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QUALITY CHARACTERISTICS AND ACRYLAMIDE CONTENT OF COMMONLY SOLD COFFEE BRANDS IN KENYAN MARKETS

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ABSTRACT

Coffee, a globally cherished beverage, has diverse nutritional and health benefits. However, the composition of the beverage varies with each cup, influenced by factors such as bean type and the addition of ingredients. Acrylamides, known to be carcinogenic and genotoxic, are found in processed coffee beans, causing concern over its consumption. This study determined the levels of acrylamides found in the commonly sold coffee brands in Kenyan markets, alongside other quality characteristics. The study was conducted in Nairobi and Kiambu Counties, where different samples of local and imported coffee brands were purposefully obtained from each sub-county. The physicochemical characterization of coffee samples including moisture content, total ash, acid insoluble ash, water-soluble ash, alkalinity of soluble ash, water-soluble matter, petroleum ether extract, and the concentration of acrylamide, Fe, Zn, P, Ca, Mg, K, Na, and caffeine were analysed at the Department of Food Science and Technology, University of Nairobi. Obtained data was analysed using statistical software R. The results showed significant differences in acrylamide concentration (F (11, 156) = 4.86, $p < 0.001$), calcium content (F (11, 156) = 2.74, $p = 0.003$), magnesium content (F (11, 156) = 2.52, $p = 0.006$), and caffeine concentration (F (11, 156) = 4.47, $p < 0.001$) among the different coffee brands. However, no significant differences were observed for the other characteristics ($p > 0.05$). The means of moisture content was 5.8%, total ash 5.8%, acid insoluble ash 0.4%, water soluble ash 79.5%, alkalinity of soluble ash 3.4mg/L, water soluble matter 47.9%, petroleum ether extract 13.8%, and acrylamide concentration 0.071 µg/100g. The mean of Fe was 7.822, Zn 6.954, P 40.669, Ca 65.596, Mg 117.588, K 222.956, Na 4.663, and Caffeine content was 0.0832, all in mg/100g. Differences especially in the level of acrylamide across the brands is a major concern. The study highlights the need for quality control measures in the coffee industry to ensure consistent quality and safety for consumers. This can go a long way in empowering individuals with insights into their coffee's nutritional worth and potential effects on their wellbeing, safeguarding its quality and health benefits.

Key words: Coffee, Quality characteristics, Acrylamides, Coffee brands, Nutritional worth, well-being

INTRODUCTION

Global coffee intake transcends geographical boundaries, making it one of the most universally cherished beverages [1]. Its roots go deep into tropical and subtropical regions worldwide, where it assumes a pivotal role as a commercial crop. In Kenya, coffee takes centre stage, cultivated predominantly by smallholder farmers, with the Central Kenyan region reigning supreme in production [2]. The Kenyan Arabica coffee variety, renowned for its exquisite brewing qualities and commanding high prices, stands as a testament to the nation's coffee excellence. The unique combination of high altitude, fertile volcanic soils, and favourable climatic conditions contributes to the exceptional flavour profile of Kenyan coffee, condition that have also been observed elsewhere [3,4]. Smallholder farmers play a crucial role in Kenya's coffee sector, with an estimated 700,000 households involved in coffee cultivation [5, 6].

Amidst Kenya's burgeoning coffee consumption, a significant gap exists in general understanding of coffee's quality characteristics and the acrylamide levels within it [7]. Coffee, a brew known for its potential health benefits and minimal calorie count, contains many vitamins and minerals that can invigorate the body and mind [8,9]. However, the composition of the beverage varies with each cup, influenced by factors like bean type and the addition of ingredients such as cinnamon or milk. Beyond its nutritional profile, coffee also has antioxidants, promising a wealth of health benefits to its enthusiasts. Despite coffee being an indispensable global beverage with quality features and organoleptic characteristics guiding coffee enthusiasts worldwide [10], the presence of acrylamide remains a major threat within the brew [11].

Acrylamide associated with ovarian, renal, lung, and digestive system cancers [12, 13] underscores the urgency of this study. It is imperative to curtail the presence of this compound coffee and, by extension, in diets. Acrylamide was first discovered in food in 2002, with high levels found in heat-treated carbonate-rich foodstuffs, particularly when asparagine is present, and the Maillard reaction plays a significant role in its formation [14]. Acrylamide can be found in various food products, including French fries, potato crisps, bread, biscuits, cereals, baby biscuits, and coffee [15].

Coffee contains a significant amount of acrylamide and according to EC Regulations, reference values for acrylamide in coffee are 400 $\mu g\ kg^{-1}$ for roasted coffee and 850 $\mu g\ kg^{-1}$ for instant coffee [16]. The formation of acrylamide in coffee depends on the roasting conditions, with levels increasing rapidly at the beginning of the roasting process and then decreasing towards the end [17]. Light roasted coffee beans may contain higher amounts of acrylamide compared to dark

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roasted beans [18], because light roasted beans have higher moisture content, leading to more acrylamide formation during roasting. Various factors such as the species of the raw material, storage conditions, fermentation, and brewing methods can also affect the formation of acrylamide in coffee [18].

This study aimed to unravel the quality characteristics of different commercially traded coffee brands within Kenyan markets, and also to determine the acrylamides levels in different coffee brands. This study endeavoured to elevate the coffee experience for all, safeguarding its quality and health benefits, and highlighting its acrylamide threat. In Kenya, where coffee thrives as an essential cultural and economic cornerstone, this study aimed to make a significant contribution to the realm of coffee production, trade, and consumption. The study was driven by a commitment to safety within coffee beverages, with applications to other foods and drinks.

MATERIALS AND METHODS

Description of the study sites

The study was conducted in Nairobi and Kiambu Counties (Figure 1). Nairobi County hosts the country's political, commercial and industrial capital with its associated high number of coffee shops. The county has 27 divisions, 64 locations and 135 sub-locations. Administratively, the county is divided into nine sub-counties namely; Dagoretti, Embakasi, Starehe, Njiru, Kamukunji, Westlands, Makadara, Langata and Kasarani, of which five were selected for the study. A sub-population of Kiambu county namely New Gatukuyu which is among the highest coffee producing areas in Kenya was purposely selected for assessment of households where home prepared coffee is commonly consumed.

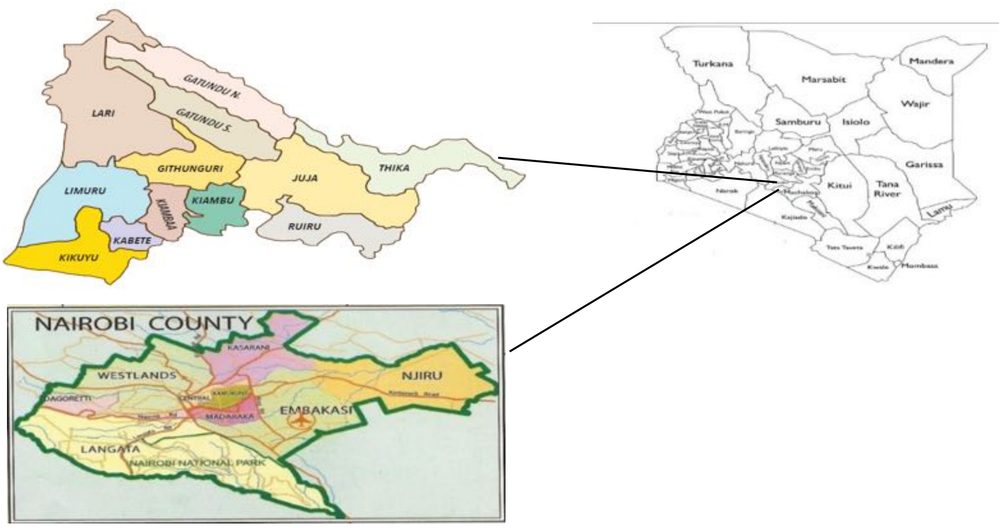

Figure 1: Map of Kiambu and Nairobi Counties where study sites were based
Source: Made by the author in QGIS

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Sample size determination
The sample size was determined in accordance with Fisher & Hall. [19]:

$$N = \frac{Z^2 pq}{d^2} \qquad n = \frac{1.96^2 \times 0.5 \times 0.5}{0.1^2} = 96$$

Whereby the required sample size (N) for the study depended on the desired level of confidence (represented by Z), estimated proportion of the population with the attribute of interest in this case being coffee brands (p), and desired margin of error (d). The complement of p (q) represents the estimated proportion of the population without the attribute of interest.

Proportionate distribution according to the population size reported by Kenya National Bureau of Statistic (2019) was used to determine the number of different local and imported coffee brand samples obtained from each constituency which included Starehe (210,423), Westlands (308,854), Makadara (189,536), Lang'ata (197,489), Kasarani (780,656) and New Gatukuyu (109,870). The samples were collected proportionally by population such that Starehe (12%), Westlands (17%), Makadara (11%), Langata (11%), Kasarani (43%) and New Gatukuyu (6%) translating to 11, 17, 10, 11, 42, 6 coffee samples respectively. The total number of brands evaluated was twelve (12).

Coffee samples for different ground and instant coffee were randomly purchased from local retail shops and supermarkets within the study areas in duplicates. The brands were biased towards the most commonly purchased types as well as the locally produced varieties, mainly Robusta and Arabica which are more conventional. These were then packaged in clean boxes and transported to the University of Nairobi, Department of Food Science Laboratories for analysis.

Determination of the physicochemical characterization of coffee samples

Water Activity
The water activity (a_w) of coffee samples was measured by a water activity measurement device with 0.001 sensitivity as described by Şenyuva & Gökmen [21].

Coffee granule size
Coffee granule size was analysed using a standard particle grind size category and denoted as fine grind, extra fine grind, coarse and medium coarse as per Kenya East African Standard; Roasted coffee beans and roasted ground coffee - Specification (KS EAS 105:2020).

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Texture Analysis
The texture of the coffee was determined as described by Budryn *et al.* [22]

Particle Density
The particle densities ($\rho_{particle}$) of coffee samples was determined using the pycnometer method. About 2.5g of sample was placed in an empty liquid pycnometer of 25 ml volumes. Toluene was then filled to volume. The density of the particles ($\rho_{particle}$) value was determined by the particle weight divided by the total volume (g/cm^3) as described by Şenyuva & Gökmen [21]

Colour measurement
The colour of different coffee samples was analysed using a standard colour meter method using the industrial colour meter measurement methods as described by Şenyuva & Gökmen [21]. Measurement of CIE (International Commission on Illumination) L*a*b* colour values were performed using a Minolta CM-3600d model spectrophotometer. According to the CIE, L* indicates lightness and a* and b* indicate colour directions. Þ a* and a* are the red and the green directions respectively while þb* and b* are the yellow and the blue directions, respectively. The sample was transferred into disposable cuvettes to measure the reflectance at least twice from both front and rear sides of the specimen.

Chlorogenic acids and caffeine analysis
These were assessed as described by Budryn *et al.* [22], on roasting in different conditions at Kenya Bureau of standards.

Mineral analysis
The mineral composition of the coffee was analysed using an inductively coupled plasma mass spectrometry as described by Vanoni Matta [23]. Sodium, potassium, iron, zinc, calcium, magnesium, and phosphorus contents were determined.

Other quality parameters
Total ash, acid insoluble ash, water soluble ash, alkalinity of soluble ash, water soluble matter, petroleum ether, and moisture content was analysed as per Kenya East African Standards; for roasted coffee beans and roasted ground coffee - Specification (KS EAS 105:2020).

Acrylamides quantification
The coffee samples purchased randomly from retail shops within the selected sub-counties within Nairobi county were analysed for their acrylamide levels using gas chromatography and flame ionizable detection as described by Ogolla *et al.* [24].

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Data analysis
Data analysis involved using R software [25] to analyze collected data. Various statistical tests were employed to understand the physico-chemical characteristics of the coffee brands. Box plots were generated to detect outliers that could affect distributional characteristics and variance homogeneity. Descriptive statistics from the pastecs package [26] summarized central tendencies and distributions. Levene's test from the car package [27] assessed variance homogeneity, and the Shapiro-Wilk test (stats package) evaluated data normality. Log transformation was applied when violated. ANOVA models examined differences among coffee brands in relevant properties, with a focus on acrylamide. Planned contrasts [28] were used to enhance the understanding of treatment effects. Mean effect size (mes) analysis and Tukey post hoc tests [29] identified specific differences among treatment groups. Parametric, and non-parametric methods including bootstrapping were employed to address distributional issues [30]. Analyses aimed to elucidate brand impacts, offering nuanced insights into dataset relationships and effects on studied variables. Plotting utilized ggplot2 [31].

RESULTS AND DISCUSSION

Quality characteristics of different traded coffee brands in Kenyan markets
The physicochemical coffee characteristics included moisture content, total ash, acid insoluble ash, water-soluble ash, alkalinity of soluble ash, water-soluble matter, petroleum ether extract, and acrylamide levels, Fe, Zn, P, Ca, Mg, K, Na, and caffeine. Results showed significant variations in acrylamide concentration, caffeine content, calcium, and magnesium among the brands, likely stemming from factors including bean origin, processing methods, blending practices, and quality control measures. This observation is consistent with the findings of Basaran *et al.* [32], who observed variations in characteristics across coffee brands. The parameters including moisture content, total ash, acid insoluble ash, water-soluble ash, alkalinity of soluble ash, water-soluble matter, petroleum ether extract, and levels of minerals such as iron, zinc, phosphorus, potassium, and sodium did not exhibit significant differences across the brands. This suggests a consistent nutritional value regardless of brand, potentially influencing consumer cost considerations. Coliforms, yeast and mold, *E. coli*, *Staphylococcus aureus*, and *Salmonella spp* were all either absent or present at very low levels (below 10 log cfu/g) across all brands, indicating overall safety and quality consistency, similar to observations of Hossain *et al.* [33].

The presence of acrylamide in all brands is worrying, as it is a potentially harmful compound that can accumulate during the roasting and processing of coffee. The dangers of acrylamide in coffee have also been documented by Barrea *et al.* [7]. The levels of acrylamide found in this study were within acceptable indicative levels as guided by EC [34]. The key threat however remains the concerns about the accumulation of the small quantities of acrylamide over a long period of time. Acrylamide and caffeine concentrations across the brands are presented in Figure 2 and 3, selected for their significance in this study.

Most response variables in Levene's test had p-values above 0.05, indicating no significant difference in variances across brands except for calcium and magnesium content ($p < 0.05$). The Shapiro-Wilk tests showed significant deviations from normal distribution ($p < 0.05$) for all coffee characteristics analyzed.

The effect of coffee brands on coffee characteristics

ANOVA results indicated significant differences in acrylamide concentration ($F(11, 156) = 4.86$, $p < 0.001$), calcium content ($F(11, 156) = 2.74$, $p = 0.003$), magnesium content ($F(11, 156) = 2.52$, $p = 0.006$), and caffeine concentration ($F(11, 156) = 4.47$, $p < 0.001$) among coffee brands (Table 1). However, no significant differences were found for other characteristics ($p > 0.05$). The means for various parameters were moisture content 5.8%, total ash -5.8%, acid insoluble ash -0.4%, water soluble ash -79.5%, alkalinity of soluble ash -3.4%, water soluble matter -47.9%, petroleum ether extract 13.8%, and acrylamide concentration 0.071 µg/kg. Additionally, the means for Fe, Zn, P, Ca, Mg, K, Na, and caffeine content were 7.822, 6.954, 40.669, 65.596, 117.588, 222.956, 4.663, and 0.083 mg/100g, respectively. These findings suggest that brand choice may significantly affect acrylamide, calcium, magnesium, and caffeine levels in coffee, warranting further investigation and potential quality control measures in production, and is consistent with the observations of Farag *et al.* [35], significant levels of coffee characteristics across different labels.

Variation in the acrylamide concentration reflects variations in roasting or processing methods, which is consistent with Fan *et al.* [36], while the variation in calcium and magnesium possibly indicates a geographical or soil-related differences; Different regions and soil compositions could influence the mineral content in coffee beans, leading to variations in calcium and magnesium levels. This insight was observed in other studies that have related soil properties to the quality of the products [37].

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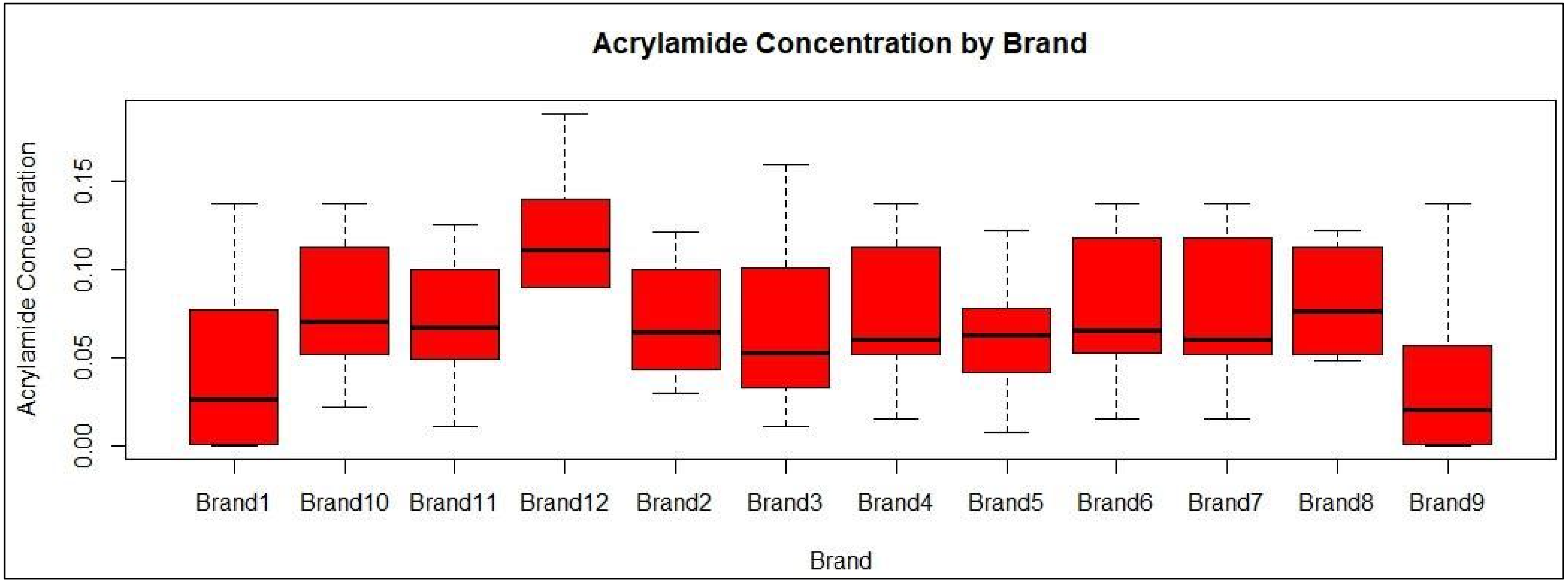

Figure 2: Acrylamide concentrations across the studied coffee brands

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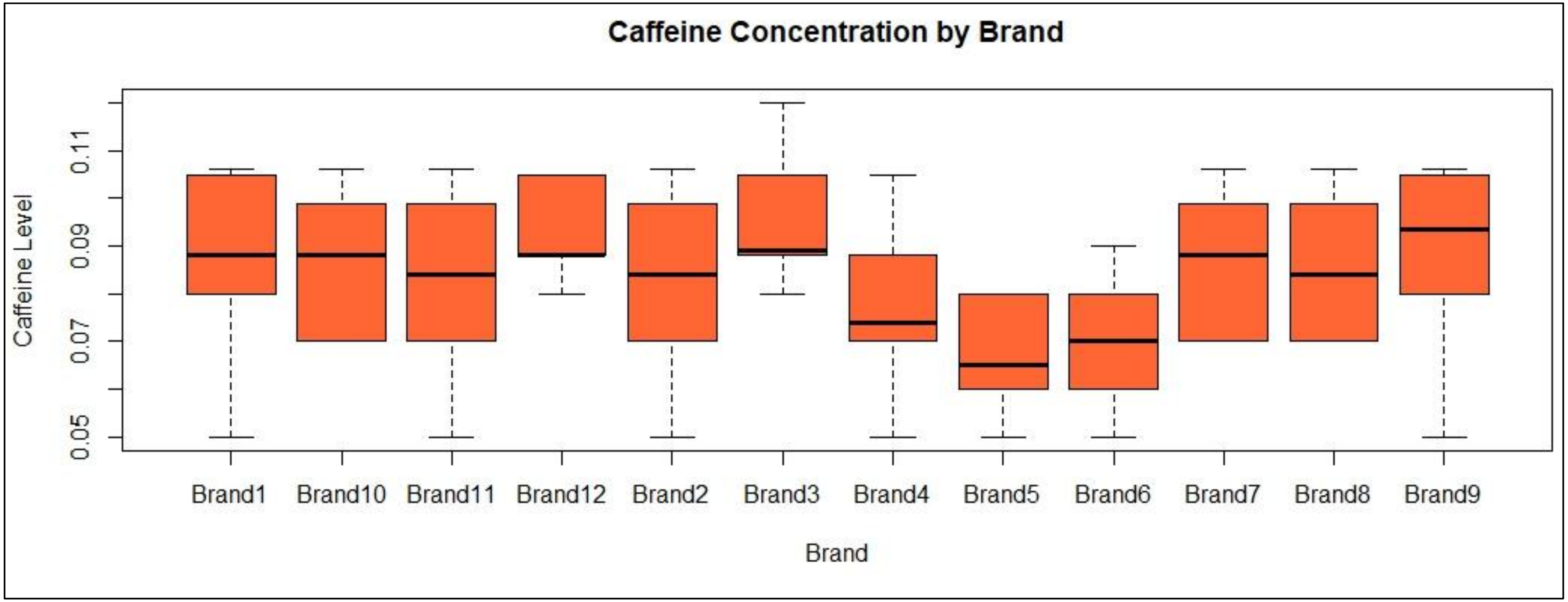

Figure 3: Caffeine concentrations across the studied coffee brand

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Other parameters including moisture content ($F(11, 156) = 0.18$, $p = 0.998$), total ash ($F(11, 156) = 0.31$, $p = 0.984$), acid-insoluble ash ($F(11, 156) = 1.52$, $p = 0.127$), water-soluble ash ($F(11, 156) = 1.14$, $p = 0.332$), alkalinity of soluble ash ($F(11, 156) = 0.95$, $p = 0.490$), water-soluble matter ($F(11, 156) = 0.50$, $p = 0.902$), and petroleum ether extract ($F(11, 156) = 0.44$, $p = 0.938$) all exhibited non-significant variations among coffee brands, suggesting consistent quality across the board. Notably, Brand 12 displayed the highest acrylamide concentration, significantly different from most other brands, which can be attributed to substandard roasting conditions, consistent with the studies of Hosseini-Esfahani *et al*. and Basaran & Aydin [12,14].

A linear regression analysis of the pooled coffee quality parameters log-transformed values showed no significant association between coffee brands, with coefficients close to zero and p-values above 0.05, and presented in Figure 4. Overall, brand choice did not strongly predict the variable, suggesting uniform benefits and risks across brands. This has implications for labelling transparency and consumer decision-making, along with ethical considerations, whichever brand you take, the benefits, the luxury, the risk, is the same. This non-significance across brands is represented by the error bars in Figure 4.

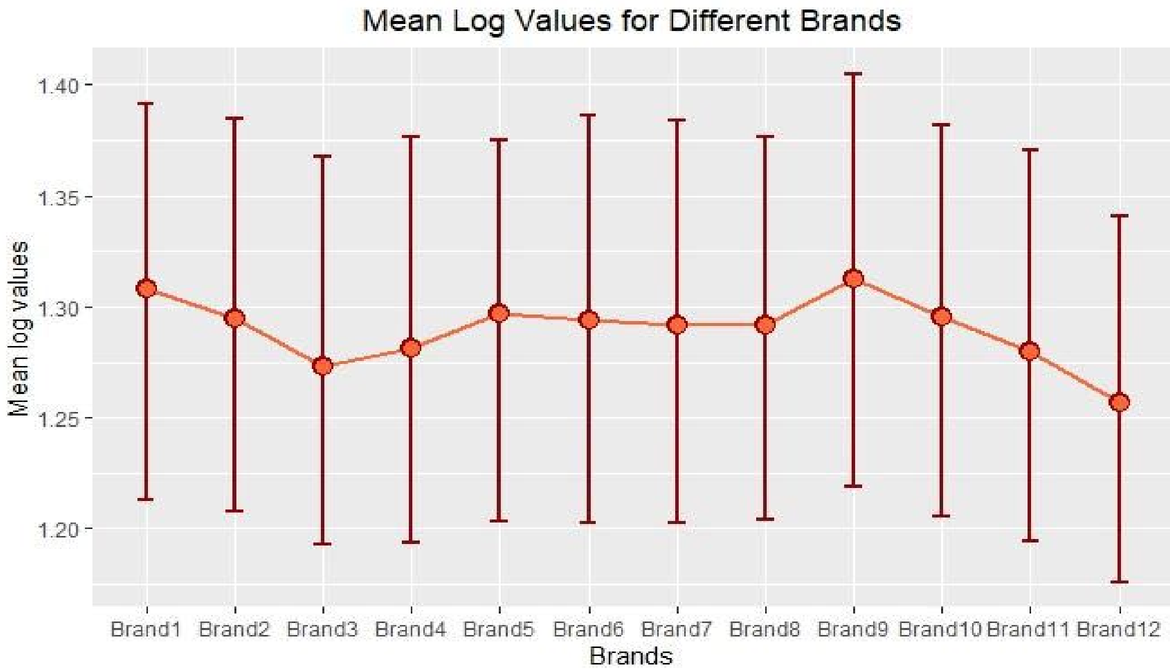

Figure 4: A line graph showing the mean values of coffee quality parameters

Descriptive statistics

Log-transformed values of overall quality for the 12 coffee brands showed slight variations in central tendencies and dispersion (Table 2). Brand 5 had the highest

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mean log value (approx. 1.826), indicating a relatively higher concentration of quality parameters, while Brand 12 had the lowest mean log value (approx. 1.6674). Brand 5 also had the lowest variability (std. deviation approx. 0.8890), while brand 8 had the highest variability (std. deviation approx. 0.9428).

General ANOVA for the log-transformed data

ANOVA was performed to assess the differences among the 12 coffee brands across various variables. The F-statistic for brand was F (11, 2171) = 0.114, with a p-value of p = 0.977. This outcome suggests that, collectively, the coffee brands do not exhibit significant variations in the measured variables including moisture content, total ash, acid insoluble ash, water-soluble ash, alkalinity of soluble ash, water-soluble matter, petroleum ether extract, and acrylamide levels, Fe, Zn, P, Ca, Mg, K, Na, and caffeine. The aim was to see if there was any difference across the brands. This could be attributed to fraud, corruption and adulteration of the labelling and similar phenomena has been observed in previous research [38].

Kruskal Wallis test for data with distributional issues

A Kruskal-Wallis rank sum test evaluated potential differences in log values in overall quality of coffee quality parameters among the 12 coffee brands, considering data distributional issues. The test resulted in a Kruskal-Wallis chi-squared statistic of 1.9901 with 11 degrees of freedom and a p-value of 0.9985. This suggests no statistically significant differences in log values among the brands, even when considering distributional characteristics. In summary, the Kruskal-Wallis test indicates that the coffee brands do not significantly vary in log values. This observation may imply the influence of advertising, potentially misleading consumers regarding product attributes. Going beyond the context of this study, the influence of advertising brands to flatter customers has been documented in a study by Lou *et al.* [39], *Flattering Me in the Right Way!*

A Dunn's test with Bonferroni correction, a post-hoc follow-up test was conducted to further examine pairwise comparisons between the 12 coffee brands, addressing distributional issues in the data. None of the pairwise comparisons yielded statistically significant differences in log values between the brands at a significance level of 0.05 after Bonferroni correction. Coffee brands with similar characteristics were also observed in previous studies, similar physico-chemical and organoleptic properties in different brands [40]. A graphical analysis of variance (GRANOVA) was displayed using box plots (Figure 5).

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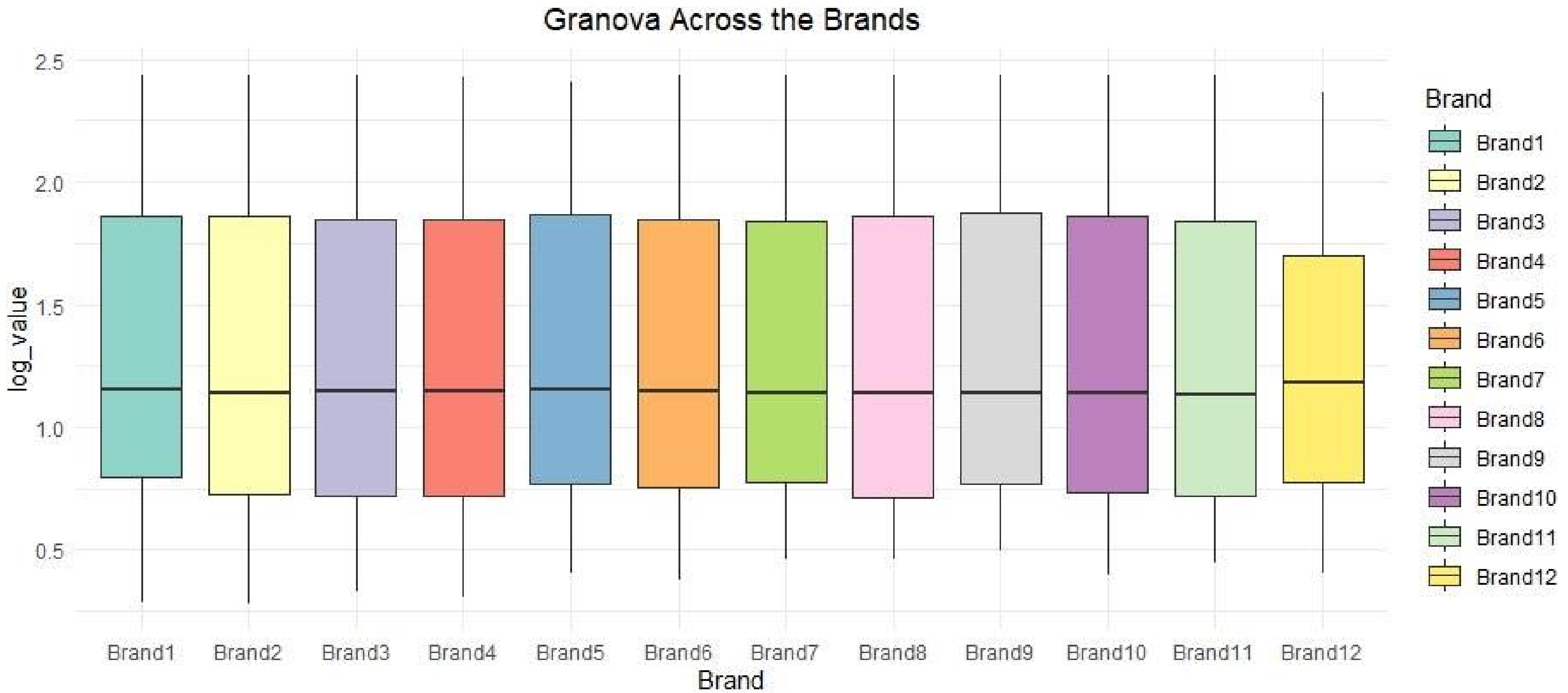

Figure 5: GRANOVA representation across the brands

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Trimmed means

Using a generalized version of Welch's method, the homoscedasticity assumption is not required in this test. A one-way analysis of variance (ANOVA) with a 20% trimmed mean assessed differences in log values among the 12 coffee brands. The test yielded an F-value of 0.0598 with 11 and approximately 514.86 degrees of freedom for the numerator and denominator, respectively. The resulting p-value was 0.9999, indicating no statistically significant differences in log values among the brands, with a small effect size (0.08). Overall, the ANOVA suggests no significant differences in log values among the 12 coffee brands. This finding was also reported by Lou *et al.* [32].

Bootstrapping

A percentile bootstrap method, with post hoc tests in the mcppb20 function, was used to test equal trimmed means among the 12 coffee brands. With 599 bootstrap samples, the test yielded a statistic of 0.0598 and a p-value of 0.99833. The effect size was estimated at 0.02, explaining approximately 0.001 of the variances. Since the p-value exceeds 0.05, there's insufficient evidence to reject the null hypothesis. Therefore, the analysis suggests no significant differences in trimmed means among the brands. Figure 6 displays the variational distribution across brands using a violin with a box plot.

Distribution of other coffee characteristics across the brands

Further analysis addressed crucial information gaps in coffee identity, including variety and manufacturing techniques. Among the 12 brands, only brands 4 and 12 indicated the coffee variety on their product. Labelling coffee variety enhances transparency, improves the consumer experience, and supports sustainability. It empowers consumers to make informed choices and explore diverse coffee flavours.

Another key missing information was the grind type which is crucial for ensuring a seamless coffee experience, as was only indicated in 2,3. and 4 of the 12 brands. It allows consumers to match their preferred brewing method with the appropriate grind size, leading to a better-tasting coffee. This information can promote consistency in brewing, simplify product selection, aid in quality control for producers, and educate consumers about the importance of grind size. Moreover, specifying the grind type could reduce waste and support customization, ultimately enhancing consumer satisfaction and overall coffee appreciation. This suggestion has been supported by Samoggia & Busi [41], who documented the importance of this information as a driver to coffee preference in Italy.

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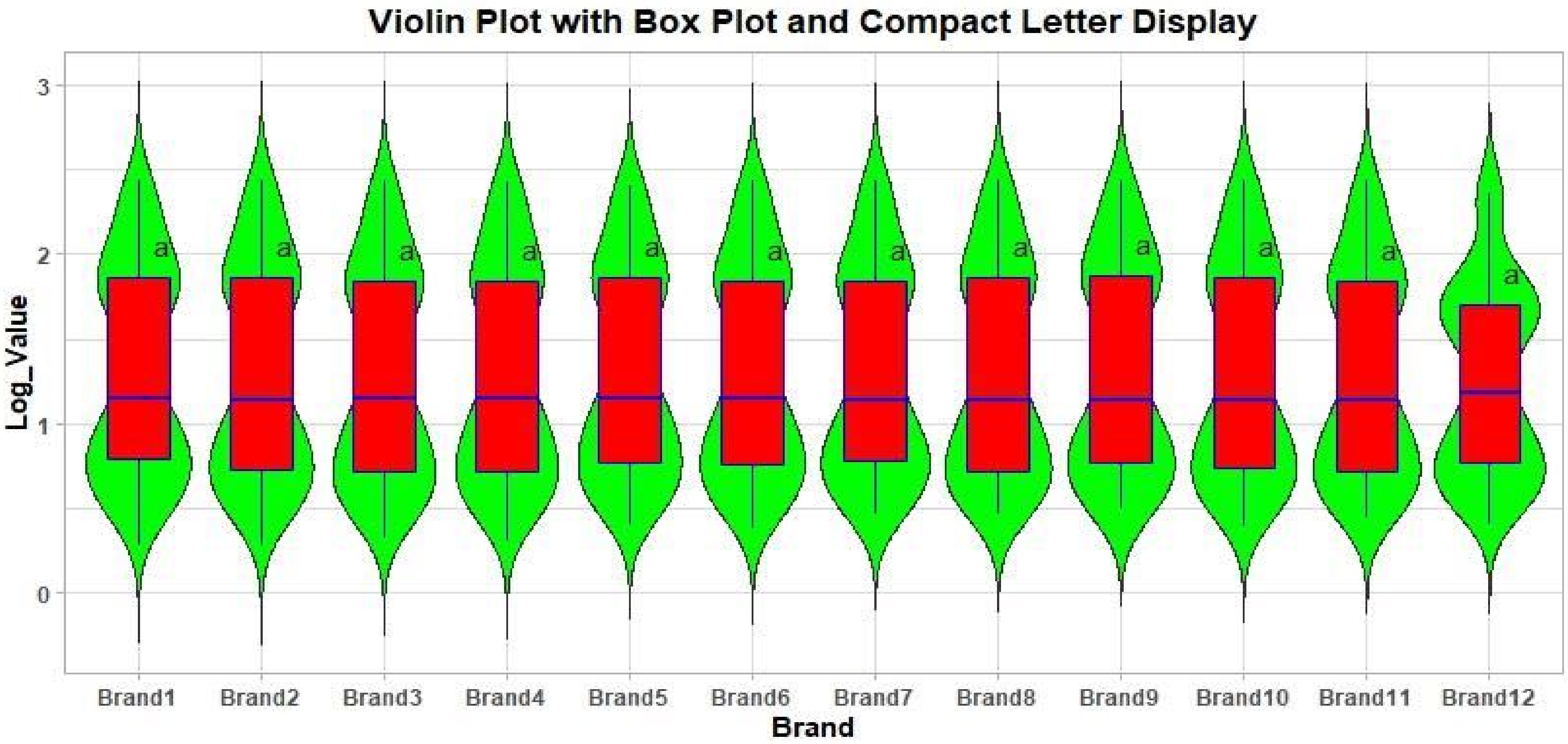

Figure 6: General variational distribution in pooled coffee quality parameters across the brands

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There is commendable job information regarding the roast type across the 12 brands as it was indicated in all. Indicating the roast type is highly significant as it informs consumers about the flavour profile, aroma, and brewing characteristics of the coffee. Light, medium, and dark roasts offer distinct flavour profiles, with light roasts often having brighter and more nuanced flavours, medium roasts offering a balanced taste, and dark roasts providing richer, bolder notes. This information could empower consumers to select coffee that aligns with their taste preferences and brewing methods. Roast type indication could also reflect transparency in the coffee supply chain, showcasing the craftsmanship of the rooster and the uniqueness of the coffee beans. The importance of this information on the flavour and consumer preference has also been published by Yeager *et al.* [42].

Information gaps in coffee brands

The widest gap appears to be in the coffee variety, grind type, and roast type on coffee packaging or products. Availing these three pieces of information could collectively empower consumers to make informed choices based on their preferences and brewing methods. Coffee variety offers transparency, flavour differentiation, and an educational element, allowing consumers to appreciate the unique characteristics of different beans. This sentiment has been echoed by Alamri *et al.* [43], as a good production practice to enhance consumer knowledge. Indicating the grind type could ensure that coffee matches the brewing method, promoting consistency and quality in the brewing process. This is in accordance with Seninde *et al.* [44], who reported the influence of roasting degree on sensory characteristics in Ugandan coffee. Roast type, whether light, medium, or dark, provides insights into flavour profiles, enabling consumers to tailor their coffee experience to their taste preferences. Labelling these factors can enhance consumer satisfaction, reduce waste, support ethical sourcing, and celebrate the diversity of coffee, enriching the coffee experience for coffee enthusiasts and casual drinkers alike.

CONCLUSION, AND RECOMMENDATIONS FOR DEVELOPMENT

The findings showed notable disparities in acrylamide concentration and caffeine content among the various brands, while also highlighting consistent mineral composition across the board. These variations highlight the importance of rigorous quality control measures within the coffee industry to ensure consumer safety and satisfaction. Given the known health risks associated with acrylamide consumption, it is imperative for coffee producers to prioritize strategies aimed at reducing its presence in processed coffee beans. Continuous monitoring of acrylamide levels, coupled with the implementation of effective mitigation

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techniques during processing, is essential to uphold the integrity and healthfulness of coffee products.

Moreover, policymakers play a pivotal role in fostering transparency and accountability within the coffee industry. Enforcing clear and informative labelling practices can empower consumers to make informed choices about their coffee purchases, particularly regarding potential health implications. Additionally, setting regulatory thresholds for key components such as acrylamide and collaborating with industry stakeholders to establish and maintain robust quality control standards are crucial steps towards ensuring the long-term sustainability and viability of the coffee market. By prioritizing consumer health and well-being through proactive measures, policymakers and industry leaders can cultivate a culture of trust and confidence among coffee consumers, fostering a healthier and more resilient coffee industry for generations to come.

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Table 1: Variations in characteristics of different coffee brands in Nairobi and Kiambu Counties, Kenya

Parameter	Mean	SD	FValue	PValue
Moisture content %	5.766	1.818	0.181	0.9983492
Total ash%	5.797	1.620	0.306	0.9838834
Acid insoluble ash%	0.361	0.230	1.525	0.1274736
Water soluble ash%	79.478	10.787	1.143	0.3320677
Alkalinity of soluble ash mg/L	3.400	0.169	0.954	0.4904005
Water soluble matter%	47.851	22.428	0.498	0.9022173
Petroleum ether extract%	13.828	1.423	0.435	0.9382904
Acrylamide conc. µg.100g	0.071	0.043	4.860	0.0000019
Fe mg.100g	7.822	2.305	0.119	0.9997815
Zn mg.100g	6.954	2.259	1.004	0.4455263
P mg.100g	40.669	14.809	0.351	0.9720733
Ca mg.100g	65.596	21.669	2.737	0.0029075
Mg mg.100g	117.588	43.977	2.523	0.0059299
K mg.100g	222.956	23.873	0.236	0.9946354
Na mg.100g	4.663	1.284	1.685	0.0813430
Caffeine mg.100g	0.083	0.016	4.474	0.0000073

Number of coffee brands = 12; The values were determined on dry weight basis

Table 2: Central tendencies and dispersion in pooled quality parameters

Brand	Range	Sum	Median	Mean	Variance	Std. Dev	Coef. Var
1	2.152	238.084	1.151	1.308	0.381	0.617	0.472
2	2.156	235.705	1.139	1.295	0.384	0.619	0.478
3	2.113	231.739	1.145	1.273	0.376	0.613	0.482
4	2.120	233.161	1.146	1.281	0.374	0.611	0.477
5	2.004	236.075	1.153	1.297	0.358	0.599	0.462
6	2.058	235.549	1.146	1.294	0.364	0.603	0.466
7	1.974	235.073	1.138	1.292	0.360	0.600	0.465
8	1.974	235.109	1.141	1.292	0.370	0.608	0.471
9	1.944	238.930	1.143	1.313	0.375	0.612	0.467
10	2.043	235.836	1.141	1.296	0.375	0.612	0.472
11	1.989	232.976	1.134	1.280	0.364	0.603	0.471
12	1.959	227.538	1.180	1.257	0.310	0.557	0.443

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