining furnace (Naberthern) for two hours. After the two hours the samples were removed from the furnace and allowed to cool and then reweighed to identify the amount of ash, in grams. Data for this study were gathered over several months, from November 2022 to May 2023. This price development data was gathered from 12 distinct locations for 12 different tea kinds. The costs were obtained from pharmacies and hypermarkets, both in real and online formats.

3. Results and Discussion

By gathering data on both the ash content and the relative humidity, a comparison can be formed with the gathering of data on the product's pricing, which varies greatly from one sort of tea to the next. The goal of this study is to demonstrate the quality-price ratio for four different types of teas, with the price being high, thus sample 1 is the cheapest and sample 4 is the costliest. Thus, the smallest point for relative humidity is found in assortment I, which is 5.3933%, while the maximum point is found in assortment IV, which is 11.6697%. The minimum point for ash content is likewise found in assortment I and is equal to 0.4205 g, while the highest point is located in assortment IV and is equal to 1.1587 g.

Figure 1 depicts the assortment's lowest and greatest relative humidity points, as well as relative humidity averages. The minimum point for assortment I is 5.393359%, the highest point is 5.7467%, and the average of the values is 5.5494%. The maximum point for assortment II is 10.2176%, and the smallest point is 8.0108%, with an average of all values for this assortment of 8.7426%. Assortment III has a lowest relative humidity of 7.7307% and a maximum relative humidity of 9.1871%, with an average of 8.2917%. The minimum point for assortment IV is 10.0469%, the maximum point is 11.6697%, and the average of the values is 10.9255%.

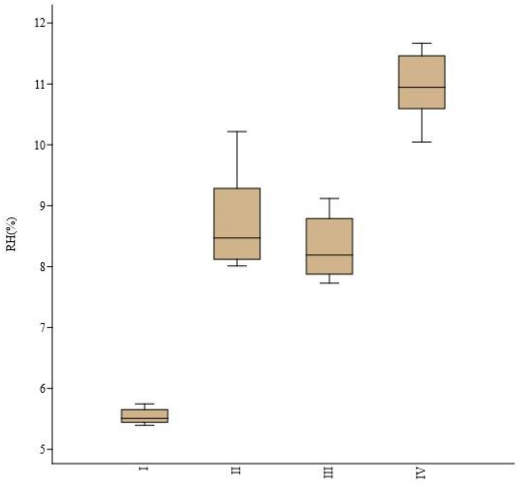

Figure 1. Variation of relative humidity depending on the studied tea type

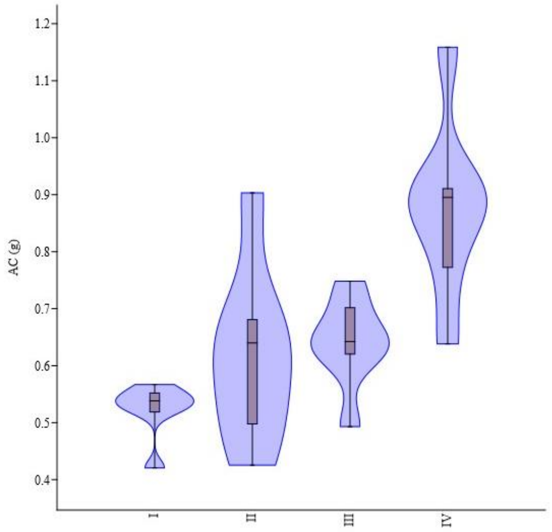

Figure 2. Ash concentration varies depending on the type of tea tested.

Figure 2 depicts the ash content of several tea types; therefore, assortment I has a minimum point of 0.4205 g and a maximum point of 0.567 g, with an average of the sample values of 0.5236 g.

The minimum point for assortment II is 0.4253 g, the maximum point is 0.9031 g, and the average of the values is 0.6172 g.

The smallest point for the assortment III is 0.4931 g, the maximum point is 0.7482 g, and the average of the values is 0.640414 g.

The average of the values for the assortment IV is 0.87734 g, with the smallest point being 0.6382 g and the greatest point being 1.1587g.

Table 1. Shapiro–Wilk test

		I	II	III	IV
RH	Shapiro-Wilk W	0,9133	0,8824	0,913	0,964
	p(normal)	0,4194	0,2375	0,4172	0,8524
AC	Shapiro-Wilk W	0,7677	0,9356	0,9293	0,9168
	p(normal)	0,01936	0,5998	0,5446	0,4448

The Shapiro test findings are shown in Table 1 for both relative humidity (RH%) and ash content (AC). The data distribution for RH(%) is normal, but not for AC, with the exception of assortment I, which has an aberrant distribution ($p<0.05$). Another test that was employed was the Levene test, which was used for both RH and AC.

Because the relative humidity result ($p=0.03347$) indicates that the data are not homogenous, the Welch test was also done, with $p=1.722E-10$, $df=10.91$, and $F=266.8$. Thus these results show a variation between samples and the lack of homogeneity is confirmed. Tukey's test is also used to determine whether groups are significantly different from one another, highlighting a difference between assortment I and assortment II, assortment I and III, assortment II and III, and assortment I, II, III, and assortment IV.

Table 2. Tukey`s test for RH

	I	II	III	IV
I		4,52E-10	9,37E-09	2,44E-14
II	15,52		0,412	6,05E-07
III	13,3	2,225		1,98E-08
IV	26,08	10,56	12,78	

The result of Levene's test for AC is 0.2195, indicating that the data are homogenous. The next test is ANOVA, with results ($p= 0.00009732$, $df= 3$ and $F=11.01$) indicating that there are at least two statistically different averages from the investigated groups. As a consequence of these findings, the Tukey's test is performed, which reveals significant differences across assortments I, II, III, and IV, indicating that assortment IV has the most varying ash content, therefore also the highest mineral content.

Table 3. Tukey`s test for AC

	I	II	III	IV
I		0,4766	0,2884	6,37E-05
II	2,064		0,9834	0,002424
III	2,575	0,5117		0,005866
IV	7,797	5,734	5,222	

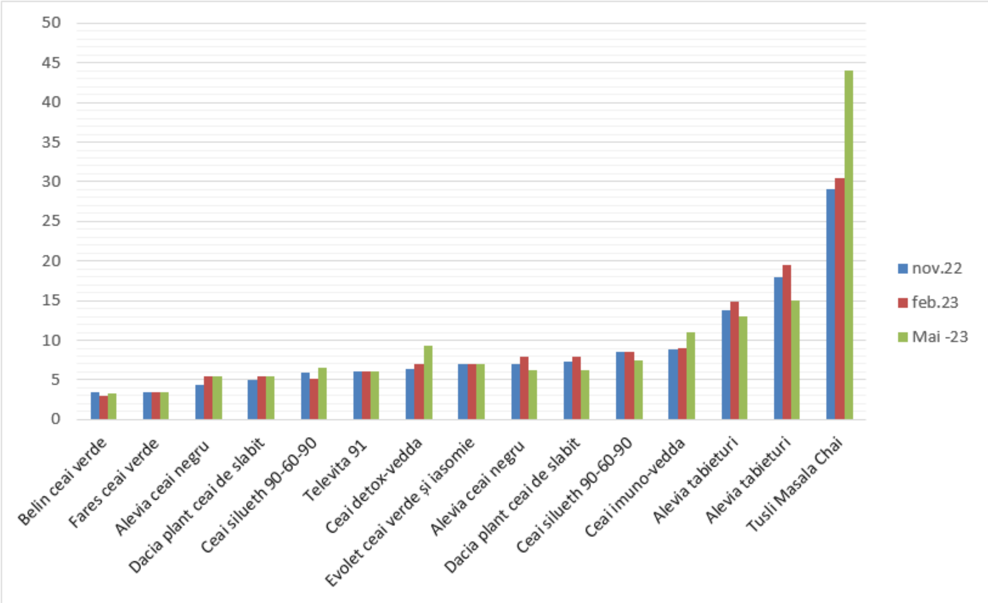

Figure 3. Analysis of the variation in tea prices from November 2022 to May 2023

Figure 3 depicts the growth of pricing for various types of tea, allowing a comparison to be formed between the amount of various tea varieties and the price increase. It can be notice a considerable increase in the Tusli assortment (44.75156 %), which is represented by the IV assortment in the above analyses, thus the price increase corresponds to both a high mineral content and the highest relative humidity. The Veldda range shows another major price rise (32.90415%), however there are also notable price drops in this graph, including the Dacia range (-21.2766%) and the Alevia range (-20.27883%). However, certain dorms, such as Evolet, maintain their prest constant. thus, the exponential growth of assortment IV can be seen in the last months represented in the graph by the green column, and the growth in the first months was 4.8295%

Thus these tests demonstrate the hypothesis that the price increases with the quality of the product. The increase in both the ash and mineral content as well as the relative humidity is very well highlighted in the IV assortment, which is also the most expensive

4.Conclusion

Along with the expansion in global tea consumption, production rose, and more and more firms emerged that make these two varieties of tea, so we can see a link between them and the progressive increase in prices after a basic price-quality study.

The IV assortment of tea had the highest ash content, as well as being the most expensive both at the beginning and end of the study, with the gradual increase in price being easy to observe. The reactive humidity was also higher in this type of assortment, with the assortment having a corresponding packaging for each tea bag. In short, there is a strong relationship between the price of a product and its quality. In this study, the quality of the tea increases with its price, which in turn increases over time

Conflict of Interest. Author has declared that no competing interests exist.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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