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# Trace Elements in Norwegian and Polish Tea Infusions

Determined by High-Resolution Inductively Coupled Plasma Mass Spectrometry (HR ICP-MS) and Ion Selective Electrode (ISE)

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## Abstract

Tea from the plant *Camellia sinensis* is the world's most popular non-alcoholic beverage, next to water. Tea can be divided into six types, and the most popular teas are black tea, green tea and oolong. In this study infusions of 85 Norwegian and Polish tea samples were analysed to investigate the content of trace elements. 40 samples from Norwegian supermarkets, 30 from the local tea and coffee shop and 15 Polish samples were infused for 5 minutes with ultrapure boiling water (1 gram tea/100 mL). The fluoride content in the tea infusions was determined using an ion selective electrode (ISE), and the rest of the elements were determined by high-resolution inductively coupled plasma mass spectrometry (HR ICP-MS).

Tea is a rich source of essential elements as calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn). The infusions also contain non essential elements as nickel (Ni),lead (Pb), fluoride (F) and aluminium (Al). The average concentrations in one cup of tea from the Norwegian market contains among other elements average concentrations of 0.6 mg Ca/L, 2.8 mg P/L, 37.1 mg K/L, 2.0 mg Mg/L, 5.9 µg Fe/L, 14.1 µg Cu/L, 26.4 µg Zn/L, 0.6 mg Mn/L, 9.9 µg Ni/L, 0.16 µg Pb/L, 0.5 µg Cr/L, 1.0 mg F/L and 1.1 mg Al/L. For the essential elements Ca, P, K, Mg, Fe, Cu and Zn the tea infusions will not contribute to attain the recommended dietary allowances (RDAs) in any extent, but for Mn where the AI are 2.3 mg/day (men) and 1.8 mg/day (women) a few cups of tea can exceed the given AI level. The amount of Pb in the infusions is sustainable lower than the provisional tolerable weekly intake (PTWI) of 25 µg/kg body weight. Drinking tea will therefore not contribute in any high extent to the PTWI.
There were on the other hand obtained vast variations of F concentrations in different types of tea and tea contributes also in huge extent to AI of F - 3 mg/day (women), 4 mg/day (men) and from 0.5- 1 mg/day (0 -12 year olds). One cup of tea could easily exceed the AI, at least considering children drinking tea. The Al content in tea is high, and for heavy tea drinkers may tea be the largest single source of Al to contribute to the total weekly intake (TWI) of 1 mg/ kg body weight/ week.

The study showed higher concentrations of elements in tea infusions made of tea bags than infusions made of loose tea. Suggesting that the elements in the crushed leaves in tea bags are more extractable than in the loose tea leaves. One other explanation is that the tea bags contain older tea leaves with lower quality and therefore older leaves with higher concentrations of e.g. Al. There was also seen a significant difference in the element composition in Norwegian and Polish infusion, with higher concentrations of elements in the Norwegian infusions.

## Sammendrag

Te fra planten *Camellia sinensis* er den alkoholfrie drikken i verden, som nytes mest, etter vann. Te kan deles inn i tre typer, hvorav de mest populære er svart te, grønn te og oolong te. I denne masteroppgaven ble grunnstoffinnholdet analysert i totalt 85 forskjellige teprøver, preparert av blader fra planten. 40 tesorter ble kjøpt inn fra norske dagligvarehandler, 30 typer kom fra den lokale te og kaffe butikken – Te og kaffehuset – i Trondheim. De siste 15 tetypene kom fra det polske markedet gjennom et samarbeidsprosjekt med Universitetet i Gdansk. 1 gram av de forskjellige prøvene ble trukket i 100 mL kokende ultrarent vann for 5 minutter. Fluorinnholdet i teprøvene ble bestemt ved bruk av ione selektive elektroder (ISE), mens resten av grunnstoffinnholdet i teen ble bestemt ved induktiv koplet plasma massespektrometer (ICP-MS).

Te er en rik kilde på essensielle grunnstoffer som kalsium (Ca), fosfor (P), kalium (K), magnesium (Mg), mangan (Mn), jern (Fe), kopper (Cu) og sink (Zn). Teuttrekkene inneholder også ikke essensielle grunnstoffer som bly (Pb), fluor (F) and aluminium (Al). En kopp te fra det norske markedet inneholder blant annet 0.6 mg Ca/L, 2.8 mg P/L, 37.1 mg K/L, 2.0 mg Mg/L, 5.9 µg Fe/L, 14.1 µg Cu/L, 26.4 µg Zn/L, 0.6 mg Mn/L, 9.9 µg Ni/L, 0.16 µg Pb/L, 0.5 µg Cr/L, 1.0 mg F/L og 1.1 mg Al/L. Innholdet av Ca, P, K, Mg, Fe, Cu og Zn i te, vil ikke bidra til å nå de anbefalte inntaksgrensene Soisial og Helsedirektoratet i Norge har satt. Innholdet av Mn i te, vil derimot bidra til å nå de anbefalte inntaksgrensene USA har satt på henholdsvis 2.3 mg Mn/ dag for menn, og 1.8 mg/dag for kvinner. Mengden Pb i teuttrekkene er så lav at tedrikking vil ikke i noen grad påvirke inntaksgrensa på 25 µg/kg kroppsvekt/ uke (PTWI). Innholdet av F i teuttrekkene bidrar i høy grad til å nå anbefalt inntaksgrenser (USA) på 3 mg/dag for kvinner, 4 mg/dag for menn og fra 0.5 – 1 mg/dag for barn i en alder av 0-12 år. Da det ble målt store variasjoner i konsentrasjonen i de forskjellige norske teene, kan en kopp te lett bidra til at inntaksgrenene blir overgått, spesielt hos barn som drikker te. Det samme ble observert med tanke på Al innholdet i te. For de som drikker veldig mye te vil Al i te være en av de viktigste kildene til å bidra til det totale ukentlige inntaket på 1 mg/kg kroppsvekt.

De endelige resultatene viste et høyere grunnstoffinnhold i te brygget meg teposer enn te brygget med løs te. Dette kan forklares med at det finmalte materialet i teposene er lettere løselig, enn grunnstoffinnholdet i de løse tebladene, eller med at kvaliteten på teen i teposene er noe lavere enn i den løse teen og at det i denne er brukt eldre blader fra teplanten. De eldre bladene inneholder større mengder av for eksempel Al og vil på denne måten bidra til å øke konsentrasjonen av grunnstoffer i teposene. Det ble også observert forskjeller i grunnstoffinnholdet mellom de norske og de polske teuttrekkene, uten at en kan si noe om hva som forårsaket dette.

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## 1 Introduction

The tea leaves from the plant *Camellia sinensis* has a complex chemical composition. Apart from polyphenols, flavonoids, proteins, amino acids, enzymes, aroma-forming substances, vitamins, fibers, volatile oils and carbohydrates, it is known that prepared tea is an important source of essential and non-essential elements (Harbowy et al., 1997, Wickremasinghe, 1978, Karak and Bhagat, 2010). In recent years, there has been much interest in and concern about the uptake of trace metals by plants from soils, because excess metals getting into the food chain through uptake by plants might be harmful to the health of humans (Li et al., 1998). This is interesting considering tea is the second most popular non-alcoholic beverage in the world, next to water (Szymczycha-Madeja et al., 2012, Wickremasinghe, 1978). During infusion of tea, the essential and non-essential elements are extracted from the leaves and into the infusion, in different concentrations. This makes the infusions a major source of minor, major and trace elements in the human diet and could have health implications (Karak and Bhagat, 2010, Welna et al., 2012).

The study started out with 70 Norwegian tea infusions, but 15 Polish infusions were included in the trace element analysis as well. The Polish infusions were included to investigate similarities between teas bought in the two countries. The infusions were analysed with ICP-MS, and the Fluoride content was determined using an ion selective electrode. A principal component analysis (PCA) was performed, used to reduce the number of variables and to manage to see a pattern in the results. In this thesis the PCA plot is only discussed briefly. A Student T-test was performed to decide if the results were significant or if the results were a coincidence.

Tea infusions are important from both a nutritional and toxicological view. The aim of this study was to determine and get an overview of the content of elements in Norwegian and Polish tea infusions. The content of elements were investigated to decide whether or not tea contribute to the intake of essential and non essential elements.

# 2 Background and theory

## 2.1 Camellia sinensis

Next to water, tea prepared from steamed and dried leaves of the plant *Camellia sinensis* is the most popular non-alcoholic beverage, consumed by about half of the world's population (Szymczycha-Madeja et al., 2012, Flaten, 2002). The tea shrub is evergreen, originally from China and can be found in tropical, sub-tropical and temperate regions. It grows best at lower temperature (5-20 ºC), in regions with relatively high humidity (80-90%) and high annual rainfall (1500-2000 mm) (Fung et al., 2003).

Tea can be classified into six basic categories: white, yellow, green, oolong, black and pu-erh (Szymczycha-Madeja et al., 2012). The global tea production in 2000 was 2,89 million tons (Flaten, 2002). The most popular ones are black, green and oolong, nearly 85% is black, 14 % is green and the remaining amount is oolong and white tea (The Tea Association of the USA, 2013). Differences in the fermentation process make the different types of tea (Szymczycha-Madeja et al., 2012, Harbowy et al., 1997). Black tea is produced by air-drying (withering) of the leaves from *Camellia sinensis* before they are bruised through rolling and cutting to activate the endogenous enzyme polyphenol oxidase. The activating of the enzyme starts the fermentation process, which largely consists of oxidation of the polyphenols present in the tea leaves. When the quality is optimal, drying stops the fermentation. Green tea is not fermented, but the leaves are steamed or pan fired to inactivate the polyphenol oxidase, thus avoiding the oxidation. If this procedure is carried out immediately after the leaves are plucked, the result is "white" tea. If the leaves are withered before firing the result is "yellow" tea (Harbowy et al., 1997). Oolong tea is an intermediate type of tea, produced employing a shorter fermentation time than for black tea (Harbowy et al., 1997), and pu-erh tea is fermented natural aged tea (Global Tea Brokers, Malinowska et al., 2008).

As mentioned in the introduction, the chemical composition of tea is complex. Apart from polyphenols, flavonoids, proteins, amino acids, enzymes, aroma forming substances, vitamins, fibers, volatile oils and carbohydrates, tea is also a rich source of dietary essential major, minor elements and trace elements (Szymczycha-Madeja et al., 2012, Welna et al., 2012, Wickremasinghe, 1978). During infusion of the tea, the elements in the leaves are differentially extracted into the infusions. The presence of different elements in tea is considered to have certain health implications for the well-being of heavily tea consumers. (Szymczycha-Madeja et al., 2012, Welna et al., 2012, Karak and Bhagat, 2010) Daily, or regularly, intake of tea may significantly contribute to recommended daily intake of some essential, nutritionally important elements like Cr, K, Mn, Ni and Zn. (Szymczycha-Madeja et al., 2012, Welna et al., 2012, Xie et al., 1998) The contribution of toxic elements (e.g., Al and Pb) can also be high due to drinking tea (Chen et al., 2010, Han et al., 2006, Flaten, 2002, Sofuoglu and Kavcar, 2008) With this information tea should not be considered neutral to human health (Salahinejad and Aflaki, 2010, Sofuoglu and Kavcar, 2008, Welna et al., 2012).

### 2.2 Recommended dietary allowance

Recommended dietary Allowance (RDA) was developed for guidance and meant to provide superior nutrition for the people. RDA is defined as the average daily dietary nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97-98 %) healthy individuals in a particular life stage and gender group (Otten et al., 2006). Acceptable daily intake (ADI) is a measure of the amount of a specific substance in food or drinking water that can be ingested on a daily basis over a lifetime without an appreciable health risk. ADIs are usually expressed in mg/kg body weight per day. Dietary reference intake (DRI) is a system of nutrition recommendations composed of Estimated Average Requirements (EAR), RDA, Adequate intake (AI) and Tolerable upper intake levels (UL). EAR is expected to satisfy the needs of 50% of the people in a certain age and AI is used where no RDA has been established, but the amount established is somewhat less firmly believed to be adequate for everyone in the demographic group. UL is used to caution against excessive intake of nutrients that can be harmful in large amounts, and this is the highest level of daily consumption that current data have shown to cause no side effects in humans (Otten et al., 2006). The Norwegian RDAs for some essential elements can be seen in Table 1.

**Table 1: Recommended dietary allowance for some essential elements given in Norwegian recommendations for nutrition and physical activity (Sosial- og Helsedirektoratet, 2005).**

| Age/Years | Ca (mg) | P (mg) | K (g) | Mg (mg) | Fe (mg) | Zn (mg) | Cu (mg) | I (µg) | Se (µg) |
|---|---|---|---|---|---|---|---|---|---|
| Children | | | | | | | | | |
| <6 months | - | - | - | - | - | - | - | - | - |
| 6-11 months | 540 | 420 | 1.1 | 80 | 8 | 5 | 0.3 | 50 | 15 |
| 12-23 months | 600 | 470 | 1.4 | 85 | 8 | 5 | 0.3 | 70 | 20 |
| 2-5 year | 600 | 470 | 1.8 | 120 | 8 | 6 | 0.4 | 90 | 25 |
| 6-9 year | 700 | 540 | 2 | 200 | 9 | 7 | 0.5 | 120 | 30 |
| Male | | | | | | | | | |
| < 13 | 900 | 700 | 3.3 | 280 | 11 | 11 | 0.7 | 150 | 40 |
| 14-17 | 900 | 700 | 3.5 | 350 | 11 | 12 | 0.9 | 150 | 50 |
| 18-30 | 800 | 600 | 3.5 | 350 | 9 | 9 | 0.9 | 150 | 50 |
| 31-60 | 800 | 600 | 3.5 | 350 | 9 | 9 | 0.9 | 150 | 50 |
| 61-74 | 800 | 600 | 3.5 | 350 | 9 | 9 | 0.9 | 150 | 50 |
| >= 75 | 800 | 600 | 3.5 | 350 | 9 | 9 | 0.9 | 150 | 50 |
| Female | | | | | | | | | |
| <13 | 900 | 700 | 2.9 | 280 | 11 | 8 | 0.7 | 150 | 35 |
| 14-17 | 900 | 700 | 3.1 | 280 | 15 | 9 | 0.9 | 150 | 40 |
| 18-30 | 800 | 600 | 3.1 | 280 | 15 | 7 | 0.9 | 150 | 40 |
| 31-60 | 800 | 600 | 3.1 | 280 | 15 | 7 | 0.9 | 150 | 40 |
| 61-74 | 800 | 600 | 3.1 | 280 | 9 | 7 | 0.9 | 150 | 40 |
| >=75 | 800 | 600 | 3.1 | 280 | 9 | 7 | 0.9 | 150 | 40 |
| Pregnant | 900 | 700 | 3.1 | 280 | - | 9 | 1 | 175 | 55 |
| Nursing | 900 | 900 | 3.1 | 280 | 15 | 11 | 1.3 | 200 | 55 |

## 2.3 Trace elements

If an organism is to grow and reproduce normally, the dietary concentrations in animals, or soil concentrations in plants, have to be maintained. These elements are essential elements (Walker et al., 2012). Carbon (C), hydrogen (H), oxygen (O) and nitrogen (N) are essential elements. In addition to these there are seven major minerals required for ionic balance and as integral parts of amino acids, nucleic acids and structural compounds. These seven major mineral elements are calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), sodium (Na), chlorine (Cl) and sulphur (S) (Walker et al., 2012). Iron (Fe), iodine (I), copper (Cu), manganese (Mn), zinc (Zn), cobalt (Co), molybdenum (Mo), selenium (Se), chromium (Cr), nickel (Ni), vanadium (V), silicon (Si) and arsenic (As) are also required and so-called trace elements. They are required in different biological processes (Klaassen and Casarett, 2008, Walker et al., 2012). Iron for example is a part of haemoglobin, the oxygencarrying pigment in red blood cells (Walker et al., 2012).

The window of essentiality for some elements is very narrow. The dose of the element determines the poison and even essential elements will become toxic with increasing exposure (Klaassen and Casarett, 2008). Nonessential elements such as mercury or cadmium, in addition to being toxic above certain levels, could also affect organisms by inducing deficiencies of essential elements through competition at active sites in biologically important molecules. It is also often the case that the nonessential toxicant elements mimic essential elements and thereby gain access to, and potentially disrupt, key cellular functions. This can also account for bioaccumulation of toxic elements (Klaassen and Casarett, 2008).

## 2.4. Content of elements in tea

Most of the organic material in plants is carbohydrate, including the cell walls that are made of cellulose. The components of carbohydrates – carbon, oxygen and hydrogen are the most abundant in plants, but also nitrogen, sulphur and phosphorus are relatively abundant in plants. Chemical elements are considered as essential elements if they are required for a plant to grow and complete its life cycle and produce another generation. The nutrients are divided into two groups – macronutrients and micronutrients. The plants require these elements in either large amounts or in small quantities. In addition to the latter group of elements – potassium, calcium and magnesium are macronutrients the plant need in large amounts for different biological processes. Chlorine (Cl), iron (Fe), manganese (Mn), boron (B), zinc (Zn), copper (Cu), nickel (Ni) and molybdenum (Mo) are on the other hand among the essential micronutrients. The minerals have different mobility within the plant. Magnesium is for example a relatively mobile element and is shunted preferentially to young leaves, and a deficiency will here first show signs in its older leaves, while a relatively immobile mineral will first affect the young leaves (Campbell and Reece).

The main source of elements in tea plants is their growth media (Salahinejad and Aflaki, 2010, Chen et al., 2010). In which extent the roots absorb the elements while leaves take them up, depend on the concentrations of the elements in soil and their physiochemical forms in soil or when the elements are bound to other soil constituents (Chen et al., 2010, Szymczycha-Madeja et al., 2012).

The tea plant is one of few plants that favour growth in acidic conditions, with pH values ranging from 4.5 to 6.0. Even though the plant will grow in soil as low as 4.0, pH higher than 5.6 is not favouring growth without adjustments of the pH in soil (Chand et al., 2011). The pH in soil is controlling the passage and the availability of some elements into the plant (Dong et al., 1999), and acidification (pH < 4,5) of soil in the different tea plantation will favour solubilisation and release of selected elements (i.e. aluminium (Al), Copper (Cu), Cadmium (Cd), Lead (Pb)) from the soil (Dong et al., 1999, Szymczycha-Madeja et al., 2012). These elements can be readily available to the root system. With a decrease in soil pH below 5.0, there has been seen a significantly increase in for example extractable Al in soils and the uptake of Al in tea leaves (Szymczycha-Madeja et al., 2012, Dong et al., 1999). Under these conditions, and together with minerals containing inorganic P, and if elements associated with Fe and Mn oxides and other inorganic residues may be released – then the uptake of elements from the soil and the accumulation in tea leaves will increase (Dong et al., 1999).

The concentrations of the different elements taken into tea plants (i.e. Al, Cu, Pb and Zn) (Chen et al., 2010, Wong, 1998, Fung et al., 2009, Fung et al., 2003) vary in the different parts of the plant (roots, branches and mature and young leaves). Accordingly, young leaves have lower levels of Al and Pb and higher levels of Cu and Zn than old leaves (Fung et al., 2009). Availability and uptake of elements and their content in leaves also significantly correlate with the age of the plantation (Fung et al., 2009, Fung et al., 2003). The tea bush is also known to accumulate elements such as aluminium (Al), Fluoride (F) and Lead (Pb) (Szymczycha-Madeja et al., 2012) and the mobility of e.g. Al within the tea plant is great, but the element is not retained in roots but transported to shoots, which is a well-known behaviour of hyperaccumulators (Fung et al., 2009).

In some cases when the soil is contaminated through pollution of water, air or industrial and urban activities (e.g., Pb), plants also take up these elements (Salahinejad and Aflaki, 2010, Chen et al., 2010, Han et al., 2006, Jin et al., 2005). The soil may also be contaminated by agriculture practices, application of crop-protection agents and measures containing Cd, Cu, Pb and Zn species or chemical and organic fertilizers of low quality (contaminated with Cd, Ni, Pb) (Han et al., 2006, Szymczycha-Madeja et al., 2012). This will result in elements getting transported directly from the soil by roots and contribute to higher levels of elements in different parts of the plant, especially leaves (Han et al., 2006, Szymczycha-Madeja et al., 2012).

During the stages of manufacturing of the tea, possible contamination by Al, Cr, Cu, Pb and Zn may happen. The water is removed from the leaves; the leaves are twisted, dried, milled and packed (Fung et al., 2003). The contamination may happen because the equipment that is used is made of copper, stainless steel or brass (Salahinejad and Aflaki, 2010, Szymczycha-

Madeja et al., 2012). In general, if the tea leaves are in contact with metallic surfaces, impurities may adsorb and be bound to leaves, thereby increasing concentrations of metals like Cu and Pb (Jin et al., 2008, Szymczycha-Madeja et al., 2012). The Al and Cu increase in black tea can also be connected with the frying of the leaves aiming to change the composition and stop the fermentation process. This is because of that the frying is done in pans made of Al-Cu alloys (Fung et al., 2003).

One of the aims of this study is as mentioned earlier to investigate how much the Norwegian and Polish infusions contribute to the intake of essential and non essential elements. There has been more focus on Mn, Al, Pb, Cr, Ni and F.

### 2.4.1 Aluminium

Tea is a major contributor to human's dietary aluminium (Al) intake, because *Camellia sinensis*, is as earlier mentioned, one of a few plants accumulating aluminium (Flaten, 2002, Szymczycha-Madeja et al., 2012). Accumulation of very high quantities of Al (5000 – 16,000 mg/kg) has been reported and it is also reported higher concentrations of Al in old than in younger leaves (Karak and Bhagat, 2010). Heavy drinking of tea would because of this contribute with more than a double of an individual's intake of Al (Flaten, 2002).

Al is the third most abundant metal in the earth's crust after oxygen and silicon, but due to its high reactivity, Al is not found in the free state in nature. Al occurs typically as $Al^{3+}$, and binds strongly to oxygen-donor ligands as citrate and phosphate (Harris W.R et al., 1996). Because of the mobility of Al within the tea plant, this element is not retained in the roots, but transported to shoots. This is well-known behaviour of hyperaccumulators (Fung et al., 2009).

Less than 1% of the Al in the diet is absorbed (Flaten, 2002, Harris W.R et al., 1996). Al is poorly absorbed during oral or inhalation exposure, and is essentially not absorbed dermally. The pH and the present complexing ligands are variables that control the absorption in the gut. Particularly carboxylic acids make the Al more absorbable. For example, in presence of citrate, the intestinal absorption is enhanced. The speciation is also of major importance in distribution and excretion of Al in mammals (Harris W.R et al., 1996). In plasma, 80-90% of the Al binds to transferrin, an iron-transport protein with receptors in many tissues. The transferrin pathway is considered a mechanism for Al transport across the blood-brain barrier (Klaassen and Casarett, 2008).

The kidneys remove the Al from the blood before it is excreted in the urine. The different Al compounds can alter absorption of other elements in the gastrointestinal tract. For example can the fluoride absorption be inhibited by the Al, and may decrease the absorption of calcium and iron compounds, and salisylic acid, which may affect the Al absorption. (Klaassen and Casarett, 2008) When Al binds to phosphorus by Al in the GI tract, this can lead to phosphate depletion and potentially, osteomalacia (Klaassen and Casarett, 2008, Flaten, 2002). Al interacts with calcium in bone and kidney, resulting in Al osteodystrophy (Klaassen and Casarett, 2008, Flaten T.P et al., 1996).

There have been discussed a possible relationship between Al and Alzheimer's disease (Flaten, 2001, Flaten, 1988 , Klaassen and Casarett, 2008), and the basis for these discussions is the elevated Al levels in Alzheimer patients´ brains. However, the increased values of Aluminium in Alzheimer's brains can also be a consequence of and not only a cause of the disease. This is because of the reduced effectiveness of the blood-brain barrier in these patients might allow more Al to pass the barrier (Klaassen and Casarett, 2008).

Since Al is very poorly absorbed in the GI tract, a dietary source of Al with high bioavailability could greatly increase the Al uptake. This would occur even if the total Al concentration in this source were not particularly high (Flaten, 2002). Studies investigating the speciation of Al in tea infusions before and after stomach condition treatment indicate a shift to lower molecular mass species under stomach conditions. When the pH increased to 6.3-6.5, as in intestinal condition, a new speciation took place and formed high molecular weight soluble species of two insoluble species.  However, some species could also be stable enough to pass the GI tract unchanged. Lipophility, hydrophility and hydrolytical stability and Al complexes are associated with differences in biological effects, and some organic complexes can be stable enough to pass through the stomach and accumulate in brain and bone (Flaten, 2002).

### 2.4.2 Lead

*Camellia Sinensis* absorb Pb from the surrounding soil, and can accumulate Pb in the leaves. It is reported higher levels of Pb in older leaves than in younger leaves (Karak and Bhagat, 2010). The adverse health effects caused by low-level exposure to Pb have been well documented, and you can find stipulated allowable levels of Pb in food and beverages. Pb concentrations in tea leaves have caused concern to both consumers and producers, as one of the major route of exposure for the general population is from food and water (Klaassen and Casarett, 2008, Karak and Bhagat, 2010, Jin et al., 2005).

By ingestion of lead adults usually absorb 5-15 % and retain 5 %, on the other hand children absorb 42% and retain 32% (Ziegler et al., 1978). The absorption could be enhanced by low dietary intake of iron and calcium, especially in children (Mahaffay, 1990). Absorption through the alveoli in the lungs by airborne lead particles can be relatively efficient, but airborne particles are a minor component of exposure (Klaassen and Casarett, 2008). Pb in blood is primarily in erythrocytes bound to hemoglobin, only 1% of circulating lead in serum is available for tissue distribution. Pb is initially distributed to soft tissues such as kidney and liver, and afterwards redistributed to skeleton and hair. Pb in blood has a half life for about 30 days, while lead in bone has a half life for about 20 years. Lead can be released from bones and contribute to keep blood lead levels high. This is important in adults with accumulated occupational exposure and in women due to bone resorption during pregnancy, lactation, menopause and from osteoporosis. Lead crosses the placenta, and in this way the accumulation in fetal tissues, including the brain of the fetus, is proportional to the mother's blood lead levels (Klaassen and Casarett, 2008).

The most important route of excretion of absorbed lead is the kidney. Renal excretion of lead is usually through glomerular filtrate with some renal tubular resorption. One third of the total excretion of absorbed lead is done by fecal excretion via biliary tract (Klaassen and Casarett, 2008).

Lead can cause a lot of adverse effects in humans depending on the dose and for how long the exposure last. The toxic effects range from inhibition of enzymes to pathology or death(Klaassen and Casarett, 2008). In adults you can see peripheral neuropathy, chronic nephropathy, and hypertension. Children are most sensitive to effects in the central nervous system (Klaassen and Casarett, 2008). It can also lead to learning disabilities and anaemia (Rosen and Needleman, 1992, Jin et al., 2005).

### 2.4.3 Manganese

Manganese (Mn) is an important element in many biochemical processes in plants and usually acts as an activator for different enzymes (Burnell  James N, 1988). According to data, Mn is an element with a significant dietary amount in tea (Street et al., 2006, Powell et al., 1998). Mn is an essential element required for many metabolic and cellular functions in humans (Aschner and Aschner, 2005), and the major source of Mn intake is from food. Vegetables, grains, fruits and nuts are other sources rich on Mn in addition to tea (Aschner and Aschner, 2005, WHO, 2003).

The guideline value of Mn in drinking water prescribed by WHO is 0.4 mg/L (WHO, 2003), and estimated daily dietary intake is 2-5 mg (Powell et al., 1998). Route of Mn excretion is with the feces. It is eliminated in the bile and reabsorbed in the intestine. Biliary excretion is poorly developed in neonates and exposure during this period may result in increased delivery of Mn to the brain and other tissue (Aschner and Aschner, 2005). A high dietary Mn intake can lead to excessive Mn accumulation in the central nervous system. This is called manganism and resembles idiopathic Parkinson's disease, resulting in adverse neurological effects both in laboratory animals and humans (Aschner and Aschner, 2005). It is not clear if deficiency has been demonstrated in humans, but deficiency in animals results in impaired growth, skeletal abnormalities, and disturbed reproductive functions (Klaassen and Casarett, 2008).

### 2.4.4 Chromium

Chromium (Cr) is an essential trace element for human beings and animals (Karak and Bhagat, 2010). Although Cr is essential, it might cause adverse effects introducing Cr to humans through food and beverages (Karak and Bhagat, 2010). Chromium is naturally occurring in soil and plants take up both Cr (III) and Cr (VI), which interfere with metabolic processes, causing toxicity to the plants.

Cr compounds are distributed to all organs of the body, because they are taken up with erythrocytes. This results in high level of Cr in liver, spleen and kidney. Absorbed Cr are excreted primarily in urine (Klaassen and Casarett, 2008). It is thought that toxicity of Cr (VI) compounds results from damage to cellular components, including generation of free radicals and formation of DNA adducts. This is thought to happen during the reduction from Cr (VI) to Cr (III) (Zhitkovich, 2004).

### 2.4.5 Copper

Copper (Cu) is a micronutrient for plants, but at high concentrations Cu can  be phytotoxic (Karak and Bhagat, 2010). Cu is widely distributed in nature, and is an essential element. The major sources of exposure are food, beverages and drinking water (Klaassen and Casarett, 2008). Overconsumption of Cu from food and beverages is also detrimental for human health as well (Kawada et al., 2002), and the content in food and beverages must be controlled (Karak and Bhagat, 2010). Average daily dietary intake of Cu through food and beverages is 2.5 mg/day (Powell et al., 1998) Route of excretion of an oral dose is absorption from the GI tract, primarily in the duodenum. 55-75% of an oral dose of Cu is absorbed. (Klaassen and Casarett, 2008) The most common adverse health effect of excess oral Cu intake is gastrointestinal distress (Klaassen and Casarett, 2008).

### 2.4.6 Nickel

Nickel (Ni) is essential for plant growth at low concentrations, and although it is also one of the most important heavy metals in terms of its potential toxicity to plants and animals (Karak and Bhagat, 2010). It has been said that NI influences iron absorption and metabolism, however biochemical functions is humans and higher animals are not been demonstrated (EFSA, 2006). Nickel are found to be carcinogenic, but the carcinogenicity of nickel compounds which occurs through inhalation mainly as a result of occupational exposure does not appear to be relevant to oral exposure from low levels in food, although data are lacking in this area (EFSA, 2006).

### 2.4.7 Fluoride

Tea is also a major contributor to human's dietary fluoride (F) intake. AlFx complexes contribute to total soluble Al and F in the soil where pH is generally less than 5.5. When pH is that low, the complex would decompose and the plants roots will absorb the free $F^-$ ion passively and the ion will be transported to the young leaves (Karak and Bhagat, 2010).

Fluorine is a halogen element and the most reactive non-metal. Chemical behaviour and properties are mainly different from other halogens elements. F an important anion too and occurs in various environmental, clinical and food samples. Fluorine is both beneficial oligoelement – that means that it is needed for growth and bone tissue upholding, teeth and toxic (Giljanovic et al., 2012). Mild dental fluorosis is seen as white areas on the tooth surface, and as yellow and brown to black stains in its severe form. In areas with endemic levels of fluorosis, dental fluorosis is more common. Skeletal fluorosis can occur after long-term exposure of high doses with fluoride, and the element is mainly deposited in the neck, knee, pelvic, and shoulder joints and/or bone, which makes it difficult to walk or move. (Klaassen and Casarett, 2008). Higher $F^-$ concentration in the human body can be resulted by living in polluted environment and feeding with polluted food. Acute fluoride intoxication can have neurological complications, urinary stone formation and hypocalcaemia as consequences on endemic patients (Giljanovic et al., 2012). There are also papers that link cancer with fluoride intake (Giljanovic et al., 2012).

The GI tract absorbs 75-90% of the fluorides, and then it is distributed throughout the body. Approximately 99% of the fluoride in the body is found in bones and teeth. The hydroxyl ion in hydroxyapatite in bones is replaced by the fluoride ion to form hydroxyfluoapatite. The fluoride in bone can be remobilized slowly s a result of the ongoing process of bone remodelling, especially in young children. The fluoride is transported across the placenta, but poorly transferred to breast milk. Fluoride is mainly excreted in urine, and the levels in urine and in plasma are related to intake and are used as a biomarker for excess exposure. Hair, fingernails and tooth enamel are indicators of long-term exposure (Klaassen and Casarett, 2008).

The content of trace elements in tea infusions from some other publications are presented in Table 2. They were selected from following criteria's: all infusions were prepared of leaves from *Camellia Sinensis*, there are both black tea, green tea and oolong tea, and the infusion methods used are almost the same as in this study.

**Table 2: Trace elements in tea infusion from some other publications.**

| Country of origin | Sample analysed | Number of samples | Extraction procedure* | Concentration range | Reference |
|---|---|---|---|---|---|
| *Aluminium (Al) (mg/L)* | | | | | |
| China and India | Black tea | 4 | 1 | 2-4 | (Varo and Koivistoinen, 1980) |
| Unknown | Black tea | 5 | 2 | 2,0-6,2 | (Flaten, 1988 ) |
| China | Black tea | - | | 2,0-6,0 | (Chen, 1984) |
| India | Black tea | 5 | 3 | 3,72 | (Natesan and Ranganathan, 1990) |
| China | Green, black and oolong | 18 | 4 | 2,3-2,5 | (Wong, 1998) |
| China, India, Indonesia, Japan, Sri Lanka and Thailand | Green tea | 17 | 6 | 1,88-16,52 | (Nookabkaew. S, 2006) |
| Turky | Black tea | 100 | 7 | 1,66-5,35 | (Sofuoglu and Kavcar, 2008) |
| China | Green and black tea | 2 | 5 | 2,45-6,76 | (Fung et al., 2003) |
| China | Oolong | 9 | 8 | 1,5-5,4 | (Fung et al., 2009) |

| Country of origin | Sample analysed | Number of samples | Extraction procedure* | Concentration range | Reference |
|---|---|---|---|---|---|
| China | Green tea | 7 | 8 | 0,7-5,5 | (Fung et al., 2009) |
| *Chromium (Cr) (µg/L)* | | | | | |
| India | Black tea | 5 | 3 | 1,7 | (Natesan and Ranganathan, 1990) |
| Turkey | Black tea | 100 | 7 | 1,58-43,2 | (Sofuoglu and Kavcar, 2008) |
| *Copper (Cu) (µg/L)* | | | | | |
| India | Black tea | 5 | 3 | 0,69 | (Natesan and Ranganathan, 1990) |
| China | Green,black and oolong | 18 | 4 | 0,029-0,061 | (Wong, 1998) |
| China, India, Indonesia, Japan, Sri Lanka and Thailand | Green tea | 17 | 6 | 0,04-0,24 | (Nookabkaew. S, 2006) |
| Turky | Black tea | 100 | 7 | 3,57-65,4 | (Sofuoglu and Kavcar, 2008) |
| Ceylon, India and Iran | Black tea | 11 | 9 | 2,38-9,00 | (Salahinejad and Aflaki, 2010) |
| *Fluoride (F) (mg/L)* | | | | | |
| Unknown | Green tea | 12 | 7 | 0,0064-0,016 | (Giljanovic et al., 2012) |
| China | Green tea and black tea | 2 | 5 | 2,45-6,76 | (Fung et al., 2003 |
| China,Japan,Sri Lanka and India | Black tea | 12 | 10 | 1,08-1,32 | Cao et al., 2004) |
| Turkey | Black tea | 100 | 7 | 0,34-1,48 | (Sofuoglu and Kavcar, 2008) |
| *Lead (Pb) (µg/L)* | | | | | |
| India | Black tea | 5 | 3 | 0,038 | (Natesan and Ranganathan, 1990) |
| China, India, Indonesia, Japan, Sri Lanka and Thailand | Green tea | 17 | 6 | 0,004-0,032 | (Nookabkaew. S, 2006) |
| *Manganese (Mn) (mg/L)* | | | | | |
| India | Black tea | 5 | 3 | 1,24 | (Natesan and Ranganathan, 1990) |
| China, India, Indonesia, Japan, Sri Lanka and Thailand | Green tea | 17 | 6 | 1,38-7,42 | (Nookabkaew. S, 2006) |

| Country of origin | Sample analysed | Number of samples | Extraction procedure* | Concentration range | Reference |
|---|---|---|---|---|---|
| Turkey | Black tea | 100 | 12 | 0,188-2,105 | (Sofuoglu and Kavcar, 2008) |
| Ceylon, India and Iran | Black tea | 11 | 13 | 125,8-164,0 | (Salahinejad and Aflaki, 2010) |
| Ceylon | Black tea | 4 | 13 | 88,7-249,4 | (Salahinejad and Aflaki, 2010) |
| *Nickel (Ni) (mg/L)* | | | | | |
| India | Black tea | 5 | 14 | 0,118 | (Natesan and Ranganathan, 1990) |
| China, India, Indonesia, Japan, Sri Lanka and Thailand | Green tea | 17 | 11 | 0,04-0,16 | (Nookabkaew. S, 2006) |
| Turkey | Black tea | 100 | 12 | 0,001-0,049 | (Sofuoglu and Kavcar, 2008) |
| Ceylon, India and Iran | Black tea | 11 | 15 | 1,86-7,65 | (Salahinejad and Aflaki, 2010) |

*1:2 g tea+100 mL deionized water, simmered for 5 min; 2: 1 g tea+100 mL distilled water, infused for 5 min.; 3:2 g tea+100 mL boiling water for 1 min; 4: 2 g tea + 200 mL boiling distilled water, 5 min.; 5: 1 g tea +100mL double-distilled water, infused at 100 °C for 5 min; 6: 2.0 g tea+100 mL of boiling deionized water, sample was left at room temperature for 5 min; 7:2 g tea+200 mL ultrapure water, boiled for 15 min; 8: 2g tea +200 mL double-distilled water, infused at 90°C for 30 min; 9: 1 g tea + 45 mL hot distilled water, kept for 5 min; 10: 2 g tea+200 mL deionized water, infused for 10 min at 100°C;11: 2,0 g tea + 100 mL of boiling deionized water, sample was left at room temperature for 5 min; 12: 2 g tea + 200 mL ultra pure water, boiled for 15 min;13: 1 g tea+45 mL hot distilled water, kept for 5 min; 14: 2 g tea+ 100 mL boiling water for 1 min; 15: 1 g tea+45 mL hot distilled water, kept for 5 min.

## 3. Materials and Methods:

### 3.1 Selection of teas

85 different teas were analysed in this study; 40 samples from three different supermarkets in Trondheim, 30 samples from the local tea and coffee shop (Te og kaffehuset) and 15 samples collected from Polish supermarkets and tea shops.

The teas from the Norwegian supermarkets were selected based on the supermarkets assortment (Appendix 1). Information of the different supermarkets assortment were collected and the teas the supermarkets had in common were assumed to be some of the most popular ones. This assumption was made out of how much space the different teas got in the stores shelf. Some of the selected samples were also personal favourites, and some of the samples were selected, to easier make comparisons. The Norwegian market is dominated by two major tea producers; Twinings and Lipton, as can be seen in Appendix 1. Some teas from a few other producers were also selected an analysed.

30 of the samples were provided by the local tea and coffee shop. These samples were a selection from their most popular and best-selling teas (Appendix 1). The collection included black tea, green tea, oolong and white tea. 15 infusions from Poland were included, in order to investigate differences between the two countries.

### 3.2 Preparation of tea infusions

Tea infusions were made by adding 100 mL boiled ultrapure water to 1.0 g of loose tea or one tea bag (~2 g). Bottles used for the infusion period were in advance rinsed three times with ultrapure water. The tea, together with blanks and reference material, was infused for 5 minutes before the sample was filtrated with 0.45 µm filter. A syringe (50 mL) was filled with the infused tea and injected through the filter. This procedure was done two times to rinse the syringe and the filter before the sample (15 mL) was filled in ICP-MS tubes (rinsed 2x with the filtered infusion) and added 5 droplets of ultra pure concentrated nitric acid ($HNO_3$). The samples were diluted 6.67x with ultrapure water and then analysed with ICP-MS (see details of the instrument conditions in Appendix 2).

Method detection limits (MDL) were calculated by 3 times the standard deviation of the blanks, or on the instrument detection limits (IDL). The IDLs were estimated from the subsequent analysis of solutions, containing decreasing, low concentrations of the element. Finally, the concentration resulting in a relative standard deviation of approximately 25% (n=3) scans were selected as IDL with baseline corrections applied for these values. The detection limit was calculated from the method that resulted in the highest values. Elements with 50 % of the samples below the detection limit were excluded. The detection limits are listed in Appendix 3.

Sample C41, N6, N16 and N31 were analysed three times to determine and calculated the relative standard deviation (RSD) from the ICP-MS analysis. The RSDs are listed in Appendix 4.

### 3.3 Reference material

Two types of certified reference material; Tea Leaves GBW-07605 and certified material from Institute of Nuclear Chemistry and Technology Warszawa- Poland, Polish Virginia Tobacco Leaves were analysed for comparing the accuracy, calibration of the instrument and to evaluate the results of the Norwegian and Polish tea infusions samples.

Reference material (~250-450 mg) was put in a Teflon tube, that had been rinsed 3x with ultrapure water, and 50% $HNO_3$ (6 mL) was added before digestion with Ultra Clave, see Appendix 5 for further information on the temperature profile. The samples were then diluted with ultrapure water until 0.6M $HNO_3$, and then transferred to ICP-MS tubes (15 mL). The determined concentrations for the two reference materials are listed in Appendix 6.

Inductively coupled plasma mass spectrometry (ICP-MS) was used to detect the different elements in the infusions, while the fluoride content was determined by use of a fluoride ion selective electrode.

### 3.4 Fluoride detected by the use of ISE

Total ionic strength adjustment buffer (TISAB) solution was prepared by adding 1M sodium chloride, 0.25M acetic acid, 0.75M Sodium acetate and 0.001M Sodium citrate in a volumetric beaker (1L) and filled with ultrapure water.

A standard solution of Sodiumfluoride (0.0491M, NaF) was made of dried NaF (110 °C for 2 hours). Standard solutions from 0.1, 0.2, 0.5, 0.7, 1, 5, 15 and 50 mL of the stock solution were put in beakers (100 mL) and 10 mL of the TISAB solution was added. The rest was filled with ultrapure water. The TISAB solution regulates the ionic strength of samples and standard solutions and adjusts the pH. It also avoids interferences by polyvalent cations such as Al (III), Fe (III) and Si (IV) that are able to complex or precipitate with fluoride, and reduce the free fluoride in the solution. (Sofuoglu and Kavcar, 2008) The fluoride level was measured with the ion selective electrode in the standard solutions, starting with the lowest concentration and a standard curve was made. See Appendix 7 for details regarding the standard curve.

The tea infusions were filtrated with a 0.45µm filter before 25 mL was added in a beaker (100mL) with TISAB solution (10 mL) and ultrapure water. The beaker was in advance rinsed three times with ultrapure water. The fluoride level was then determined in each of the 70 Norwegian infusions, together with blanks and triplicates. The fluoride level was also measured in 4 samples of tea that had been infused for 30 minutes. The average of the blanks were subtracted from the calculated fluoride concentrations and the concentrations were corrected for final volume and gram of tea in the infusion, before the fluoride concentrations were calculated in mg/L per gram of tea used in the infusions. This can be seen in Appendix 7, together with relative standard deviation (RSD), calculated for the triplicates N16 and N31.

### 3.5 Principal component analysis

A Principal component analysis (PCA) was perfomed using SIMCA (Version 13, Umetrics, Umeå, Sweden) to manage group and sort the results. PCA extracts the most important information and patterns from a data set; it excludes much of the noise, and simplifies the data set while retaining the maximum level of variation. The simplified information is expressed as a set of new variables called principal components. The first principal component contain the highest level of variance and the second the highest possible level of variance under the constraint of being orthogonal to the first principal component (Abdi and Williams, 2010).

Two PCA plots were created, one of the samples (score plot) and another of the variables (loading plot). Samples that group, or are closely associated in the score plot, can be expected to show similar variable compositions. Variables that cluster or are in the same area in the loading plot are likely to correlate positively. Possible outliers can be examined using the Hotellings T2 with a 95% confidence interval that forms an ellipse in the score plot. Student T-test was performed using Statistica.

## 4 Results

### 4.1 Trace elements detected by use of ICP-MS

Data from the ICP-MS analysis can be seen in Appendix 1. The average values, standard deviation and the range for each element are presented in Table 3. In Table 4, the concentration of detected elements per cup is listed. These results are further discussed in section 5 Discussion.

**Table 3: Average ± standard deviation, and range of detected trace elements in tea infusions (µg/L) from Poland (Po) and Norway (No). The results are grouped in loose tea and tea bag.**

| | | Y | Cd | Sn | Cs | Ce |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.106±0.0698 (0.0184-0.234) | 0.0145±0.0138 (0.00308-0.0528) | 0.00863±0.00769 (0.00123-0.0294) | 1.45±1.15 (0.253-3.24) | 0.0639±0.0396 (0.0129-0.155) |
| | No | 0.177±0.176 (0.0125-0.936) | 0.0217±0.0114 (0.00607-0.0487) | 0.0144±0.0194 (0.000412-0.0932) | 3.38±4.99 (0.131-28) | 0.0876±0.0438 (0.02-0.18) |
| Tea bag | Po | 0.348±0.187 (0.0479-0.651) | 0.0215±0.0148 (0.00992-0.059) | 0.00785±0.00661 (-0.0000778-0.0218) | 6.7±12.6 (0.721-40.7) | 0.18±0.205 (0.0563-0.735) |
| | No | 0.552±0.293 (0.112-1.4) | 0.0652±0.0704 (0.00561-0.425) | 0.0533±0.217 (-0.00122-1.34) | 6.69±5.61 (0.209-19.2) | 0.384±0.32 (0.0195-1.44) |
| | | **Pr** | **Nd** | **Sm** | **Tb** | **Dy** |
| Loose tea | Po | 0.0121±0.00743 (0.00101-0.0244) | 0.047±0.0285 (0.00734-0.0956) | 0.0119±0.00659 (0.0034-0.0225) | 0.00268±0.00159 (0.000602-0.00571) | 0.0156±0.00952 (0.00263-0.0314) |
| | No | 0.018±0.018 (0.00288-0.111) | 0.0762±0.0735 (0.00984-0.441) | 0.0172±0.0147 (0.0012-0.0807) | 0.00392±0.00373 (0.000266-0.0173) | 0.0249±0.0216 (0.00225-0.112) |
| Tea bag | Po | 0.0429±0.022 (0.00791-0.0764) | 0.163±0.082 (0.0301-0.286) | 0.0365±0.0175 (0.00888-0.06) | 0.00753±0.00399 (0.00145-0.0136) | 0.0481±0.0255 (0.00772-0.0862) |
| | No | 0.0627±0.0412 (0.00693-0.178) | 0.258±0.162 (0.0311-0.666) | 0.0618±0.0367 (0.0074-0.142) | 0.012±0.00657 (0.00191-0.0271) | 0.0793±0.0421 (0.0149-0.185) |

| | | Ho | Er | Tm | Yb | Lu |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.00351±0.00238<br>(0.000611-0.00743) | 0.0109±0.00729<br>(0.00108-0.0243) | 0.00186±0.00133<br>(0.000234-0.00457) | 0.0104±0.007<br>(0.00211-0.0252) | 0.0019±0.00142<br>(0.000148-0.00507) |
| | No | 0.00562±0.00547<br>(0.000187-0.0286) | 0.0182±0.0183<br>(0.000623-0.0923) | 0.00306±0.00312<br>(0.000159-0.0159) | 0.0212±0.022<br>(0.00143-0.11) | 0.00333±0.00356<br>(0.000168-0.0184) |
| Tea bag | Po | 0.0114±0.00656<br>(0.00164-0.0216) | 0.0345±0.0196<br>(0.00492-0.0663) | 0.00572±0.00367<br>(0.000539-0.0129) | 0.0373±0.0223<br>(0.0036-0.0784) | 0.0069±0.0042<br>(0.000891-0.0151) |
| | No | 0.0178±0.00967<br>(0.0031-0.0416) | 0.0575±0.0318<br>(0.0104-0.14) | 0.00948±0.00513<br>(0.00168-0.0228) | 0.0635±0.0353<br>(0.00886-0.154) | 0.0102±0.00578<br>(0.00147-0.0268) |
| | | Hf | Tl | Pb | Th | U |
| Loose tea | Po | 0.0015±0.000904<br>(0.000622-0.00323) | 0.203±0.194<br>(0.0131-0.609) | 0.521±1.09<br>(0.0432-3.92) | 0.00263±0.00238<br>(0.000493-0.00714) | 0.00391±0.00416<br>(0.000575-0.0143) |
| | No | 0.000928±0.00069<br>(-0.0000561-0.0035) | 0.282±0.217<br>(0.038-0.872) | 0.392±0.323<br>(0.0213-1.3) | 0.00396±0.00226<br>(0.000819-0.0111) | 0.00725±0.00632<br>(0.000589-0.0278) |
| Tea bag | Po | 0.00162±0.00121<br>(0.000811-0.00477) | 0.31±0.362<br>(0.0446-1.09) | 0.315±0.497<br>(0.0227-1.6) | 0.00384±0.00334<br>(0.00134-0.0124) | 0.0131±0.0161<br>(0.00307-0.055) |
| | No | 0.00152±0.00117<br>(-0.0000975-0.0061) | 0.499±0.335<br>(0.0368-1.4) | 0.759±0.647<br>(0.0473-2.32) | 0.016±0.0174<br>(0.000304-0.0545) | 0.0234±0.0195<br>(0.00124-0.0767) |
| | | Li | B | Na | Mg | Al |
| Loose tea | Po | 0.201±0.117<br>(0.0412-0.412) | 19±10.8<br>(8.24-44.5) | 133±115<br>(31.8-404) | 3310±1260<br>(1620-6170) | 1100±496<br>(144-1810) |
| | No | 0.406±0.204<br>(0.0527-0.918) | 31.9±19.4<br>(5.71-91.9) | 260±248<br>(41.9-1020) | 4190±2000<br>(1540-9260) | 1850±1120<br>(316-5300) |
| Tea bag | Po | 0.493±0.312<br>(0.207-1.25) | 48.9±24.7<br>(28.9-95.8) | 712±1610<br>(74.8-5230) | 4930±1090<br>(2930-6860) | 3240±1480<br>(1860-5910) |
| | No | 1.23±0.776<br>(0.077-2.84) | 75.2±27.9<br>(24.5-141) | 5150±5610<br>(115-18300) | 9910±2460<br>(4460-15000) | 5760±2330<br>(1150-12100) |

| | | Si | P | S | K | Ca |
|---|---|---|---|---|---|---|
| Loose tea | Po | 56.2±55.3 (4.92-207) | 8770±2220 (5370-13600) | 5960±1700 (3600-9130) | 96200±20500 (57200-121000) | 420±149 (192-649) |
| | No | 144±92.7 (21.7-452) | 9430±3700 (3850-24800) | 6870±1910 (2600-10800) | 111000±26800 (50400-159000) | 796±459 (378-2630) |
| Tea bag | Po | 153±112 (42.9-302) | 8390±1820 (4450-11000) | 7380±1520 (5110-9390) | 110000±18600 (75500-134000) | 966±472 (494-1660) |
| | No | 412±207 (71-1140) | 14200±4490 (4700-24700) | 15500±5010 (4270-37200) | 185000±48100 (56600-279000) | 3040±2180 (417-12600) |
| | | Ti | V | Cr | Mn | Fe |
| Loose tea | Po | 0.123±0.032 (0.0636-0.167) | 0.0455±0.024 (0.0156-0.0867) | 0.842±1.09 (0.124-3.78) | 797±441 (279-1780) | 7.34±4.17 (2.77-15.1) |
| | No | 0.192±0.0533 (0.0912-0.303) | 0.0446±0.0236 (0.00946-0.116) | 0.635±0.99 (0.065-5.6) | 1100±863 (273-5140) | 13.8±10.3 (2.79-51.7) |
| Tea bag | Po | 0.136±0.0305 (0.0939-0.173) | 0.0776±0.0505 (0.0164-0.178) | 2.85±2.06 (0.354-6.97) | 1800±789 (291-2930) | 8.53±8.71 (3.9-32.9) |
| | No | 0.334±0.168 (0.163-1.12) | 0.116±0.0725 (0.0164-0.361) | 2.52±1.77 (0.191-8.86) | 2990±1220 (744-5710) | 29.8±21.2 (5.73-73.7) |
| | | Co | Ni | Cu | Zn | Sr |
| Loose tea | Po | 0.455±0.272 (0.124-1.15) | 12.6±6.4 (4.87-25.9) | 21.5±5.95 (12.6-32.3) | 59.6±17.5 (34.3-90.3) | 1.98±1.45 (0.166-5.38) |
| | No | 0.677±0.573 (0.187-2.92) | 19.2±8.28 (6.69-40.6) | 28.1±15.7 (1.4-80.7) | 67.4±33.2 (23.2-147) | 4.49±2.44 (1.27-11) |
| Tea bag | Po | 0.538±0.341 (0.135-1.07) | 20.8±6.81 (11.4-29.6) | 35.5±8.83 (23.9-50.3) | 74.8±27.2 (45.3-120) | 6.58±3.33 (1.45-12.3) |
| | No | 1.67±0.718 (0.587-3.11) | 49.7±20.1 (7.64-87.8) | 70.3±29.2 (14.9-128) | 132±45 (57.2-262) | 18.1±10.5 (2.51-47.3) |

| | | Ru | Ba | La | Nb | Rb |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.00431±0.00196 (0.00139-0.00788) | 4.26±3.11 (0.59-9.37) | 0.0497±0.0306 (0.0093-0.0942) | 0.00217±0.00161 (0.000341-0.00514) | 311±135 (114-554) |
| | No | 0.00923±0.00472 (0.00241-0.0201) | 9.21±5.74 (1.36-23.8) | 0.0811±0.0825 (0.0141-0.514) | 0.00398±0.00207 (0.000696-0.0118) | 364±165 (126-810) |
| Tea bag | Po | 0.00502±0.00296 (0.000667-0.0108) | 19±17.9 (1.69-49.7) | 0.19±0.0999 (0.028-0.321) | 0.00205±0.0014 (-0.000885-0.00423) | 464±146 (155-676) |
| | No | 0.0132±0.00438 (0.0039-0.0242) | 42.8±27.3 (2.38-90.4) | 0.278±0.201 (0.0337-0.902) | 0.00658±0.00222 (0.00111-0.0109) | 584±191 (170-882) |

**Table 4: Results from calculation of trace elements per cup of tea, when a cup is 200 mL. All results are given in µg/cup of tea. The results are grouped in to loose tea, tea bag, Norwegian and Polish tea. For each element the average ± standard deviation and range.**

| | | Y | Cd | Sn | Cs | Ce |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.0212±0.014 (0.00367-0.0467) | 0.00289±0.00276 (0.000616-0.0106) | 0.00173±0.00154 (0.000246-0.00588) | 0.29±0.23 (0.0506-0.648) | 0.0128±0.00792 (0.00258-0.0311) |
| | No | 0.0354±0.0353 (0.00249-0.187) | 0.00434±0.00228 (0.00121-0.00974) | 0.00288±0.00387 (0.0000823-0.0186) | 0.677±0.998 (0.0263-5.6) | 0.0175±0.00876 (0.004-0.036) |
| Tea bag | Po | 0.0696±0.0373 (0.00958-0.13) | 0.0043±0.00297 (0.00198-0.0118) | 0.00157±0.00132 (-0.0000156-0.00437) | 1.34±2.52 (0.144-8.15) | 0.0361±0.041 (0.0113-0.147) |
| | No | 0.11±0.0587 (0.0224-0.279) | 0.013±0.0141 (0.00112-0.0851) | 0.0107±0.0433 (-0.000243-0.269) | 1.34±1.12 (0.0418-3.84) | 0.0769±0.0641 (0.00389-0.289) |
| | | **Pr** | **Nd** | **Sm** | **Tb** | **Dy** |
| Loose tea | Po | 0.00242±0.00149 (0.000201-0.00489) | 0.00939±0.00569 (0.00147-0.0191) | 0.00238±0.00132 (0.00068-0.0045) | 0.000536±0.000318 (0.00012-0.00114) | 0.00312±0.0019 (0.000527-0.00628) |
| | No | 0.00359±0.00361 (0.000577-0.0222) | 0.0152±0.0147 (0.00197-0.0883) | 0.00343±0.00293 (0.00024-0.0161) | 0.000783±0.000747 (0.0000532-0.00347) | 0.00498±0.00433 (0.000451-0.0225) |
| Tea bag | Po | 0.00858±0.0044 (0.00158-0.0153) | 0.0327±0.0164 (0.00602-0.0572) | 0.00729±0.00351 (0.00178-0.012) | 0.00151±0.000799 (0.000289-0.00272) | 0.00961±0.0051 (0.00154-0.0172) |
| | No | 0.0125±0.00825 (0.00139-0.0355) | 0.0515±0.0323 (0.00621-0.133) | 0.0124±0.00735 (0.00148-0.0284) | 0.00241±0.00131 (0.000382-0.00542) | 0.0159±0.00843 (0.00298-0.037) |

| | | Ho | Er | Tm | Yb | Lu |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.000702±0.000475 (0.000122-0.00149) | 0.00218±0.00146 (0.000216-0.00485) | 0.000372±0.000265 (0.0000468-0.000915) | 0.00208±0.0014 (0.000422-0.00505) | 0.000381±0.000283 (0.0000295-0.00101) |
| | No | 0.00112±0.00109 (0.0000374-0.00572) | 0.00365±0.00366 (0.000125-0.0185) | 0.000612±0.000624 (0.0000317-0.00319) | 0.00425±0.00439 (0.000286-0.022) | 0.000665±0.000712 (0.0000337-0.00367) |
| Tea bag | Po | 0.00228±0.00131 (0.000328-0.00433) | 0.0069±0.00392 (0.000983-0.0133) | 0.00114±0.000735 (0.000108-0.00258) | 0.00745±0.00446 (0.00072-0.0157) | 0.00138±0.000839 (0.000178-0.00303) |
| | No | 0.00357±0.00193 (0.000621-0.00833) | 0.0115±0.00637 (0.00208-0.028) | 0.0019±0.00103 (0.000337-0.00457) | 0.0127±0.00706 (0.00177-0.0307) | 0.00205±0.00116 (0.000295-0.00535) |

| | | Hf | Tl | Pb | Th | U |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.0003±0.000181 (0.000124-0.000645) | 0.0407±0.0388 (0.00262-0.122) | 0.104±0.218 (0.00865-0.785) | 0.000526±0.000476 (0.0000986-0.00143) | 0.000783±0.000833 (0.000115-0.00287) |
| | No | 0.000186±0.000138 (-0.0000112-0.000701) | 0.0565±0.0435 (0.0076-0.174) | 0.0785±0.0646 (0.00426-0.261) | 0.000791±0.000452 (0.000164-0.00222) | 0.00145±0.00126 (0.000118-0.00557) |
| Tea bag | Po | 0.000325±0.000241 (0.000162-0.000954) | 0.062±0.0723 (0.00893-0.219) | 0.063±0.0993 (0.00453-0.32) | 0.000769±0.000668 (0.000268-0.00248) | 0.00262±0.00322 (0.000614-0.011) |
| | No | 0.000303±0.000233 (-0.0000195-0.00122) | 0.0997±0.067 (0.00737-0.28) | 0.152±0.129 (0.00947-0.464) | 0.00321±0.00347 (0.0000608-0.0109) | 0.00468±0.00391 (0.000249-0.0153) |
| | | **Li** | **B** | **Na** | **Mg** | **Al** |
| Loose tea | Po | 0.0401±0.0234 (0.00825-0.0823) | 3.8±2.16 (1.65-8.89) | 26.5±22.9 (6.36-80.8) | 662±251 (324-1230) | 221±99.2 (28.9-362) |
| | No | 0.0812±0.0408 (0.0105-0.184) | 6.38±3.88 (1.14-18.4) | 52.1±49.6 (8.39-204) | 838±401 (308-1850) | 369±224 (63.1-1060) |
| Tea bag | Po | 0.0986±0.0624 (0.0414-0.25) | 9.78±4.93 (5.78-19.2) | 142±323 (15-1050) | 986±217 (587-1370) | 649±297 (371-1180) |
| | No | 0.246±0.155 (0.0154-0.567) | 15±5.59 (4.9-28.1) | 1030±1120 (23.1-3650) | 1980±491 (893-2990) | 1150±466 (231-2410) |
| | | **Si** | **P** | **S** | **K** | **Ca** |
| Loose tea | Po | 11.2±11.1 (0.985-41.4) | 1750±444 (1070-2710) | 1190±340 (719-1830) | 19200±4100 (11400-24200) | 84±29.8 (38.4-130) |
| | No | 28.7±18.5 (4.33-90.5) | 1890±739 (770-4950) | 1370±382 (521-2160) | 22100±5370 (10100-31800) | 159±91.7 (75.7-525) |
| Tea bag | Po | 30.6±22.3 (8.58-60.4) | 1680±365 (891-2210) | 1480±304 (1020-1880) | 22100±3710 (15100-26700) | 193±94.3 (98.8-332) |
| | No | 82.3±41.5 (14.2-227) | 2830±897 (940-4940) | 3100±1000 (854-7440) | 37100±9630 (11300-55700) | 608±436 (83.4-2530) |

| | | Ti | V | Cr | Mn | Fe |
|---|---|---|---|---|---|---|
| Loose tea | Po | 0.0245±0.0064<br>(0.0127-0.0334) | 0.00911±0.0048<br>(0.00312-0.0173) | 0.168±0.218<br>(0.0248-0.757) | 159±88.2<br>(55.8-355) | 1.47±0.834<br>(0.555-3.01) |
| | No | 0.0384±0.0107<br>(0.0182-0.0606) | 0.00891±0.00473<br>(0.00189-0.0232) | 0.127±0.198<br>(0.013-1.12) | 220±173<br>(54.7-1030) | 2.76±2.07<br>(0.558-10.3) |
| Tea bag | Po | 0.0271±0.00611<br>(0.0188-0.0345) | 0.0155±0.0101<br>(0.00329-0.0356) | 0.569±0.411<br>(0.0708-1.39) | 360±158<br>(58.3-587) | 1.71±1.74<br>(0.781-6.58) |
| | No | 0.0668±0.0336<br>(0.0325-0.224) | 0.0232±0.0145<br>(0.00328-0.0722) | 0.504±0.354<br>(0.0382-1.77) | 598±244<br>(149-1140) | 5.96±4.25<br>(1.15-14.7) |
| | | Co | Ni | Cu | Zn | Sr |
| Loose tea | Po | 0.0911±0.0544<br>(0.0249-0.23) | 2.52±1.28<br>(0.974-5.17) | 4.31±1.19<br>(2.52-6.45) | 11.9±3.5<br>(6.86-18.1) | 0.395±0.29<br>(0.0332-1.08) |
| | No | 0.135±0.115<br>(0.0374-0.583) | 3.84±1.66<br>(1.34-8.12) | 5.63±3.14<br>(0.28-16.1) | 13.5±6.65<br>(4.63-29.4) | 0.897±0.488<br>(0.253-2.21) |
| Tea bag | Po | 0.108±0.0681<br>(0.0271-0.214) | 4.17±1.36<br>(2.28-5.92) | 7.1±1.77<br>(4.77-10.1) | 15±5.43<br>(9.06-23.9) | 1.32±0.667<br>(0.291-2.46) |
| | No | 0.334±0.144<br>(0.117-0.622) | 9.93±4.01<br>(1.53-17.6) | 14.1±5.85<br>(2.99-25.5) | 26.4±9<br>(11.4-52.4) | 3.63±2.1<br>(0.502-9.46) |
| | | Ru | Ba | La | Nb | Rb |
| Loose tea | Po | 0.000862±0.000392<br>(0.000278-0.00158) | 0.853±0.623<br>(0.118-1.87) | 0.00994±0.00611<br>(0.00186-0.0188) | 0.000434±0.000323<br>(0.0000681-0.00103) | 62.2±27<br>(22.9-111) |
| | No | 0.00185±0.000945<br>(0.000483-0.00403) | 1.84±1.15<br>(0.273-4.76) | 0.0162±0.0165<br>(0.00282-0.103) | 0.000796±0.000414<br>(0.000139-0.00236) | 72.7±33<br>(25.1-162) |
| Tea bag | Po | 0.001±0.000592<br>(0.000133-0.00216) | 3.79±3.59<br>(0.337-9.93) | 0.038±0.02<br>(0.00561-0.0641) | 0.00041±0.000279<br>(-0.000177-0.000846) | 92.9±29.1<br>(30.9-135) |
| | No | 0.00264±0.000877<br>(0.000781-0.00484) | 8.56±5.46<br>(0.476-18.1) | 0.0556±0.0402<br>(0.00675-0.18) | 0.00132±0.000444<br>(0.000223-0.00219) | 117±38.2<br>(33.9-176) |

## 4.2 Principal component analysis

PCA revealed patterns between different groupings of the elements in the tea infusions. Results from the fluoride analysis were not included in the PCA plot. The analysis resulted in a model with 4 principal components (In Appendix 8 you can see the details of the model). In order to explain the diverse contents of elements in the infusions, object scores were drawn for samples to which particular teas correspond. All infusions were seen in score plot (Figure 1) and (Figure 2). Plot of loadings can be seen in Figure 3. Results from the Student T-test can be seen in Appendix . Both the PCA and Student T-test are discussed in section 5.3 Principal Component Analysis.

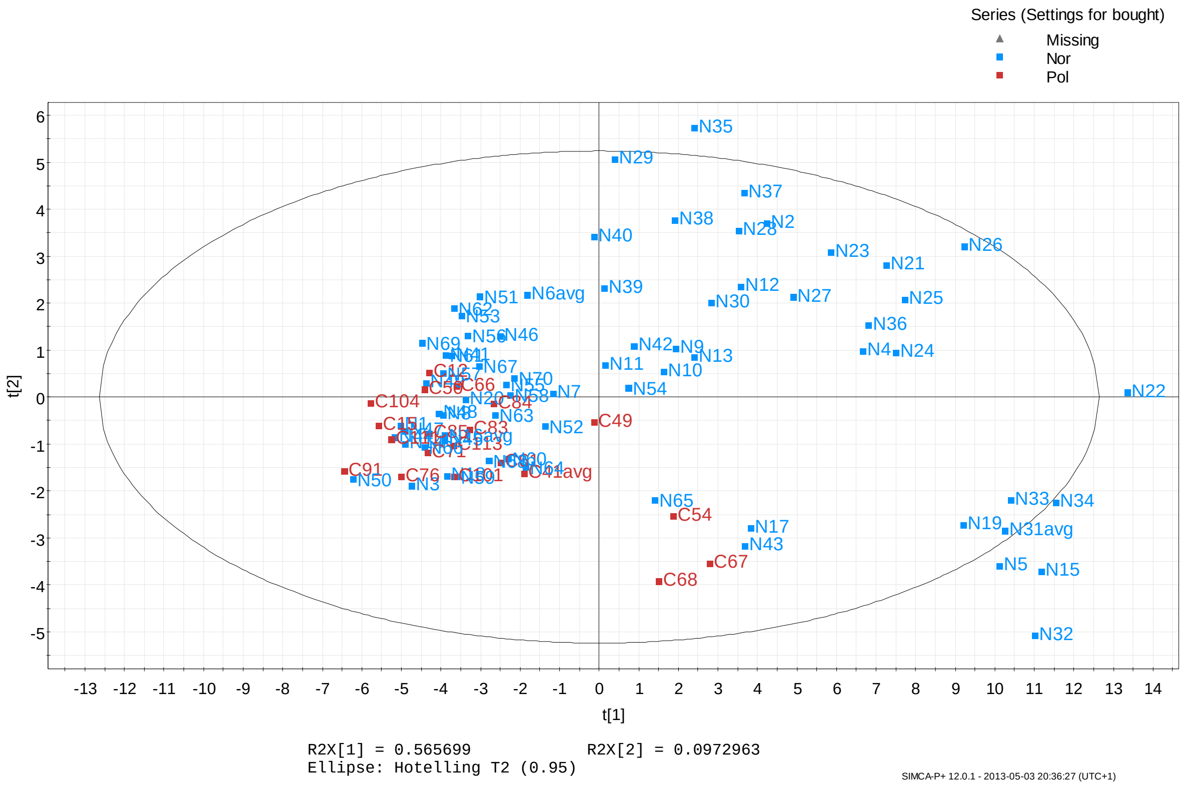


**Figure 1: PCA score plot over the Norwegian (N) and Polish (C) tea infusions, divided into Norwegian (blue) and Polish (red).**

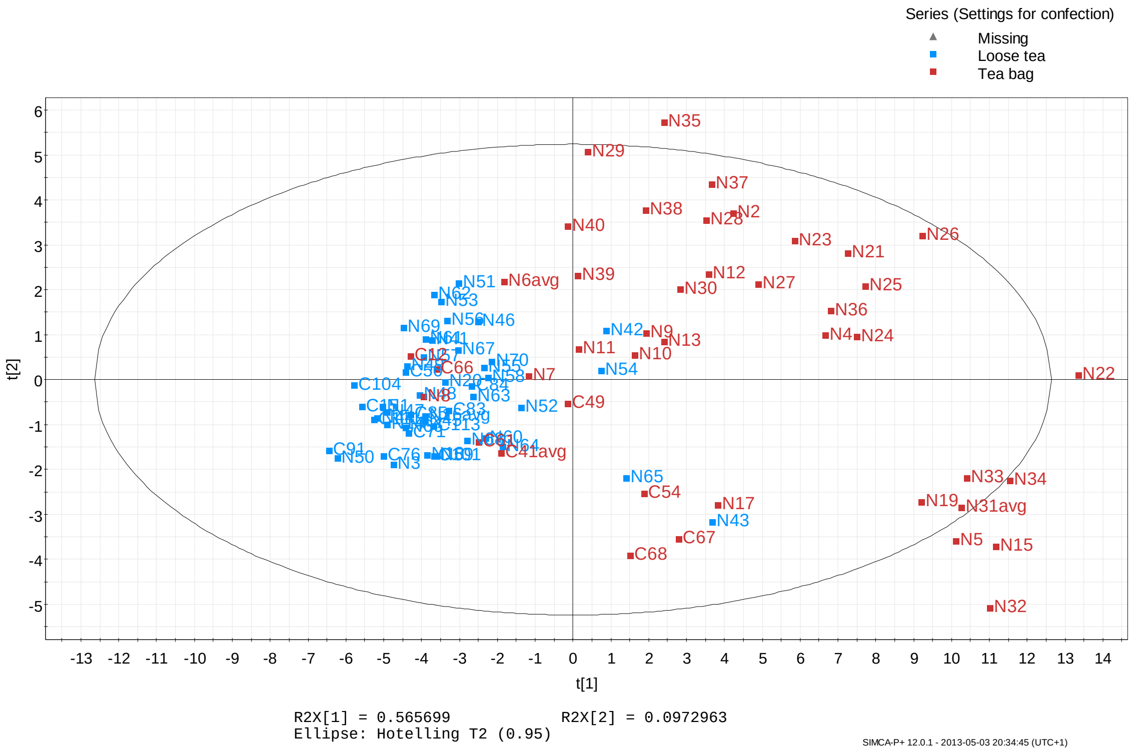


**Figure 2: PCA score plot for the Norwegian (N) and Polish (C) infusions, grouped into loose tea (blue) and tea bag (red).**

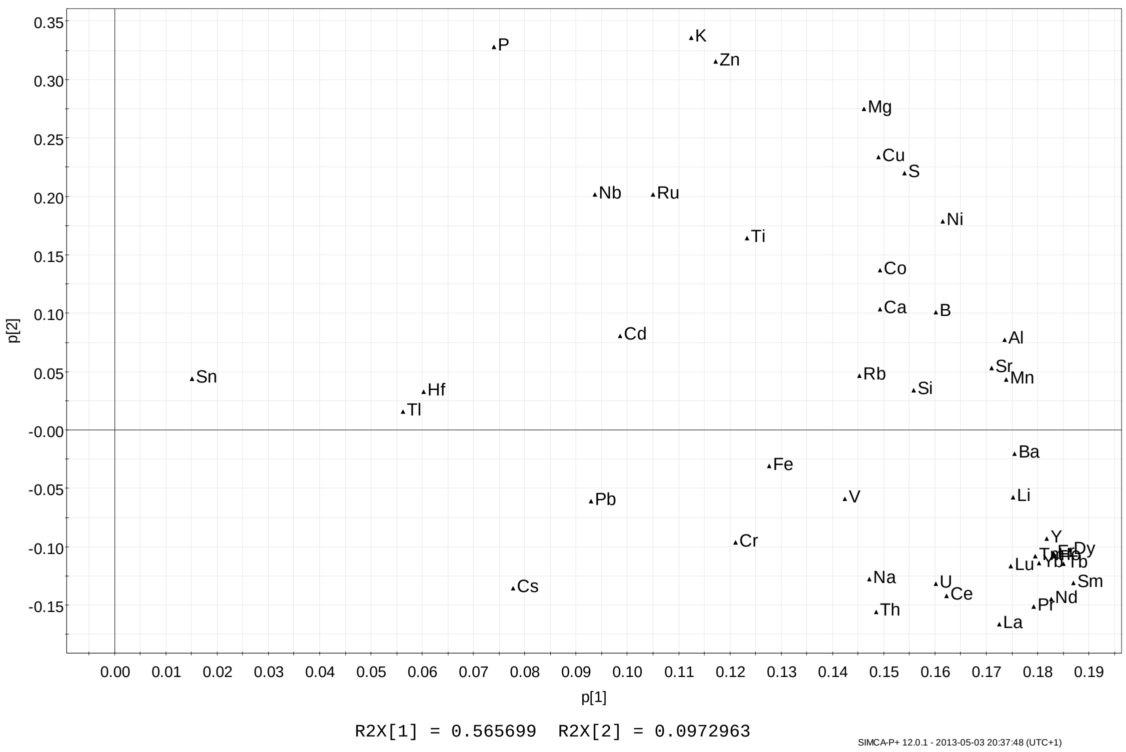


**Figure 3: PCA loading plot for principal component 1 and 2. Includes the chemical elements detected using ICP-MS.**

### 4.3 Fluoride

Data from the fluoride analysis and calculations are listed in Appendix 7. In Table 5 the average, standard deviation, median and range from the fluoride analysis are presented. In Table 6 the fluoride content in one cup of tea (200 mL) is presented. Results are discussed in section 5.22 Fluoride.

**Table 5: Fluoride content in loose tea and in tea bag infused for 5 and 30 minutes. The results are presented as average ± standard deviation, median and range in mg/L.**

| | $F^-$(mg/L) (5 minutes) | $F^-$(mg/L) (30 minutes) |
|---|---|---|
| Loose tea | 5.35±6.26<br>2.65<br>(0.579-34.6) | 1.75±0.934<br>1.75<br>(1.09-2.41) |
| Tea bag | 2.02±1.04<br>1.81<br>(0.77-5.67) | 4.34±0.657<br>4.343<br>(3.88-4.81) |

**Table 6: Fluoride content in one cup of tea (200 mL). Divided in loose tea or tea bag, and presented as average ± standard deviation, median and range in mg/cup.**

| | $F^-$ (mg/cup) |
|---|---|
| Loose tea | 1.07±1.25<br>0.53<br>(0.116-6.92) |
| Tea bag | 0.405±0.208<br>0.362<br>(0.154-1.13) |

## 5 Discussion

### 5.1 Reference material – accuracy

The reference material used in this study were, as earlier mentioned; Tea Leaves GBW-07605 and certified material from Institute of Nuclear Chemistry and Technology Warszawa-Poland, Polish Virginia Tobacco Leaves. Both reference materials were plant material added nitric acid ($HNO_3$) and digested in Ultra Clave. In Appendix 6, one can see from the reference material that the accuracy for most elements is between the 85% confidence interval. For both of the reference materials the results are low in Hf – 12.1% and 2.6%. In addition to Hf, the accuracy is too low in Ag, Be, Dy, Hg, Ho, Lu, Nd, Pr, Si, Sm, Ti, V and Yb in the tea leaves, and in Cr, Cs, Ni, Pb, Th, Sb, Sc, Ta, U and Yb in the reference material Polish tobacco.

The low values of some elements can be explained by the reason that certified results are totally digested, by use of hydrogenflouride (HF) together with $HNO_3$, since $HNO_3$ added before the digestion does not solve all the analytes in the material, for example hafnium (Hf), wolfram (W) and so on. This indicates that the values attained in this study also could be higher, especially for elements as Hf, Ag, Be, Dy, Hg, Ho, Lu, Nd, Pr, Si, Sm, Ti, V, Cr, Cs, Ni, Pb, Th, Sb, Sc, Ta, U and Yb.

For the elements were no accuracy given, it did not exist certified values. Au, Ga, Ge, In, Ir, Nb, Pt, Rh, Tm, W and Zr are not certified in both of the reference material – the tea leaves and the Polish tobacco. In addition to those elements, Er, Sn and U were not certified in the tea leaves, and Be, Dy, Ho, Se and Si were not given in the Polish tobacco.

### 5.2…And precision

In Appendix 4 the relative standard deviation (RSD) from parallel samples is listed. The measurements were performed to investigate the method and its repeatability. For the selected samples three analysis were carried out for sample C41 (Lipton Yellow Label), N6 (Lipton Indian Chai), N16 (Twinings Earl Grey) and N31 (Twinings Apple, cinnamon and raisins).

Concerning the REEs, the variation in precision is higher for these elements. The RSDs are higher when measured values are close to the detection limits. This is because the instrument in this region is having trouble separating the analyte from the noise. Tea sample C41 – Lipton Yellow Label – is the one of the triplicates that is least homogen, since the values are higher than the other triplicates. N16 also have high values of RSDs, while N6 has less high values and in N31 the precision seems to be good since the most elements have an RSD less than 10% and some of them also have a RSD less than 5%. This indicates that there are variability between each of the determined concentrations of the triplicates, and higher RSDs – higher variability.

### 5.3 Principal Component Analysis

PCA reveals, as earlier mentioned, patterns between different groupings of the elements in the different infusions. The analysis resulted in a model with 4 principal components; t[1], t[2], t[3] and t[4] (In Appendix 8 the details of the model can be seen). Factor 4 was not significant with a negative Q2 and a low eigenvalue. The three components described 74,1 % of the variability contained in the raw data set. The eigenvalues of these factors are 25.5 (t[1]), 4.38 (t[2]), 3.49 (t[3]), respectively. In order to explain the causes of the diverse contents of elements in the tea infusions, object scores (Figure 1 and Figure 2) were drawn for the samples.

As can be seen in Figure 1 the Polish infusions are characterised of lower values of component t[1], while the Norwegian infusions are more widely spread characterized by lower and higher values of t[1]. In Figure 2 one can see that infusions where tea bags were used are characterised of higher values of component t[1], in contrast to infusions made of loose tea described by lower values of t[1]. In spite of some overlapping between the infusions with tea bag or loose tea, there is enough clear diversification between the infusions with the lowest and highest values of t1.

In order to state which element that is responsible for the grouping of the infusions, plots of loadings were drawn (Figure 3) for component t[1] and t[2]. The distribution of the points corresponding to the individual elements shows that factor p[1] achieves the lowest loadings for Sn, Tl and Hf. This group is clearly distinct from the group connected with elements such as Ce, Lu, La, Pt, Nd, Sm, Er, Yb, Y, Dy, Tb and Tm, the REEs. This latter group of elements is ascribed to the points mostly corresponding to the infusions brewed with tea bags (Figure 2) i.e. with higher values of t[1]. There were made scores from factor t[1] and t[3] as well, but this did not reveal anything and are therefore left out. N35, N22, N34, N5, N15 and N32 are all outside the Hotelling T2 95% confidence. They are outliers, but not strong enough outliers to pull the PCA toward themselves. It must also be mentioned that with N observations, it is to be expected that around N*0,05 will be found outside the 95% confidence region. Only a handful of these “potential” outliers are likely to be “real” outliers (Eriksson et al., 2006).

### 5.4 Differences in Norwegian and Polish tea infusions

The PCA plot revealed patterns as described over between the Norwegian and Polish infusions (Figure 1). From the student T-test in Appendix 9 (Table 22) one can see that the p-value>0.05 for Sn, Cs, Ce, Pr, Hf, Tl, Pb, U, V and Cr considering the Norwegian and Polish infusions. Therefore, one could suspect that the differences between the latter elements are a coincidence, but for all the other elements there are significant differences. The reason for this difference is difficult to say something about other than that the difference exist, because it is not enough information collected about the different teas and the country of origin. In the Norwegian tea samples from the local tea and coffee store, most of the original countries are known. These are countries from the whole world, which can possibly explain the higher content of elements, due to different local growth conditions.

### 5.5 Differences between infusions made of loose tea and tea bags

In Table 23 one can see that the average of the infusions with tea bag are clearly higher than the mean values for the infusions with loose tea. One explanation is that the tea leaves in the tea bags are more crushed into smaller pieces, and therefore the elements are more extractable than elements in whole leaves. However, the tea bags are often filled with older tea leaves, low cost tea, with a higher content of elements than the younger leaves (Malinowska et al., 2008, Szymczycha-Madeja et al., 2012). If you consider the clustering of the REEs in the plot of loadings (Figure 3), you see that the REEs are present in tea bags in a higher content than in loose tea. Those metals could be easier to extract, or it could be explained by the quality of the leaves used in tea bags or loose tea. If the REEs are not that mobile the older leaves will have higher concentrations. There was no success attaining literature that supported this theory.

As can be seen in Table 23, Sn and Pb have p-values greater than 0.05; therefore, the differences considering tea brewed with bags or loose tea are not significant for these two elements. Considering all the other elements, the differences are significant and cannot be explained by coincidence since $p<0.05$.

### 5.6 Tea infusions with flavour – no flavour

As can be seen from Table 16, there were observed differences in mean values in tea with flavour and no flavour. Mean values of trace elements in tea with added flavours were higher than in regular tea. Cd, Sn, Cs, Hf, Pb, Mg, P, K, Cr, Zn and Rb are not significant with p-values > 0.05. Other elements were considered significant with p-values < 0.05. This indicates that the additatives in the tea might also contribute with a content of elements in the different tea infusions.

### 5.7 Infusion time

There are possibilities that differences in infusion time will affect the results. In this study the tea brewed in 5 minutes, which is a few more minutes than some of the producers recommend in their description. Szymczycha-Madeja et al. (2012) reported that the type of water used for brewing, its temperature, the pH and the infusion time can also affect the yield of the brewing process. This will be further discussed in section 5.22 were some of the samples where brewed for 30 minutes, before the fluoride level was determined in the infusions.

### 5.8 Differences in content of elements in the infusions due to processing of the tea leaves

Tea is, as mentioned earlier, divided into six basic categories by processing: white, yellow, green, oolong, black and pu-erh. The most popular ones are green, oolong and black. When the results from the trace metal analysis were compared and divided into groups of processing, no pattern was seen. However, Szymczycha-Madeja et al. (2012) and Malinowska et al. (2008) report that black and oolong teas very often contain higher concentrations of As, Cd, Cr, Cu, Pb and F than green teas. There are also exceptions, since apparently some green teas have higher concentrations of Al, Cd and Co than other types of tea. As may be anticipated, differences in the elemental composition among tea brands are quite individual. The observed differences are mostly related to methods of the production, type, the amount and the age of the leaves, the season of harvesting, the degree of fermentation, the use of subsequent substances and processes and finally the ways of maturing and storing made teas. Green teas are usually produced from younger leaves than black and oolong and usually contain lower amounts of elements than older leaves (i.e. Al and Pb). Therefore, green teas are characterised by lower concentrations of trace elements.

### 5.9 Sodium

From Table 22 there can be seen huge variations in mean values for Sodium (Na). When the results were observed for possible outliers, there was seen a pattern with higher Na values in tea produced by Twinings, than with the other producers (see Appendix 1). You can especially see vast differences between the two producers Lipton and Twinings, suggesting differences in the manufacturing and processing of the leaves. There are no other publications supporting this theory.

### 5.10 Calcium

The content of Ca in the Norwegian infusions were determined to 796 µg/L (loose tea) and 3040 µg/L (tea bag), while in the Polish infusions the content was less than in the Norwegian infusions 420 µg/L (loose) and 966 µg/L (bag) (Table 3). In Appendix 6 one can see the detected concentrations of Ca in the two reference materials gave accuracy of 101 % (tea leaves) and 106 % (Polish tobacco), which suggests that the determined Ca content in the Norwegian and Polish infusions are accurate. Considering the RSDs for Ca (Appendix 4) the range of variability is 7.4-29.0 % for the four triplicates and this suggests that the variability is high.

The Ca content calculated from one cup of tea is 680 µg in the Norwegian infusions made of tea bags, and 159 µg/cup in the infusions made of loose tea. This is lower than the Norwegian RDAs (Table 1) that ranges from 540 mg-900 mg Ca each day, and even though tea infusions contribute to the Ca intake, drinking tea will not contribute exceeding the RDAs.

### 5.11 Phosphorous

The content of P (Table 3) in Norwegian infusions were 9.4 mg/L (loose) and 14.2 mg/L (bag), while the content in Polish infusions were 8.8 mg/L (loose) and 8.4 mg/L (bag). The differences between the Norwegian and Polish infusions are also observable here. The accuracy is 105% (tea leaves) and 111% (polish tobacco) as can be seen in Appendix 6, which are accurate. The RSDs in Appendix 4 were 18.9%, 3.3%, 10.1% and 3.8%. This means that the variability is not that high, since three of the triplicates are 10% or lower.

Teas infused with tea bags have an averagely content of 2.8 mg P/cup, while in loose tea the content is 1.9 mg P/cup (Table 4). From Table 1 one can see that the concentration of P in Norwegian tea infusions do not contribute to the RDAs (420-900 mg) in any extent.

### 5.12 Potassium

As can be seen from Table 3, the Norwegian infusions contained 0.1 g K/L (loose) and 0.2 g K/L (tea bag), while the Polish infusions contained 0.09 g K/L (loose) and 0.1 g K/L (bag) that corresponds to earlier findings. In Appendix 6 the accuracy of determined reference material; 95.8 % (tea leaves) and 90.5% (Polish tobacco), respectively, suggested that the attained values might have been lower than reported. The RSDs were 19.2 %, 6.4 %, 8.9%

and 3.6 % (Appendix 4) – as one can see, the variability were not that huge, with three triplicates lower than 10%.

The level of K was below the Norwegian RDAs, which are between 1.1 g-3.1 g. The content of K was 37,1 mg/cup in the tea bag infusions and 22,1 mg/cup in the samples brewed with loose tea. This indicates that K in tea infusions does not contribute to the recommended dietary allowances in any extent.

### 5.13 Magnesium

The Norwegian tea infusions contain 4.2 mg Mg/L (loose) and 9.9 mg Mg/L (bag). The Polish infusions contain 3.3 mg Mg/L (loose) and 4.9 mg Mg/L (bag) as given in Table 3. The calculated accuracy determined from analysis of the reference material was 94.1% and 93.2 % (Appendix 6). This means that the attained values can be a little lower than reported. The RSDs were 18.1 %, 14.2 %, 13.8 % and 10.1 % as can be seen in Appendix 4; this means that there is variability between the determined triplicates.

As can be seen in Table 1, the RDAs for Mg are between 80-280 mg. The calculated concentrations of Mg in Norwegian infusions were 0.8 mg/cup (loose) and 2.0 mg/cup (bag). Tea therefore contributes in a low extent to humans recommended dietary allowance for Mg.

### 5.14 Iron

From Table 3 one can see that the Norwegian and Polish tea infusions contained 13.8 µg Fe/L (loose), 29.8 µg Fe/L (bag), 7.34 µg Fe/L (loose) and 8.53 µg Fe/L (bag), respectively. The Polish infusions have also lower concentrations of Fe as the earlier mentioned elements. From Appendix 6 one can see the values of accuracy from the determination of elements in the reference material – 96.1% in tea leaves and 107.3% in the Polish tobacco. This suggests that attained values for Fe in the Norwegian and Polish infusions were accurate. The RSDs listed in Appendix 4; 11.4%, 34.6%, 15.6 % and 5.9% showed some variability in the triplicates and indicates some variability in the concentrations.

The Nowegian RDA for Fe range from 8-15 mg as seen in Table 1. The content of Fe in one cup of tea from the Norwegian market results in an intake of 2.76 µg/L (loose tea) and 5.96 µg/L (tea bag) (Table 4). Drinking tea will therefore not contribute exceeding the limits of RDA, considering the Fe content in the Norwegian and Polish infusions.

### 5.15 Zinc

67.4 µg Zn/L were detected in Norwegian infusions made of loose tea, 132 µg Zn/L in tea bag infusions, while the Polish infusions contained 59.6 µg Zn/L (loose tea) and 74.8 µg Zn/L in infusions made of tea bags, as can be seen in Table 3. From the analysis of the reference materials the accuracy were determined; 103% (tea leaves) and 93.5% (polish tobacco) (Appendix 6). This means that the accuracy is high and that the values attained in this study are accurate. In Appendix 4 the RSDs for the triplicates are listed. Considering Zn the values were 38.5, 3.1, 26.1 and 5.3, these values indicates that the variability is high in two of the triplicates – which indicates that the values in this study have some variability.

The Norwegian RDAs for Zn, listed in Table 1, range from 5 -11 mg. One cup of tea from the Norwegian supermarkets contains 13.5 µg Zn (loose) and 26.4 µg Zn (tea bag) (Table 4), respectively. This means that the content of Zn in tea infusions is so low that it will not affect the recommended dietary allowances for Zn.

### 5.16 Copper

Norwegian tea infusions contain 28.1 µg Cu/L (loose tea) and 70.3 µg Cu/L (tea bag), while Polish infusions contain 21.5 µg Cu/L (loose tea) and 35.5 µg Cu/L (tea bag) (Table 3). These values were a lot higher than attained average values in this study than values reported from some other publications listed in Table 2. This suggests an analytical error in the study. Accuracy determined from analysis of reference material (Appendix 6) resulted in 96.8 % in the tea leaves and 87.7% in the Polish tobacco, which are accurate in the tea leaves, but less accurate in the Polish tobacco. This indicates that values attained could be lower than the ones reported for Cu. The RSDs (Appendix 4) were 13.0%, 8.5%, 8.5% and 4.9% that suggested that the variability was low and that the analysis of Cu in the infusions had high precision, since three of the triplicates had RSDs below 10%.

As can be seen in Table 4, the content Cu in one cup of Norwegian infusions were 5.63 µg/cup in infusions made of loose tea and 14.1 µg/cup in infusions made of tea bags. The Norwegian RDAs range from 0.3 -1.3 mg (Table 1) and the intake of Cu through a few cups of tea will not contribute in any extent to exceed the RDA.

### 5.17 Manganese

Results from Mehra and Baker (2007) showed that in general , tea provides 35.5% of available Mn, as a percentage of the average daily dietary intake. Hence, tea drinking may be regarded as a major source of essential dietary Mn. As can be seen from Table 3 the average concentrations of Mn in the Norwegian infusions are 1.1 mg/L (loose tea) and 3.0 mg/L (tea bag), while the concentration in the Polish infusions were 0.8 mg/L (loose) and 1.8/L (bag). The accuracy attained from analysis of the two reference materials (Appendix 6) were 94.5% (tea leaves) and 94.4% (Polish tobacco), which is accurate. The RSDs (Appendix 4) were 18.2%, 15.7%, 12.7% and 7.1%, respectively. The variability was high in three of the triplicates regarding Mn, which means there can be variability in the determined Mn concentrations.

The EU Scientific Committee on Food considered a “safe and adequate intake of Mn” to be 1-10 mg/person/day (Becker et al., 2008) The US Food and Nutrition Board have settled a level for adequate intake (AI). AI for men and women are 2.3 and 1.8 mg/day, respectively. In Nordic Nutrition Recommendations 2004 (Becker et al., 2008) Mn recommendations are not included, since the data is to limited. Considering the calculated concentrations per cup of tea, 0.22 mg/cup (loose tea) and 0.60 mg/cup (tea bag) as one can see in Table 4 a few cups of tea, especially made out of tea bags, will contribute to attain the AI to a high extent.

### 5.18 Aluminium

As can be seen in Table 3, the Norwegian infusions contained 1.85 mg/L (loose tea) and 5.76 mg Al/L (tea bag). The Polish infusions contained 1.1 mg Al/L (loose tea) and 3.2 mg Al/L (tea bag). These results correspond to earlier results from similar procedures, which range from 2-16 mg/L (Table 2). In Appendix 6 the accuracy from analysis of reference materials are listed, and for Al the accuracy was 89.2 % in tea leaves and 137.6% in Polish tobacco. This means that the achieved results in this study would not be that accurate considering Al. From Appendix 4 one can also see that the RSDs were 21.2 %, 7.0%, 12.8% and 7.8 %, meaning the variability is low in two of the triplicates – N6 and N31- while higher in the two other triplicates, indicating the Al concentrations also have variability.

The tolerable weekly intake (TWI) for Al is 1 mg/kg body weight (EFSA et al., 2008). Considering the TWI one can see that the content of AL in one cup of tea, 0.369 mg (loose tea) and 1.15 mg (tea bags), would be an important source for Al intake for heavily tea consumers. For the majority of heavy tea drinkers around the world, tea is likely to be the largest single source of Al intake (Karak and Bhagat, 2010, Flaten, 2002).

### 5.19 Lead

Average content Pb (Table 3) in the Norwegian infusions is 0.39 µg/L (loose) and 0.75 µg/L (tea bag), while the content in Polish infusions is 0.52 µg/L (loose tea) and 0.32 µg/L (tea bag). This is higher than the reported values in Table 2, where the range was 0,004-0,038 µg/L. It is difficult to say why there is a difference in the results since there is not given any information about country of origin in most of the Norwegian and Polish samples, so growth conditions, processing and manufacturing can not be out ruled, but this is believable caused by some analytical error. As can be seen in Appendix 6, the accuracy from the reference materials was 86.1 % in tea leaves and 68.1 % in Polish tobacco. These low values indicate that the accuracy on Pb is low and that the values attained in this study probably are lower than they actually are. From Appendix 4, one can see that the calculated values; 12.1 %, 22.0%, 9.5% and 12.6% suggests some variability in the analysis.

Considering the amount of Pb in one cup of tea from Norwegian supermarkets – the calculated concentrations were 0.152 µg/cup (tea bag) and 0.079 µg/cup (loose tea). The Joint FAO/WHO Expert Committee on Food Additives (1993) established a provisional tolerable weekly intake (PTWI) of Pb at 25 µg/kg body weight for infants and children, and later extended this value for all groups. The amount of Pb in tea infusions is sustainable lower than the PRWI.

### 5.20 Chromium

As can be seen in Table 3 the concentrations of Cr were 0.635 µg/L (loose tea), 2.52 µg/L (tea bag) in Norwegian infusions, 0.84 µg/L (loose tea) and 2.85 µg/L (tea bag) in Polish infusions. These values was similar to selected values from some other publications (Table 2) where the results was in the same range as in this study, but the highest concentrations in one of them were much higher (~43 µg/L) than the results in this study. In Appendix 6 the accuracy listed were 89.3 % for tea leaves and 70.6 % for Polish tobacco. These values suggests that the accuracy were to low for Cr and that the obtained values in this study are to low. 21.3%, 13.6%, 19.7 % and 7.4% (Appendix 4) indicates that the variability between the triplicates was high. As earlier mentioned, pattern repeats and the concentration of Cr is as higher in the infusions made of tea bags than with loose tea, but for Cr the concentrations are higher in the Polish infusions than in the Norwegian infusions.

The Norwegian infusions contain 0.127 µg Cr/cup (loose tea) and 0.504 µg Cr/cup (tea bag) (Table 4). The US Food and Nutrition Board calculated AI for chromium (19-50 years) to 35 µg/day for men and 25 µg/day for women. The Nordic Nutritions Recommendations 2004 did not include recommendations for Cr, because of lacking data (Becker et al., 2008). The level of Cr in tea will not be significant for heavy tea drinkers, and Sofuoglu and Kavcar (2008) concluded with that the risk levels through consumption of black tea were not significant for the carcinogenic distribution. Karak and Bhagat (2010) reported of lack of focus and not enough information to say something about the speciation of Cr in tea.

### 5.21 Nickel

The Norwegian tea infusions contained 19.2 µg Ni/L (loose), 49.7µg Ni/L (tea bag), while Polish tea infusions contained 12.6 µg Ni/L (loose tea) and 20.8 µg Ni/L (tea bag) (Table 3). These values were in the same range as the values listed from other publications in Table 2. In Appendix 6 one can see that detecting Ni in the reference material obtained 96.9 % accuracy in tea leaves and 81.9 % for Polish tobacco. This indicates that the content of Ni in this study could be lower than they are. The RSDs were 14.4%, 25.6%, 10.5% and 7.0 % indicating variability between each of the triplicates and in the other samples (Appendix 4). EFSA (2006) did no manage to establish a tolerable upper intake level, due to absence of adequate dose-response data for these effects, so it is difficult to make conclusions based on the Ni content per cup of Norwegian tea, which were 3.8 µg in loose tea and 9.93 µg in infusions made out of tea bags.

### 5.22 Fluoride

The fluoride level in Norwegian infusions is shown in Table 5. The average concentration in infusions made from loose tea in this study was 5.35 mg/L, and the average level in the infusions made with tea bags 2.02 mg/L. These levels are similar to levels from other literature presented in Table 2, where the average levels are from 0-3 mg/L, but the highest ones are 6 mg F/L. However, if the total average concentration of fluoride in tea is taken into consideration (Appendix 7, Table 19), the content is 3.7 mg/L, which is more similar to the other published values. One can also study the median value when the variation in data is huge – 2.65 mg F/L in loose tea infusions and 1.81 mg F/L in tea bag infusions. Considering the median values, the values are not too far from concentrations of F in other publication.. The RSDs (Appendix 7) were 33.1 % (N16) and 5.4 % (N31), which shows that the data for

N16 have some variability and suggests that the obtained values from the analysis have some variability.

There was expected a distinct difference in fluoride content in loose tea and the fluoride content in tea bag. It was expected a higher fluoride content in tea infused with tea bags, because of the tea leaves being more crushed and the fluoride easier extractable from the leaves. This was presumably because tea bags have lower quality, low cost and is made of older leaves (Malinowska et al., 2008, Giljanovic et al., 2012, Cao et al., 2006). Some of the teas had really high measured levels of fluoride, which created a significant variation. Mango tea and Mexican Mango (Appendix ) had fluoride levels as high as 16,8 mg/L and 34,6 mg/L, suggesting some analytical error. These high levels increased the average so no conclusion can be made regarding the expected difference in loose tea or the tea bag infusions. The fluoride level in these samples was measured two times to control the high values. Since these teas are from smaller, more local producers, the growth media would perhaps make the plant absorb a lot more fluoride than in other areas. Szymczycha-Madeja et al. (2012) reports that great variance in concentrations of elements is observed due to geographical origin of the tea, referring to the composition of local soils, different agricultural and climatic factors. In addition, the mango tea is among other additatives added mango flower, which could have an impact on the fluoride content in the tea.

From the tea brewed for almost 30 minutes (Table 5) the pattern is as expected; the fluoride content in tea infused from tea bags is higher than from loose tea. The fluoride content is as well higher than the amount in tea infused for five minutes (Malinowska et al., 2008, Szymczycha-Madeja et al., 2012). This would have an impact on daily dietary intake, if the bag or the tea leaves are not left out from the tea after a couple of minutes, following the manufacturers advice. Even though there was no observations of a pattern between black, oolong and green teas, Malinowska et al. (2008) and Szymczycha-Madeja et al. (2012) have reported that there are expected to observe differences in the amount of F (see more detailed section 5.8.

Nordic Nutrition Recommendations (NNR) 2004 (Becker et al., 2008) did not give any daily fluoride intake since it is not considered an essential trace element. Neither did the EU Scientific Committee on Foods. The US Institute of Medicine was unable to establish an RDA, but has set a reference value for fluoride. The reference value was based on observed estimated intake to reduce dental caries with adults. For adults this limit was set to 3 mg/day (women) and 4 mg/day (men). NNR 2004 have settled that an intake of 2.2 g F/kg body weight is lethal in adults and 15 mg/kg body weight in children. Fluorosis develops during teeth formation between 0 to 6-7 years of age. The recommended maximum daily dose of intake for this group is 0.75 mg, for 6-12 year olds 1.0 mg and the water content is recommended to be below 0.8-1 mg/L (Becker et al., 2008). Considering the calculated content of F per cup of tea 1.07mg (loose tea) and 0.41 mg (tea bag), would humans who consume a lot of tea, easily exceed the limits. Shyu and Chen (2013) suggest that tea beverages should be indicated with F concentrations to prevent the intake of excessive fluoride, especially considering children drinking them. As earlier mentioned, with big variation in different types of tea, this could make tea drinkers consume high levels of F, which not only gives positive effects.

### 5.23 The content of elements extracted from the tea leaves

It is difficult to say something about how much of the fluoride in the tea leaves has been extracted into the solution. To do this the tea leaves should have been digested in the ultra clave and the concentration of trace elements should have been measured. Then the percentage of trace elements solved into the solution could have been calculated.

As mentioned earlier, the achieved results from this study are higher than in other similar studies (Table 2). The different preparation methods will also affect the results. The water quality and the content of elements in the water, will affect the amount of free fluoride measured by the electrodes (Malinowska et al., 2008).

## 6 Conclusion

Tea made of *Camellia sinensis* consist of a lot of elements – essential and non-essential. Essential elements as Ca, P, K, Mg, Fe, Cu and Zn contribute to the recommended dietary allowance to a lower extent, while the essential element Mn, and non essential elements F and Al are among the elements that contribute to a vast extent – and possibly exceeding the RDA or TWI for the elements.

One cup of tea from the Norwegian market contains among other elements average concentrations of 0.6 mg Ca/L, 2.8 mg P/L, 37.1 mg K/L, 2.0 mg Mg/L, 5.9 µg Fe/L, 14.1 µg Cu/L, 26.4 µg Zn/L, 0.6 mg Mn/L, 0.16 µg Pb/L, 0.5 µg Cr/L, 1.0 mg F/L and 1.1 mg Al/L. . For the essential elements Ca, P, K, Mg, Fe, Cu and Zn the tea infusions wilt not contribute to attain the recommended dietary aloowances (RDAs) in any extent, but for Mn, the AI are 2.3 mg/day (men) and 1.8 mg/day /women) and a few cups of tea can exceed the given AI level.

The amount of Pb in the infusions is sustainable lower than the PTWI of 25 µg/kg body weight. Drinking tea will therefore no contribute in any high extent to the PTWI.
The fluoride content is high and will contribute to the AI of F (Becker et al., 2008), and in some cases exceed the limits of 3 mg/day (women), 4 mg/day (men) and from 0.5- 1 mg/day (0 -12 year olds). Because of this, Shyu and Chen (2013) suggest that tea beverages should be indicated with F concentrations to prevent the intake of excessive fluoride, especially considering children drinking them. With big variation in different types of tea, this could make tea drinkers consume high levels of F, which not only lead to positive effects in form of healthy teeth (Giljanovic et al., 2012), but excessive intake of F can lead to mild dental fluorosis or skeletal fluorosis (Yi and Cao, 2008, Malinowska et al., 2008, Wong et al., 2003). The Al content in tea is high, and will for heavy tea drinkers be the largest single source of Al (Flaten, 2002) to contribute exceeding the TWI of 1 mg/ kg body weight/ day (EFSA et al., 2008).

There was observed a higher content of elements in the infusions made with tea bags, than in infusions made of loose tea. This was presumably because of the quality of the tea. Tea bags consist often of low cost tea and older leaves, which have a higher content of some elements (e.g. Al and Pb). Another pattern discovered was different amount of elements in the infusion that had been infused for a longer time. There were significant differences determined in the tea infusions that had been infused for 5 minutes and the infusions that had been infused for 30 minutes. The longer brewing time, more elements were extracted into the solution (Malinowska et al., 2008).

Food and beverages are the most important source of essential and non essential elements, and it is the total consumption that determines if the calculated intake levels are exceeded. There are positive and negative effects by drinking tea. The essential elements in tea contribute to several important biological processes in the human body (Klaassen and Casarett, 2008) and habitual drinking of tea may protect against cardiovascular diseases and several types of cancer (Karak and Bhagat, 2010, Flaten, 2002). Although investigations in this study are focused on the total concentration of elements in tea, this study does not enable information about the existing species of elements. The identification of physiochemical forms of the different elements in tea infusions are important to for the evaluation of their actual bioavailability and/or toxicity to humans.

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## Appendix 1

**Table 7: Raw data with all information regarding the different samples. Number, name, if the tea is brewed with bag (T) or if it is loose (L), producer, country of origin, if it is bought in Poland (P) or Norway (N), which store it is bought, the processing; black tea (b), green tea (g), white tea (w), oolong (o). The table show as well if the tea is flavoured (flav.) or with no flavour (no), and the results for each element. Results presented in 4.1 and discussed in section 5 Discussion.**

| Nr | Tea | T/L | Producer | Origin | Bought | Shop | Proc. | Flav. | Y | Cd | Sn | Cs | Ce | Pr | Nd | Sm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C12 | Ceylon | T | Ahmad Tea | Sri Lanka | P | Supermarket | b | no | 0.048 | 0.032 | 0.017 | 1.076 | 0.0921 | 0.0079 | 0.0301 | 0.009 |
| C15 | Scottish Breakfast | L | Chelton Tea Collection | Sri Lanka | P | Supermarket | b | no | 0.023 | 0.00667 | 0.008 | 1.247 | 0.0523 | 0.0041 | 0.0114 | 0.003 |
| C49 | Black Tea | T | Minutka | blend | P | Supermarket | b | no | 0.328 | 0.018 | 0.003335 | 3.250 | 0.1993 | 0.0358 | 0.1512 | 0.038 |
| C50 | Darjeeling | L | Premier`s Tea Limited | India | P | Supermarket | b | no | 0.096 | 0.00667 | 0.029 | 0.542 | 0.0444 | 0.0072 | 0.0286 | 0.007 |
| C54 | Black Tea | T | Saga | blend | P | Supermarket | b | no | 0.607 | 0.00667 | 0.003335 | 14.047 | 0.2057 | 0.0514 | 0.2258 | 0.055 |
| C61 | Intensive Tea | T | Tetley | India | P | Supermarket | b | no | 0.260 | 0.00667 | 0.003335 | 2.012 | 0.0985 | 0.0362 | 0.1309 | 0.033 |
| C66 | Darjeeling Tea | T | Twinings | India | P | Supermarket | b | no | 0.135 | 0.025 | 0.022 | 0.736 | 0.0563 | 0.0087 | 0.0401 | 0.012 |
| C67 | Earl Grey | T | Twinings | blend | P | Supermarket | b | no | 0.651 | 0.00667 | 0.007 | 40.741 | 0.2132 | 0.0575 | 0.2348 | 0.057 |
| C68 | Prince of Wales | T | Twinings | China | P | Supermarket | b | no | 0.368 | 0.059 | 0.008 | 2.662 | 0.7353 | 0.0764 | 0.2859 | 0.060 |
| C71 | Black Tea | L | Yunnan | China | P | Supermarket | b | no | 0.116 | 0.00667 | 0.008 | 3.010 | 0.0887 | 0.0156 | 0.0610 | 0.013 |
| C76 | Kenia GFOP „Milima | L | | Kenya | P | Maraska | b | no | 0.132 | 0.00667 | 0.015 | 0.275 | 0.0315 | 0.0149 | 0.0549 | 0.014 |
| C83 | Earl Grey | L | | blend | P | Maraska | b | no | 0.206 | 0.013 | 0.003335 | 2.604 | 0.0788 | 0.0176 | 0.0637 | 0.023 |
| C84 | Kenia TGFOP Golden Tipped | L | | Kenya | P | Maraska | b | no | 0.234 | 0.00667 | 0.012 | 0.459 | 0.0505 | 0.0244 | 0.0956 | 0.018 |
| C85 | Kenia Marinyn | L | | Kenya | P | Five o`clock | b | no | 0.154 | 0.016 | 0.003335 | 2.676 | 0.0528 | 0.0187 | 0.0723 | 0.018 |
| C91 | Assam Marangi FTGFOP1 | L | | India | P | Five o`clock | b | no | 0.018 | 0.00667 | 0.009 | 0.253 | 0.0129 | 0.0010005 | 0.0073 | 0.004 |
| C101 | Lapsang Souchong | L | | China | P | Five o`clock | b | no | 0.082 | 0.053 | 0.003335 | 3.238 | 0.1555 | 0.0139 | 0.0577 | 0.012 |
| C104 | China Black Golden Monkey | L | | China | P | Five o`clock | b | no | 0.026 | 0.00667 | 0.003335 | 0.294 | 0.0231 | 0.0028 | 0.0124 | 0.004 |
| C111 | Ceylon High Grown | L | | Sri Lanka | P | Czas na herbate | b | no | 0.060 | 0.00667 | 0.003335 | 1.302 | 0.0701 | 0.0070 | 0.0283 | 0.008 |
| C113 | China Keemun Congu | L | | China | P | Czas na herbate | b | no | 0.127 | 0.028 | 0.003335 | 1.482 | 0.1069 | 0.0180 | 0.0702 | 0.019 |
| C41 | Yellow Label Tea | T | Lipton | Sri Lanka | P | Supermarket | b | no | 0.361 | 0.014 | 0.003 | 0.842 | 0.067 | 0.052 | 0.178 | 0.033 |
| N1 | Lipton Yellow Label | L | Lipton | | Nor | Supermarket | b | no | 0.067 | 0.00667 | 0.003335 | 1.550 | 0.0756 | 0.0070 | 0.0335 | 0.007 |
| N2 | Lipton Yellow Label | T | Lipton | | Nor | Supermarket | b | no | 0.578 | 0.030 | 0.007 | 9.212 | 0.1970 | 0.0620 | 0.2365 | 0.055 |
| N3 | Russian Earl Grey | L | Lipton | | Nor | Supermarket | b | no | 0.103 | 0.00667 | 0.003335 | 1.727 | 0.1025 | 0.0223 | 0.0832 | 0.015 |
| N4 | Green Tea Mandarin Orange | T | Lipton | | Nor | Supermarket | g | flav | 0.846 | 0.038 | 0.003335 | 16.925 | 0.1191 | 0.0778 | 0.3296 | 0.086 |
| N5 | White tea Raspberry | T | Lipton | | Nor | Supermarket | w | flav | 1.397 | 0.053 | 0.003335 | 0.209 | 0.3853 | 0.1777 | 0.6660 | 0.142 |
| N7 | Greeen Gunpowder | T | Lipton | | Nor | Supermarket | g | no | 0.290 | 0.014 | 0.007 | 19.210 | 0.0476 | 0.0203 | 0.0902 | 0.030 |

| Nr | Tea | T/L | Producer | Origin | Bought | Shop | Proc. | Flav. | Y | Cd | Sn | Cs | Ce | Pr | Nd | Sm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N8 | Green tea | T | Lipton | | Nor | Supermarket | g | no | 0.112 | 0.00667 | 0.003335 | 7.796 | 0.0195 | 0.0069 | 0.0311 | 0.007 |
| N9 | Peach & Mango | T | Lipton | | Nor | Supermarket | b | flav | 0.407 | 0.028 | 1.343 | 6.445 | 0.2631 | 0.0390 | 0.1634 | 0.045 |
| N10 | Forest Fruit | T | Lipton | | Nor | Supermarket | b | flav | 0.484 | 0.037 | 0.014 | 3.336 | 0.2416 | 0.0427 | 0.1843 | 0.050 |
| N11 | Blue Fruit | T | Lipton | | Nor | Supermarket | b | flav | 0.342 | 0.023 | 0.003335 | 2.373 | 0.2241 | 0.0312 | 0.1351 | 0.038 |
| N12 | Russian Earl Grey | T | Lipton | | Nor | Supermarket | b | no | 0.530 | 0.016 | 0.014 | 11.631 | 0.2076 | 0.0533 | 0.2260 | 0.052 |
| N13 | Earl Grey | T | Lipton | | Nor | Supermarket | b | no | 0.470 | 0.024 | 0.008 | 4.984 | 0.2782 | 0.0434 | 0.1907 | 0.048 |
| N14 | Prince of Wales | L | Twinings | | Nor | Supermarket | b | no | 0.065 | 0.028 | 0.003335 | 1.868 | 0.0652 | 0.0100 | 0.0402 | 0.012 |
| N15 | Prince of Wales | T | Twinings | | Nor | Supermarket | b | no | 0.685 | 0.108 | 0.011 | 4.705 | 1.4427 | 0.1369 | 0.5360 | 0.107 |
| N17 | Earl Grey | T | Twinings | | Nor | Supermarket | b | no | 0.544 | 0.041 | 0.008 | 9.955 | 0.4636 | 0.0647 | 0.2903 | 0.060 |
| N18 | Lady Grey | L | Twinings | | Nor | Supermarket | b | no | 0.134 | 0.018 | 0.010 | 2.186 | 0.1252 | 0.0239 | 0.0951 | 0.019 |
| N19 | Lady Grey | T | Twinings | | Nor | Supermarket | b | no | 0.852 | 0.070 | 0.009 | 15.914 | 0.6396 | 0.1008 | 0.4112 | 0.103 |
| N6 | Indian Chai | T | Lipton | | Nor | Supermarket | b | flav | 0.129 | 0.023 | 0.003 | 0.880 | 0.090 | 0.015 | 0.060 | 0.016 |
| N20 | English Breakfast tea | L | Twinings | | Nor | Supermarket | b | no | 0.193 | 0.00667 | 0.003335 | 3.707 | 0.0654 | 0.0151 | 0.0610 | 0.014 |
| N21 | English Breakfast tea | T | Twinings | | Nor | Supermarket | b | no | 0.612 | 0.050 | 0.008 | 6.410 | 0.3904 | 0.0787 | 0.3067 | 0.066 |
| N22 | Green tea& Cranberry | T | Twinings | | Nor | Supermarket | g | flav | 0.780 | 0.157 | 0.093 | 3.434 | 0.9883 | 0.1151 | 0.4775 | 0.109 |
| N23 | Green tea & apple | T | Twinings | | Nor | Supermarket | g | flav | 0.524 | 0.094 | 0.059 | 4.594 | 0.2678 | 0.0440 | 0.1902 | 0.054 |
| N24 | Pure green tea | T | Twinings | | Nor | Supermarket | g | no | 0.619 | 0.135 | 0.026 | 2.454 | 0.5435 | 0.0671 | 0.2958 | 0.074 |
| N25 | Green tea & orange | T | Twinings | | Nor | Supermarket | g | flav | 0.624 | 0.114 | 0.117 | 4.186 | 0.3793 | 0.0625 | 0.2536 | 0.064 |
| N26 | Green tea & lemon | T | Twinings | | Nor | Supermarket | g | flav | 0.530 | 0.117 | 0.026 | 5.116 | 0.4019 | 0.0554 | 0.2160 | 0.059 |
| N27 | Green tea & lemon eco. | T | Twinings | | Nor | Supermarket | g | flav | 0.551 | 0.031 | 0.096 | 0.645 | 0.2113 | 0.0476 | 0.2099 | 0.060 |
| N28 | Voyage Indian Chai | T | Twinings | | Nor | Supermarket | b | flav | 0.359 | 0.063 | 0.008 | 2.063 | 0.3147 | 0.0441 | 0.1870 | 0.042 |
| N29 | Voyage Brazilian Baia | T | Twinings | | Nor | Supermarket | b | flav | 0.186 | 0.030 | 0.003335 | 5.684 | 0.1084 | 0.0182 | 0.0789 | 0.017 |
| N30 | White tea & pomegranate | T | Twinings | | Nor | Supermarket | w | flav | 0.336 | 0.064 | 0.018 | 2.729 | 0.2465 | 0.0345 | 0.1466 | 0.038 |
| N32 | Blackcurrant | T | Twinings | | Nor | Supermarket | b | flav | 1.023 | 0.082 | 0.013 | 14.585 | 0.9910 | 0.1313 | 0.5290 | 0.128 |
| N33 | Four Red Fruits | T | Twinings | | Nor | Supermarket | b | flav | 0.874 | 0.077 | 0.007 | 13.560 | 0.7044 | 0.1044 | 0.4253 | 0.112 |
| N34 | Passionfruit, Mango, Orange | T | Twinings | | Nor | Supermarket | b | flav | 0.876 | 0.094 | 0.013 | 9.776 | 0.8380 | 0.1058 | 0.4400 | 0.100 |
| N35 | Darjeeling tea | T | Twinings | | Nor | Supermarket | b | no | 0.395 | 0.033 | 0.011 | 1.569 | 0.1313 | 0.0213 | 0.0936 | 0.024 |
| N36 | Earl Grey tea eco. | T | Twinings | | Nor | Supermarket | b | no | 0.880 | 0.023 | 0.010 | 6.578 | 0.2504 | 0.0813 | 0.3380 | 0.081 |
| N37 | Earl Grey Fair trade | T | Confecta | | Nor | Supermarket | b | no | 0.452 | 0.021 | 0.003335 | 1.378 | 0.2174 | 0.0466 | 0.1962 | 0.037 |
| N38 | Earl Grey | T | Jacobs utvalgte øko | | Nor | Supermarket | b | no | 0.425 | 0.425 | 0.035 | 1.434 | 0.1519 | 0.0417 | 0.1625 | 0.037 |
| N39 | Earl Grey | T | First Price | | Nor | Supermarket | b | no | 0.239 | 0.035 | 0.010 | 2.879 | 0.1796 | 0.0270 | 0.1114 | 0.024 |
| N40 | Earl Grey | T | Landlord | | Nor | Supermarket | b | no | 0.189 | 0.047 | 0.003335 | 2.503 | 0.1953 | 0.0192 | 0.0888 | 0.019 |
| N31 | Apple, cinnamon & raisins | T | Twinings | | Nor | Supermarket | b | flav | 0.863 | 0.076 | 0.005 | 15.742 | 0.766 | 0.112 | 0.456 | 0.112 |

| Nr | Tea | T/L | Producer | Origin | Bought | Shop | Proc. | Flav. | Y | Cd | Sn | Cs | Ce | Pr | Nd | Sm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N41 | Darjeeling green tea | L | | India | Nor | Te og kaffehuset | g | no | 0.104 | 0.00667 | 0.063 | 1.583 | 0.0250 | 0.0045 | 0.0188 | 0.004 |
| N42 | Ceylon Breakfast | L | | Sri Lanka | Nor | Te og kaffehuset | b | no | 0.527 | 0.016 | 0.011 | 1.263 | 0.1566 | 0.0391 | 0.1726 | 0.039 |
| N43 | Tanzania | L | | Tanzania | Nor | Te og kaffehuset | b | no | 0.936 | 0.025 | 0.003335 | 0.393 | 0.1041 | 0.1110 | 0.4415 | 0.081 |
| N44 | White China tea eco | L | | China | Nor | Te og kaffehuset | w | no | 0.064 | 0.015 | 0.038 | 0.821 | 0.0712 | 0.0073 | 0.0333 | 0.0017 |
| N45 | Krydder te | L | | Sri Lanka | Nor | Te og kaffehuset | b | flav | 0.142 | 0.037 | 0.003335 | 3.376 | 0.0551 | 0.0133 | 0.0532 | 0.013 |
| N46 | Jasmin tea | L | | China | Nor | Te og kaffehuset | g | no | 0.125 | 0.028 | 0.051 | 2.587 | 0.1350 | 0.0164 | 0.0723 | 0.017 |
| N47 | Lapsang Souchong | L | | China | Nor | Te og kaffehuset | b | flav | 0.044 | 0.027 | 0.003335 | 0.425 | 0.0480 | 0.0068 | 0.0275 | 0.004 |
| N48 | Keemun eco | L | | China | Nor | Te og kaffehuset | b | no | 0.073 | 0.025 | 0.003335 | 0.809 | 0.0872 | 0.0148 | 0.0576 | 0.009 |
| N49 | Japan Kukicha | L | | Japan | Nor | Te og kaffehuset | b | no | 0.106 | 0.00667 | 0.011 | 1.054 | 0.0365 | 0.0107 | 0.0425 | 0.007 |
| N50 | Søndags te | L | | India | Nor | Te og kaffehuset | b | flav | 0.035 | 0.00667 | 0.003335 | 0.131 | 0.0276 | 0.0047 | 0.0156 | 0.004 |
| N51 | Assam Gbop | L | | India | Nor | Te og kaffehuset | b | no | 0.089 | 0.017 | 0.003335 | 1.048 | 0.0606 | 0.0081 | 0.0336 | 0.007 |
| N52 | Japan Bancha eco | L | | Japan | Nor | Te og kaffehuset | g | no | 0.187 | 0.037 | 0.023 | 0.505 | 0.1798 | 0.0231 | 0.1029 | 0.029 |
| N53 | Assam Tgfop 1 | L | | India | Nor | Te og kaffehuset | g | no | 0.061 | 0.00667 | 0.093 | 1.048 | 0.0268 | 0.0035 | 0.0189 | 0.005 |
| N54 | Kaktus te | L | | | Nor | Te og kaffehuset | b/g | flav | 0.332 | 0.045 | 0.003335 | 8.419 | 0.1750 | 0.0339 | 0.1598 | 0.036 |
| N55 | Blå blomst te | L | | | Nor | Te og kaffehuset | b | flav | 0.209 | 0.049 | 0.003335 | 5.866 | 0.0716 | 0.0172 | 0.0861 | 0.021 |
| N56 | Darjeeling | L | | India | Nor | Te og kaffehuset | b | no | 0.138 | 0.017 | 0.021 | 0.930 | 0.0606 | 0.0113 | 0.0425 | 0.013 |
| N57 | Ceylon Bop | L | | Sri Lanka | Nor | Te og kaffehuset | b | flav | 0.080 | 0.00667 | 0.013 | 1.873 | 0.1668 | 0.0109 | 0.0476 | 0.010 |
| N58 | Samowar Douchka | L | | Russia | Nor | Te og kaffehuset | b | flav | 0.201 | 0.048 | 0.003335 | 1.461 | 0.1146 | 0.0211 | 0.0880 | 0.021 |
| N59 | Skomakerens julete | L | | | Nor | Te og kaffehuset | b | flav | 0.124 | 0.026 | 0.003335 | 0.618 | 0.1248 | 0.0169 | 0.0811 | 0.017 |
| N60 | Formosa Oolong | L | | Taiwan | Nor | Te og kaffehuset | o | no | 0.245 | 0.023 | 0.011 | 4.769 | 0.1438 | 0.0237 | 0.0950 | 0.025 |
| N61 | Golden Nepal | L | | Nepal | Nor | Te og kaffehuset | b | no | 0.069 | 0.018 | 0.014 | 0.999 | 0.0477 | 0.0072 | 0.0294 | 0.007 |
| N62 | Yunnan Pu Erh | L | | China | Nor | Te og kaffehuset | p | no | 0.028 | 0.017 | 0.003335 | 1.521 | 0.0568 | 0.0064 | 0.0346 | 0.006 |
| N63 | Mango te | L | | India/China | Nor | Te og kaffehuset | b | flav | 0.236 | 0.038 | 0.003335 | 7.124 | 0.0785 | 0.0182 | 0.0860 | 0.024 |
| N64 | Gunpowder eco | L | | China | Nor | Te og kaffehuset | g | no | 0.367 | 0.028 | 0.013 | 9.422 | 0.1361 | 0.0253 | 0.1076 | 0.028 |
| N65 | Mexican Mango | L | | | Nor | Te og kaffehuset | b | flav | 0.534 | 0.016 | 0.017 | 28.017 | 0.1265 | 0.0390 | 0.1734 | 0.044 |
| N66 | Advents te | L | | | Nor | Te og kaffehuset | b | flav | 0.137 | 0.014 | 0.003335 | 4.981 | 0.0546 | 0.0120 | 0.0531 | 0.012 |
| N67 | Choui Fong | L | | Thailand | Nor | Te og kaffehuset | g | no | 0.122 | 0.00667 | 0.027 | 2.707 | 0.1217 | 0.0181 | 0.0705 | 0.015 |
| N68 | Bengal Fire | L | | India | Nor | Te og kaffehuset | b | flav | 0.301 | 0.00667 | 0.003335 | 12.717 | 0.0952 | 0.0259 | 0.1171 | 0.023 |
| N69 | Rwanda Grønn | L | | Rwanda | Nor | Te og kaffehuset | g | no | 0.012 | 0.027 | 0.039 | 0.785 | 0.0200 | 0.0029 | 0.0098 | 0.0017 |
| N70 | Bjørnebær te | L | | China/Sri Lanka | Nor | Te og kaffehuset | b | flav | 0.267 | 0.017 | 0.003335 | 6.204 | 0.0724 | 0.0210 | 0.0856 | 0.019 |
| N16 | Earl Grey Twinings | L | Twinings | | Nor | Supermarket | b | no | 0.090 | 0.024 | 0.008 | 1.364 | 0.071 | 0.010 | 0.042 | 0.014 |

**Table 8: Raw data for each sample number and name. For more information about the different samples see Table 7 Results presented in 4.1 and discussed in section 5.**

| Nr | Tea | Tb | Dy | Ho | Er | Tm | Yb | Lu | Hf | Tl | Pb | Th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C12 | Ceylon | 0.0014 | 0.0067 | 0.0016 | 0.0049 | 0.0017 | 0.0036 | 0.0007 | 0.0048 | 0.1772 | 0.0959 | 0.0017 |
| C15 | Scottish Breakfast | 0.0007 | 0.0067 | 0.0007 | 0.0025 | 0.0017 | 0.0013 | 0.0007 | 0.0016 | 0.3997 | 0.0432 | 0.0017 |
| C49 | Black Tea | 0.0072 | 0.0443 | 0.0114 | 0.0318 | 0.0058 | 0.0372 | 0.0066 | 0.0016 | 0.4908 | 0.1951 | 0.0061 |
| C50 | Darjeeling | 0.0017 | 0.0067 | 0.0031 | 0.0089 | 0.0017 | 0.0075 | 0.0007 | 0.0014 | 0.0406 | 0.6755 | 0.0017 |
| C54 | Black Tea | 0.0127 | 0.0862 | 0.0216 | 0.0648 | 0.0106 | 0.0667 | 0.0121 | 0.0005 | 0.7470 | 0.2935 | 0.0046 |
| C61 | Intensive Tea | 0.0056 | 0.0336 | 0.0086 | 0.0264 | 0.0041 | 0.0298 | 0.0056 | 0.0014 | 0.0709 | 0.0375 | 0.0017 |
| C66 | Darjeeling Tea | 0.0026 | 0.0197 | 0.0038 | 0.0128 | 0.0017 | 0.0114 | 0.0022 | 0.0005 | 0.0569 | 0.7021 | 0.0017 |
| C67 | Earl Grey | 0.0136 | 0.0833 | 0.0215 | 0.0663 | 0.0129 | 0.0784 | 0.0151 | 0.0012 | 1.0937 | 0.1479 | 0.0017 |
| C68 | Prince of Wales | 0.0107 | 0.0685 | 0.0130 | 0.0369 | 0.0055 | 0.0385 | 0.0066 | 0.0010 | 0.3097 | 1.6001 | 0.0124 |
| C71 | Black Tea | 0.0032 | 0.0193 | 0.0043 | 0.0124 | 0.0017 | 0.0105 | 0.0016 | 0.0030 | 0.1262 | 0.1727 | 0.0055 |
| C76 | Kenia GFOP „Milima | 0.0032 | 0.0169 | 0.0039 | 0.0121 | 0.0017 | 0.0106 | 0.0020 | 0.0016 | 0.0151 | 0.0850 | 0.0017 |
| C83 | Earl Grey | 0.0048 | 0.0314 | 0.0074 | 0.0243 | 0.0046 | 0.0252 | 0.0051 | 0.0005 | 0.6093 | 0.3051 | 0.0017 |
| C84 | Kenia TGFOP Golden Tipped | 0.0057 | 0.0305 | 0.0074 | 0.0218 | 0.0036 | 0.0192 | 0.0033 | 0.0032 | 0.0340 | 0.0934 | 0.0017 |
| C85 | Kenia Marinyn | 0.0034 | 0.0181 | 0.0053 | 0.0150 | 0.0017 | 0.0125 | 0.0026 | 0.0023 | 0.2187 | 0.1276 | 0.0017 |
| C91 | Assam Marangi FTGFOP1 | 0.0007 | 0.0067 | 0.0007 | 0.0010 | 0.0017 | 0.0013 | 0.0007 | 0.0005 | 0.0748 | 0.0605 | 0.0017 |
| C101 | Lapsang Souchong | 0.0026 | 0.0171 | 0.0025 | 0.0105 | 0.0017 | 0.0102 | 0.0027 | 0.0005 | 0.3190 | 3.9231 | 0.0071 |
| C104 | China Black Golden Monkey | 0.0007 | 0.0067 | 0.0007 | 0.0026 | 0.0017 | 0.0013 | 0.0007 | 0.0005 | 0.0131 | 0.0874 | 0.0017 |
| C111 | Ceylon High Grown | 0.0018 | 0.0067 | 0.0018 | 0.0064 | 0.0017 | 0.0078 | 0.0014 | 0.0012 | 0.4182 | 0.1440 | 0.0017 |
| C113 | China Keemun Congu | 0.0035 | 0.0218 | 0.0041 | 0.0135 | 0.0017 | 0.0148 | 0.0022 | 0.0010 | 0.1724 | 0.5283 | 0.0064 |
| C41 | Yellow Label Tea | 0.0072 | 0.0458 | 0.0109 | 0.0337 | 0.0053 | 0.0357 | 0.0066 | 0.0014 | 0.0516 | 0.0263 | 0.0017 |
| N1 | Lipton Yellow Label | 0.0016 | 0.0067 | 0.0024 | 0.0089 | 0.0017 | 0.0122 | 0.0017 | 0.0005 | 0.5455 | 0.0934 | 0.0017 |
| N2 | Lipton Yellow Label | 0.0106 | 0.0728 | 0.0149 | 0.0519 | 0.0092 | 0.0598 | 0.0098 | 0.0030 | 0.2523 | 0.1577 | 0.0041 |
| N3 | Russian Earl Grey | 0.0027 | 0.0162 | 0.0036 | 0.0101 | 0.0017 | 0.0099 | 0.0018 | 0.0005 | 0.5139 | 0.1637 | 0.0017 |
| N4 | Green Tea Mandarin Orange | 0.0178 | 0.1264 | 0.0301 | 0.0907 | 0.0153 | 0.1059 | 0.0195 | 0.0012 | 1.3683 | 0.1170 | 0.0017 |
| N5 | White tea Raspberry | 0.0271 | 0.1851 | 0.0416 | 0.1400 | 0.0228 | 0.1537 | 0.0268 | 0.0035 | 0.0368 | 0.1640 | 0.0158 |
| N7 | Greeen Gunpowder | 0.0064 | 0.0415 | 0.0103 | 0.0293 | 0.0051 | 0.0365 | 0.0067 | 0.0005 | 1.0454 | 0.1635 | 0.0017 |
| N8 | Green tea | 0.0019 | 0.0149 | 0.0031 | 0.0104 | 0.0017 | 0.0089 | 0.0023 | 0.0016 | 0.4896 | 0.0473 | 0.0017 |
| N9 | Peach & Mango | 0.0084 | 0.0582 | 0.0131 | 0.0442 | 0.0070 | 0.0504 | 0.0074 | 0.0005 | 1.4020 | 0.3140 | 0.0040 |
| N10 | Forest Fruit | 0.0104 | 0.0679 | 0.0158 | 0.0527 | 0.0092 | 0.0527 | 0.0094 | 0.0005 | 0.8880 | 0.3807 | 0.0017 |

| Nr | Tea | Tb | Dy | Ho | Er | Tm | Yb | Lu | Hf | Tl | Pb | Th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N11 | Blue Fruit | 0.0072 | 0.0554 | 0.0113 | 0.0354 | 0.0060 | 0.0441 | 0.0062 | 0.0011 | 0.8078 | 0.3410 | 0.0017 |
| N12 | Russian Earl Grey | 0.0102 | 0.0617 | 0.0151 | 0.0450 | 0.0075 | 0.0478 | 0.0078 | 0.0061 | 0.4629 | 0.2352 | 0.0054 |
| N13 | Earl Grey | 0.0094 | 0.0664 | 0.0159 | 0.0507 | 0.0080 | 0.0558 | 0.0098 | 0.0011 | 1.1071 | 0.4641 | 0.0077 |
| N14 | Prince of Wales | 0.0016 | 0.0067 | 0.0017 | 0.0060 | 0.0017 | 0.0067 | 0.0007 | 0.0005 | 0.0954 | 0.3480 | 0.0038 |
| N15 | Prince of Wales | 0.0192 | 0.1152 | 0.0246 | 0.0807 | 0.0127 | 0.0853 | 0.0123 | 0.0021 | 0.5066 | 2.3186 | 0.0527 |
| N17 | Earl Grey | 0.0117 | 0.0840 | 0.0174 | 0.0538 | 0.0100 | 0.0667 | 0.0129 | 0.0015 | 0.2375 | 0.7843 | 0.0296 |
| N18 | Lady Grey | 0.0034 | 0.0188 | 0.0045 | 0.0132 | 0.0017 | 0.0122 | 0.0018 | 0.0010 | 0.4235 | 0.3603 | 0.0072 |
| N19 | Lady Grey | 0.0204 | 0.1143 | 0.0273 | 0.0948 | 0.0144 | 0.1018 | 0.0152 | 0.0005 | 0.5311 | 1.1119 | 0.0337 |
| N6 | Indian Chai | 0.0030 | 0.0211 | 0.0039 | 0.0116 | 0.0017 | 0.0118 | 0.0019 | 0.0010 | 0.2857 | 0.2409 | 0.0025 |
| N20 | English Breakfast tea | 0.0038 | 0.0258 | 0.0063 | 0.0223 | 0.0040 | 0.0231 | 0.0045 | 0.0005 | 0.4939 | 0.0807 | 0.0042 |
| N21 | English Breakfast tea | 0.0132 | 0.0875 | 0.0191 | 0.0599 | 0.0091 | 0.0628 | 0.0103 | 0.0011 | 0.4806 | 0.5111 | 0.0166 |
| N22 | Green tea& Cranberry | 0.0176 | 0.1242 | 0.0259 | 0.0845 | 0.0131 | 0.0876 | 0.0137 | 0.0039 | 0.5025 | 2.2206 | 0.0545 |
| N23 | Green tea & apple | 0.0113 | 0.0684 | 0.0184 | 0.0561 | 0.0086 | 0.0547 | 0.0083 | 0.0005 | 0.2850 | 1.1387 | 0.0111 |
| N24 | Pure green tea | 0.0138 | 0.0917 | 0.0196 | 0.0629 | 0.0099 | 0.0637 | 0.0107 | 0.0023 | 0.4221 | 1.8733 | 0.0100 |
| N25 | Green tea & orange | 0.0136 | 0.0919 | 0.0182 | 0.0604 | 0.0099 | 0.0632 | 0.0100 | 0.0017 | 0.3254 | 1.3139 | 0.0300 |
| N26 | Green tea & lemon | 0.0126 | 0.0807 | 0.0194 | 0.0619 | 0.0102 | 0.0627 | 0.0098 | 0.0037 | 0.5884 | 1.7819 | 0.0105 |
| N27 | Green tea & lemon eco. | 0.0117 | 0.0783 | 0.0177 | 0.0615 | 0.0089 | 0.0629 | 0.0105 | 0.0014 | 0.0413 | 0.3540 | 0.0125 |
| N28 | Voyage Indian Chai | 0.0077 | 0.0555 | 0.0103 | 0.0356 | 0.0049 | 0.0405 | 0.0058 | 0.0015 | 0.1225 | 0.3855 | 0.0084 |
| N29 | Voyage Brazilian Baia | 0.0035 | 0.0249 | 0.0049 | 0.0143 | 0.0017 | 0.0195 | 0.0025 | 0.0014 | 0.5298 | 0.1534 | 0.0034 |
| N30 | White tea & pomegranate | 0.0075 | 0.0485 | 0.0113 | 0.0373 | 0.0053 | 0.0404 | 0.0058 | 0.0010 | 0.2634 | 0.8930 | 0.0065 |
| N32 | Blackcurrant | 0.0225 | 0.1413 | 0.0350 | 0.1093 | 0.0171 | 0.1209 | 0.0189 | 0.0010 | 0.3589 | 1.3746 | 0.0417 |
| N33 | Four Red Fruits | 0.0203 | 0.1266 | 0.0286 | 0.0924 | 0.0155 | 0.1094 | 0.0156 | 0.0016 | 0.3827 | 1.2244 | 0.0441 |
| N34 | Passionfruit, Mango, Orange | 0.0195 | 0.1321 | 0.0299 | 0.0885 | 0.0160 | 0.1090 | 0.0177 | 0.0016 | 0.4506 | 1.7918 | 0.0430 |
| N35 | Darjeeling tea | 0.0072 | 0.0421 | 0.0120 | 0.0325 | 0.0062 | 0.0326 | 0.0057 | 0.0013 | 0.1056 | 0.8121 | 0.0052 |
| N36 | Earl Grey tea eco. | 0.0180 | 0.1126 | 0.0248 | 0.0840 | 0.0151 | 0.0901 | 0.0164 | 0.0005 | 0.1733 | 0.2839 | 0.0043 |
| N37 | Earl Grey Fair trade | 0.0093 | 0.0633 | 0.0134 | 0.0446 | 0.0078 | 0.0512 | 0.0086 | 0.0010 | 0.2358 | 0.4283 | 0.0017 |
| N38 | Earl Grey | 0.0085 | 0.0637 | 0.0140 | 0.0485 | 0.0086 | 0.0533 | 0.0091 | 0.0005 | 0.4296 | 0.1904 | 0.0017 |
| N39 | Earl Grey | 0.0056 | 0.0348 | 0.0077 | 0.0251 | 0.0048 | 0.0343 | 0.0048 | 0.0012 | 0.8750 | 0.3377 | 0.0038 |
| N40 | Earl Grey | 0.0033 | 0.0241 | 0.0063 | 0.0197 | 0.0039 | 0.0233 | 0.0037 | 0.0014 | 0.8927 | 0.4673 | 0.0017 |
| N31 | Apple, cinnamon & raisins | 0.0202 | 0.1313 | 0.0296 | 0.0975 | 0.0159 | 0.1080 | 0.0165 | 0.0007 | 0.4952 | 1.3288 | 0.0422 |
| N41 | Darjeeling green tea | 0.0018 | 0.0067 | 0.0019 | 0.0088 | 0.0013 | 0.0104 | 0.0017 | 0.0035 | 0.0421 | 0.8476 | 0.0044 |
| N42 | Ceylon Breakfast | 0.0089 | 0.0665 | 0.0170 | 0.0546 | 0.0088 | 0.0529 | 0.0081 | 0.0021 | 0.3892 | 0.2984 | 0.0017 |
| N43 | Tanzania | 0.0173 | 0.1123 | 0.0286 | 0.0923 | 0.0159 | 0.1102 | 0.0184 | 0.0024 | 0.0622 | 0.0213 | 0.0038 |

| Nr | Tea | Tb | Dy | Ho | Er | Tm | Yb | Lu | Hf | Tl | Pb | Th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N44 | White China tea eco | 0.0007 | 0.0067 | 0.0018 | 0.0067 | 0.0013 | 0.0060 | 0.0007 | 0.0005 | 0.1540 | 0.9530 | 0.0042 |
| N45 | Krydder te | 0.0029 | 0.0196 | 0.0049 | 0.0143 | 0.0013 | 0.0182 | 0.0024 | 0.0015 | 0.3140 | 0.2901 | 0.0017 |
| N46 | Jasmin tea | 0.0028 | 0.0203 | 0.0035 | 0.0141 | 0.0013 | 0.0142 | 0.0025 | 0.0010 | 0.4393 | 0.6488 | 0.0047 |
| N47 | Lapsang Souchong | 0.0014 | 0.0067 | 0.0017 | 0.0041 | 0.0013 | 0.0028 | 0.0007 | 0.0005 | 0.0675 | 0.3107 | 0.0048 |
| N48 | Keemun eco | 0.0025 | 0.0146 | 0.0028 | 0.0059 | 0.0013 | 0.0066 | 0.0007 | 0.0005 | 0.0504 | 0.5450 | 0.0065 |
| N49 | Japan Kukicha | 0.0017 | 0.0067 | 0.0023 | 0.0060 | 0.0013 | 0.0060 | 0.0007 | 0.0012 | 0.1379 | 0.1011 | 0.0017 |
| N50 | Søndags te | 0.0007 | 0.0067 | 0.0007 | 0.0031 | 0.0013 | 0.0055 | 0.0007 | 0.0005 | 0.0553 | 0.0515 | 0.0017 |
| N51 | Assam Gbop | 0.0018 | 0.0135 | 0.0024 | 0.0080 | 0.0013 | 0.0092 | 0.0007 | 0.0005 | 0.2450 | 0.4297 | 0.0017 |
| N52 | Japan Bancha eco | 0.0044 | 0.0267 | 0.0061 | 0.0189 | 0.0036 | 0.0216 | 0.0039 | 0.0022 | 0.1430 | 1.3033 | 0.0051 |
| N53 | Assam Tgfop 1 | 0.0007 | 0.0067 | 0.0017 | 0.0050 | 0.0013 | 0.0062 | 0.0007 | 0.0005 | 0.0589 | 0.8339 | 0.0017 |
| N54 | Kaktus te | 0.0150 | 0.0473 | 0.0105 | 0.0385 | 0.0056 | 0.0417 | 0.0065 | 0.0005 | 0.8720 | 0.6909 | 0.0017 |
| N55 | Blå blomst te | 0.0042 | 0.0334 | 0.0080 | 0.0254 | 0.0040 | 0.0275 | 0.0048 | 0.0011 | 0.5339 | 0.3112 | 0.0017 |
| N56 | Darjeeling | 0.0028 | 0.0189 | 0.0048 | 0.0122 | 0.0013 | 0.0147 | 0.0023 | 0.0005 | 0.1018 | 0.7996 | 0.0017 |
| N57 | Ceylon Bop | 0.0021 | 0.0067 | 0.0028 | 0.0135 | 0.0013 | 0.0121 | 0.0016 | 0.0005 | 0.4711 | 0.1275 | 0.0017 |
| N58 | Samowar Douchka | 0.0046 | 0.0309 | 0.0058 | 0.0173 | 0.0034 | 0.0220 | 0.0031 | 0.0005 | 0.1967 | 0.4867 | 0.0068 |
| N59 | Skomakerens julete | 0.0036 | 0.0181 | 0.0042 | 0.0121 | 0.0013 | 0.0101 | 0.0007 | 0.0013 | 0.1450 | 0.2215 | 0.0111 |
| N60 | Formosa Oolong | 0.0048 | 0.0340 | 0.0079 | 0.0290 | 0.0057 | 0.0452 | 0.0066 | 0.0005 | 0.5811 | 1.1908 | 0.0061 |
| N61 | Golden Nepal | 0.0007 | 0.0067 | 0.0018 | 0.0053 | 0.0013 | 0.0077 | 0.0007 | 0.0005 | 0.0620 | 0.6832 | 0.0052 |
| N62 | Yunnan Pu Erh | 0.0007 | 0.0067 | 0.0007 | 0.0020 | 0.0013 | 0.0030 | 0.0007 | 0.0005 | 0.0380 | 0.2058 | 0.0071 |
| N63 | Mango te | 0.0053 | 0.0337 | 0.0072 | 0.0245 | 0.0056 | 0.0320 | 0.0050 | 0.0005 | 0.5151 | 0.1517 | 0.0017 |
| N64 | Gunpowder eco | 0.0081 | 0.0577 | 0.0133 | 0.0439 | 0.0071 | 0.0450 | 0.0076 | 0.0011 | 0.0970 | 0.4082 | 0.0017 |
| N65 | Mexican Mango | 0.0113 | 0.0669 | 0.0153 | 0.0549 | 0.0089 | 0.0741 | 0.0110 | 0.0012 | 0.4793 | 0.0638 | 0.0017 |
| N66 | Advents te | 0.0030 | 0.0211 | 0.0047 | 0.0135 | 0.0013 | 0.0154 | 0.0023 | 0.0005 | 0.3057 | 0.1444 | 0.0017 |
| N67 | Choui Fong | 0.0029 | 0.0196 | 0.0048 | 0.0163 | 0.0013 | 0.0232 | 0.0032 | 0.0005 | 0.1394 | 0.1178 | 0.0054 |
| N68 | Bengal Fire | 0.0052 | 0.0382 | 0.0083 | 0.0272 | 0.0049 | 0.0374 | 0.0057 | 0.0010 | 0.7059 | 0.1304 | 0.0044 |
| N69 | Rwanda Grønn | 0.0007 | 0.0067 | 0.0007 | 0.0010 | 0.0013 | 0.0013 | 0.0007 | 0.0005 | 0.1053 | 0.1125 | 0.0017 |
| N70 | Bjørnebær te | 0.0055 | 0.0392 | 0.0090 | 0.0293 | 0.0044 | 0.0339 | 0.0058 | 0.0005 | 0.4912 | 0.1934 | 0.0017 |
| N16 | Earl Grey Twinings | 0.0021 | 0.0135 | 0.0031 | 0.0083 | 0.0014 | 0.0089 | 0.0013 | 0.0007 | 0.2203 | 0.3983 | 0.0062 |

**Table 9: Raw data for each sample number and name. For further information about the different samples see Table 7 .Results presented in 4.1 and discussed in section 5.**

| Nr | Tea | U | Li | B | Na | Mg | Al | Si | P | S | K | Ca |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C12 | Ceylon | 0.0031 | 0.2157 | 29.0823 | 96.4160 | 4361.8439 | 2397.9105 | 55.1574 | 8543.6658 | 8672.8335 | 133566.5305 | 500.3240 |
| C15 | Scottish Breakfast | 0.0008 | 0.1001 | 14.4994 | 87.2803 | 2387.4976 | 1201.5908 | 16.0584 | 7504.2946 | 7604.7414 | 115949.8097 | 267.8386 |
| C49 | Black Tea | 0.0112 | 0.4287 | 68.2240 | 173.9341 | 5071.4107 | 4464.1647 | 228.7770 | 9834.6820 | 8395.5749 | 127033.8874 | 1362.0441 |
| C50 | Darjeeling | 0.0032 | 0.1001 | 18.7498 | 33.3500 | 4028.6954 | 1368.1207 | 35.3777 | 9831.4762 | 6648.6513 | 112256.9102 | 573.0624 |
| C54 | Black Tea | 0.0161 | 0.6017 | 83.2189 | 134.7162 | 5862.9212 | 5141.2873 | 297.6659 | 8441.3986 | 8793.2447 | 119430.7141 | 1459.6335 |
| C61 | Intensive Tea | 0.0048 | 0.2068 | 46.0281 | 109.2028 | 4611.2231 | 2066.7317 | 90.9957 | 8596.1205 | 5448.1372 | 102156.9593 | 769.5564 |
| C66 | Darjeeling Tea | 0.0047 | 0.2431 | 30.2551 | 74.8136 | 4937.6754 | 1856.9993 | 62.2683 | 9995.0001 | 7658.8757 | 110423.8230 | 721.7108 |
| C67 | Earl Grey | 0.0230 | 0.6365 | 95.8115 | 1013.4693 | 6863.3466 | 5911.1183 | 302.2398 | 6831.9209 | 7265.3362 | 116764.0934 | 1503.0471 |
| C68 | Prince of Wales | 0.0550 | 1.2491 | 40.5809 | 5229.9351 | 2933.7575 | 3764.5888 | 289.7232 | 4454.4076 | 9387.4042 | 75536.9037 | 1661.8997 |
| C71 | Black Tea | 0.0056 | 0.1001 | 13.2157 | 302.1092 | 3411.1148 | 969.3388 | 64.9055 | 8915.9917 | 4773.1840 | 88146.6993 | 396.3336 |
| C76 | Kenia GFOP „Milima | 0.0008 | 0.1001 | 24.3366 | 80.0224 | 3124.6183 | 790.7830 | 16.0584 | 5826.7189 | 3701.1418 | 70931.4961 | 383.4320 |
| C83 | Earl Grey | 0.0043 | 0.2248 | 33.7992 | 127.0416 | 4382.0370 | 1811.6513 | 78.2492 | 9003.7006 | 9127.2883 | 120529.7660 | 552.1708 |
| C84 | Kenia TGFOP Golden Tipped | 0.0019 | 0.2371 | 44.4527 | 33.3500 | 6166.9620 | 1424.5003 | 58.1284 | 10016.6385 | 6294.8633 | 120865.3013 | 568.5491 |
| C85 | Kenia Marinyn | 0.0034 | 0.1001 | 18.3448 | 72.3777 | 4133.7827 | 859.3261 | 33.3493 | 9371.0125 | 4993.0531 | 105237.0669 | 358.9921 |
| C91 | Assam Marangi FTGFOP1 | 0.0008 | 0.1001 | 8.9913 | 33.3500 | 1698.6061 | 417.1658 | 32.4118 | 5366.6981 | 3596.9296 | 57201.2841 | 192.2278 |
| C101 | Lapsang Souchong | 0.0143 | 0.4083 | 8.2428 | 33.3500 | 1621.3882 | 1703.9402 | 101.3842 | 8497.6397 | 6567.9186 | 78880.4540 | 522.5481 |
| C104 | China Black Golden Monkey | 0.0008 | 0.1001 | 8.8680 | 200.8077 | 3138.1268 | 144.4024 | 16.0584 | 13560.6897 | 4312.3682 | 84029.4581 | 259.4234 |
| C111 | Ceylon High Grown | 0.0008 | 0.2620 | 19.5290 | 403.9781 | 2826.5610 | 1134.5937 | 16.0584 | 6926.6942 | 7377.4915 | 101224.2953 | 314.6770 |
| C113 | China Keemun Congu | 0.0094 | 0.4116 | 15.2102 | 126.8922 | 2785.5425 | 1414.1321 | 207.2194 | 10445.5438 | 6472.8491 | 98570.7236 | 649.2798 |
| C41 | Yellow Label Tea | 0.0044 | 0.4497 | 31.9864 | 96.4085 | 4883.8048 | 2274.6663 | 67.9184 | 9072.2585 | 6044.5885 | 106539.5296 | 559.4357 |
| N1 | Lipton Yellow Label | 0.0019 | 0.1001 | 26.3950 | 130.5808 | 3635.8722 | 1336.6976 | 66.5294 | 7409.4384 | 7492.5418 | 117377.9530 | 412.0963 |
| N2 | Lipton Yellow Label | 0.0077 | 0.6961 | 87.9849 | 1011.0200 | 14490.4399 | 7455.7696 | 325.0422 | 22011.8790 | 17525.3882 | 263890.7938 | 1769.1508 |
| N3 | Russian Earl Grey | 0.0037 | 0.2460 | 17.0267 | 158.7982 | 2414.1683 | 879.0974 | 78.6562 | 4730.9382 | 5052.6128 | 79912.7062 | 1300.1373 |
| N4 | Green Tea Mandarin Orange | 0.0097 | 1.1974 | 96.5334 | 264.7343 | 11676.9357 | 6629.6865 | 457.4590 | 13203.0991 | 11964.1541 | 178344.1531 | 2038.3316 |
| N5 | White tea Raspberry | 0.0242 | 1.5393 | 62.8582 | 115.4212 | 10809.0773 | 4954.5419 | 288.8626 | 13165.6332 | 10013.8678 | 173921.7981 | 2382.5735 |
| N7 | Greeen Gunpowder | 0.0032 | 0.3551 | 56.6400 | 155.7673 | 8204.7028 | 2773.8081 | 262.4712 | 9660.1308 | 9755.0422 | 136732.7957 | 1075.3132 |
| N8 | Green tea | 0.0008 | 0.1001 | 28.5593 | 555.1970 | 4462.7849 | 1153.9314 | 689.2865 | 4699.0353 | 4270.0009 | 56626.0935 | 416.7944 |
| N9 | Peach & Mango | 0.0220 | 0.8528 | 58.3777 | 801.6425 | 7021.1025 | 4056.2489 | 596.8882 | 12210.3124 | 13517.4035 | 175418.0341 | 2111.5376 |
| N10 | Forest Fruit | 0.0114 | 0.6032 | 67.7383 | 359.2753 | 7721.9092 | 4864.4710 | 395.0401 | 11505.4275 | 12171.4759 | 183530.2137 | 2068.3283 |
| N11 | Blue Fruit | 0.0107 | 0.5749 | 43.8901 | 294.5238 | 6870.8074 | 3524.0689 | 344.3225 | 11000.6656 | 11547.2483 | 162445.1168 | 1352.9944 |

| Nr | Tea | U | Li | B | Na | Mg | Al | Si | P | S | K | Ca |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N12 | Russian Earl Grey | 0.0062 | 0.4516 | 97.8534 | 775.3208 | 12755.5611 | 7649.6995 | 686.1561 | 16920.7741 | 15482.9796 | 206903.8573 | 2776.3706 |
| N13 | Earl Grey | 0.0154 | 0.7331 | 50.5360 | 4102.0397 | 7718.6207 | 4759.0285 | 398.7065 | 13004.5730 | 14148.7391 | 192167.8520 | 1577.4020 |
| N14 | Prince of Wales | 0.0096 | 0.4065 | 10.2344 | 89.2621 | 1988.7336 | 1027.5896 | 92.3882 | 8803.7320 | 5166.4933 | 85443.7780 | 471.9731 |
| N15 | Prince of Wales | 0.0622 | 2.5292 | 68.6277 | 18265.0726 | 8338.7766 | 7073.4153 | 578.8746 | 11653.0176 | 17345.0253 | 142911.1184 | 3548.6469 |
| N17 | Earl Grey | 0.0350 | 1.1991 | 51.9053 | 11229.9105 | 5559.8097 | 5004.4962 | 245.5551 | 7000.3098 | 10660.2925 | 96692.2175 | 2307.9564 |
| N18 | Lady Grey | 0.0101 | 0.5120 | 11.1476 | 165.8117 | 1539.6735 | 1342.8387 | 74.2069 | 5145.1756 | 4932.2744 | 68895.4329 | 673.7855 |
| N19 | Lady Grey | 0.0411 | 1.9691 | 99.5699 | 10434.4321 | 9133.1275 | 6922.8074 | 519.0115 | 12403.1248 | 14656.9395 | 156258.5174 | 3865.8098 |
| N6 | Indian Chai | 0.0068 | 0.6208 | 31.3633 | 1930.1365 | 8149.5883 | 2096.5902 | 190.4509 | 18015.2050 | 11928.7833 | 192174.6264 | 988.9703 |
| N20 | English Breakfast tea | 0.0034 | 0.3111 | 27.2336 | 207.3185 | 4998.3683 | 2510.2343 | 82.6186 | 9370.6945 | 8985.9913 | 132412.1960 | 538.2924 |
| N21 | English Breakfast tea | 0.0188 | 1.0771 | 94.6332 | 5716.2762 | 14962.5461 | 9095.9301 | 463.4996 | 24717.8768 | 20514.6267 | 268736.1140 | 2769.6649 |
| N22 | Green tea& Cranberry | 0.0767 | 2.8366 | 77.3532 | 8466.1639 | 10350.1989 | 6573.8419 | 1137.2591 | 12839.0368 | 17271.5584 | 161010.4934 | 5394.3308 |
| N23 | Green tea & apple | 0.0326 | 1.1127 | 72.3615 | 1538.5325 | 10277.4744 | 5838.6319 | 379.7026 | 11962.5326 | 20804.1708 | 178491.4025 | 5674.4048 |
| N24 | Pure green tea | 0.0503 | 2.7879 | 78.1027 | 4058.5235 | 9600.1115 | 6096.3233 | 612.8286 | 11006.5691 | 17228.8195 | 148045.7346 | 5240.3876 |
| N25 | Green tea & orange | 0.0459 | 1.8163 | 63.1966 | 3386.0950 | 11932.8022 | 5637.6988 | 517.3743 | 12162.8095 | 19564.9140 | 175613.5234 | 5641.5832 |
| N26 | Green tea & lemon | 0.0442 | 2.3345 | 82.7145 | 10187.4101 | 11721.1697 | 5385.8435 | 679.7642 | 11802.4403 | 37207.0835 | 176614.6304 | 12642.1787 |
| N27 | Green tea & lemon eco. | 0.0134 | 0.4548 | 133.9775 | 1556.8613 | 9290.1797 | 7050.9535 | 229.8629 | 8704.8366 | 11604.3584 | 171140.7437 | 6268.8190 |
| N28 | Voyage Indian Chai | 0.0106 | 0.9689 | 72.9486 | 3683.9044 | 10671.7392 | 6560.4701 | 338.8381 | 15387.7968 | 14945.7357 | 242127.2606 | 2748.2719 |
| N29 | Voyage Brazilian Baia | 0.0035 | 0.5637 | 75.6088 | 1681.7497 | 12494.9407 | 5782.4385 | 240.5836 | 24035.4887 | 17420.9374 | 262946.9292 | 2638.4783 |
| N30 | White tea & pomegranate | 0.0217 | 1.1822 | 52.0911 | 5134.2758 | 9211.4057 | 3589.9657 | 463.7087 | 12382.9166 | 13570.3439 | 158566.7849 | 4038.1169 |
| N32 | Blackcurrant | 0.0559 | 2.0785 | 86.4573 | 16123.8085 | 7652.8078 | 7159.8629 | 350.8897 | 9519.7270 | 13307.0675 | 132451.0527 | 2952.6600 |
| N33 | Four Red Fruits | 0.0386 | 2.1930 | 94.5586 | 14149.5625 | 9325.7251 | 7885.5780 | 443.4723 | 13639.5046 | 17646.0516 | 166814.2851 | 3685.0749 |
| N34 | Passionfruit, Mango, Orange | 0.0446 | 2.4728 | 107.8872 | 16299.6872 | 9224.6931 | 7536.7296 | 651.4789 | 13783.9160 | 19114.4961 | 157085.4959 | 3917.4291 |
| N35 | Darjeeling tea | 0.0087 | 0.7956 | 57.3290 | 1159.3925 | 14171.2988 | 4735.0984 | 118.4183 | 24223.2551 | 17416.7311 | 262276.3004 | 2029.1573 |
| N36 | Earl Grey tea eco. | 0.0139 | 0.9657 | 116.2357 | 1325.2531 | 12687.3114 | 12053.6172 | 366.1086 | 14992.5683 | 19334.7147 | 237401.5565 | 2840.7223 |
| N37 | Earl Grey Fair trade | 0.0083 | 0.4388 | 140.6608 | 984.9985 | 13815.2999 | 9686.5406 | 326.5571 | 19194.4579 | 18624.5822 | 278594.7403 | 2381.6697 |
| N38 | Earl Grey | 0.0032 | 0.3253 | 80.9536 | 823.0539 | 10146.6717 | 3150.0655 | 70.9817 | 16263.4782 | 14390.7342 | 233884.0898 | 940.0297 |
| N39 | Earl Grey | 0.0056 | 0.8228 | 47.6256 | 4169.8663 | 10152.4132 | 4412.2507 | 155.4355 | 13724.5530 | 15887.4082 | 211668.4624 | 1189.6160 |
| N40 | Earl Grey | 0.0050 | 0.9063 | 54.0236 | 861.2569 | 12062.7979 | 4092.3765 | 251.0904 | 16736.2604 | 17047.4647 | 236727.0431 | 1824.0910 |
| N31 | Apple, cinnamon & raisins | 0.0392 | 1.9936 | 101.0571 | 13380.2782 | 9147.9114 | 7813.2728 | 495.8177 | 12978.6750 | 15881.6084 | 159481.6577 | 3490.6082 |
| N41 | Darjeeling green tea | 0.0025 | 0.4513 | 18.4794 | 33.3500 | 5189.5059 | 1316.0823 | 62.9176 | 10163.0990 | 7108.1124 | 129070.1012 | 584.9620 |
| N42 | Ceylon Breakfast | 0.0038 | 0.4012 | 80.4947 | 213.3061 | 8580.5964 | 3234.2067 | 136.6279 | 9165.8688 | 9337.7793 | 158814.8390 | 1260.6321 |

| Nr | Tea | U | Li | B | Na | Mg | Al | Si | P | S | K | Ca |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N43 | Tanzania | 0.0066 | 0.7341 | 48.9015 | 68.4477 | 6295.4807 | 4035.1057 | 153.6733 | 9393.4535 | 7921.7675 | 133207.6018 | 769.1643 |
| N44 | White China tea eco | 0.0028 | 0.1001 | 15.4903 | 82.5705 | 1631.0607 | 315.6620 | 16.0584 | 7865.2884 | 3576.4283 | 70905.1598 | 448.4903 |
| N45 | Krydder te | 0.0035 | 0.3972 | 30.1337 | 220.0105 | 3188.7275 | 1980.6040 | 166.1309 | 7120.0539 | 6530.8049 | 93437.4553 | 851.4273 |
| N46 | Jasmin tea | 0.0068 | 0.1001 | 33.4246 | 188.3709 | 4585.2825 | 862.6054 | 145.0058 | 11150.5001 | 6226.9311 | 112270.5249 | 949.0405 |
| N47 | Lapsang Souchong | 0.0087 | 0.4978 | 10.8131 | 33.3500 | 1619.9510 | 1577.2543 | 126.3767 | 6687.1463 | 4757.0705 | 73309.6436 | 443.6667 |
| N48 | Keemun eco | 0.0063 | 0.3162 | 16.5073 | 881.4487 | 2408.4155 | 1101.7043 | 164.1260 | 11779.1778 | 6224.0329 | 100449.8240 | 623.3524 |
| N49 | Japan Kukicha | 0.0017 | 0.5134 | 35.2105 | 484.9497 | 4704.7539 | 879.8390 | 141.9171 | 10023.4322 | 5553.4319 | 129002.1400 | 842.8499 |
| N50 | Søndags te | 0.0008 | 0.2259 | 5.7074 | 33.3500 | 1787.8867 | 639.1215 | 44.3760 | 4884.0089 | 2603.0825 | 50370.5603 | 378.4073 |
| N51 | Assam Gbop | 0.0050 | 0.6761 | 25.0366 | 106.0623 | 9260.3181 | 1139.3621 | 195.5463 | 16677.9021 | 10822.1010 | 154473.7554 | 905.2107 |
| N52 | Japan Bancha eco | 0.0228 | 0.9183 | 33.7022 | 33.3500 | 2507.3292 | 2902.1655 | 452.3513 | 5633.0234 | 7096.2233 | 95897.7188 | 1394.2418 |
| N53 | Assam Tgfop 1 | 0.0030 | 0.3795 | 35.4914 | 79.1751 | 5875.2409 | 1277.5196 | 110.1860 | 9958.5382 | 6152.2895 | 124884.4210 | 692.4399 |
| N54 | Kaktus te | 0.0255 | 0.8073 | 68.8350 | 146.9562 | 5683.1878 | 4039.1624 | 332.8410 | 10223.3588 | 10584.8600 | 147598.8206 | 1420.4894 |
| N55 | Blå blomst te | 0.0052 | 0.3569 | 43.2904 | 300.1502 | 6093.3965 | 2963.1526 | 176.4351 | 11904.1187 | 9560.0792 | 142084.6526 | 1076.5508 |
| N56 | Darjeeling | 0.0055 | 0.2172 | 20.9246 | 33.3500 | 6851.6059 | 1346.8177 | 68.6692 | 14323.7622 | 7544.5171 | 145152.1640 | 691.3862 |
| N57 | Ceylon Bop | 0.0018 | 0.1001 | 59.1356 | 334.6239 | 4639.1084 | 871.3523 | 49.4825 | 12280.8091 | 9543.8670 | 133813.6327 | 512.2231 |
| N58 | Samowar Douchka | 0.0112 | 0.5038 | 31.7767 | 1022.0695 | 4169.0090 | 2728.0539 | 215.5958 | 10319.4756 | 8305.1236 | 121659.8306 | 830.4845 |
| N59 | Skomakerens julete | 0.0095 | 0.3902 | 62.6657 | 600.4167 | 3149.4945 | 672.7522 | 108.4702 | 3851.5961 | 3225.8838 | 75082.8605 | 2625.0979 |
| N60 | Formosa Oolong | 0.0092 | 0.3227 | 17.4997 | 101.6928 | 2377.1565 | 1500.0853 | 245.2880 | 8784.6070 | 6025.0313 | 93742.6017 | 577.0598 |
| N61 | Golden Nepal | 0.0048 | 0.2222 | 24.5529 | 158.3826 | 5075.4136 | 1448.0923 | 101.9444 | 11324.8016 | 6118.5980 | 125525.0382 | 536.4075 |
| N62 | Yunnan Pu Erh | 0.0027 | 0.3306 | 39.1094 | 289.2826 | 3525.4920 | 417.1251 | 251.9105 | 24752.3630 | 7379.3980 | 120650.5744 | 401.6778 |
| N63 | Mango te | 0.0047 | 0.2568 | 35.1527 | 843.0643 | 4798.1878 | 2744.0258 | 62.9036 | 10083.5803 | 8881.1663 | 125449.7815 | 933.0125 |
| N64 | Gunpowder eco | 0.0072 | 0.3476 | 22.3287 | 33.3500 | 3181.2415 | 1309.1010 | 145.4142 | 6371.2618 | 6060.7198 | 83036.6529 | 676.9908 |
| N65 | Mexican Mango | 0.0278 | 0.5782 | 91.9305 | 259.0069 | 5969.2065 | 5300.5786 | 353.3766 | 6922.7846 | 6292.5887 | 111739.4972 | 1931.9098 |
| N66 | Advents te | 0.0039 | 0.3935 | 29.5879 | 253.2743 | 3095.5666 | 1830.0167 | 110.1937 | 7757.5210 | 6183.4482 | 97251.5464 | 595.2805 |
| N67 | Choui Fong | 0.0119 | 0.1001 | 41.4277 | 33.3500 | 6097.1231 | 1715.2469 | 39.4759 | 10712.0542 | 6478.2720 | 131588.2517 | 447.1015 |
| N68 | Bengal Fire | 0.0025 | 0.2412 | 28.1465 | 258.5229 | 4739.5262 | 2587.3942 | 105.0356 | 8652.4349 | 7282.7423 | 107825.5869 | 590.3737 |
| N69 | Rwanda Grønn | 0.0018 | 0.3201 | 34.7367 | 33.3500 | 6910.0531 | 739.3451 | 48.0316 | 10418.4033 | 6038.0829 | 123867.8939 | 416.8109 |
| N70 | Bjørnebær te | 0.0045 | 0.3250 | 32.4129 | 256.5955 | 4978.4423 | 2987.8186 | 150.6949 | 11289.0931 | 9672.6348 | 137397.0908 | 859.5675 |
| N16 | Earl Grey Twinings | 0.0110 | 0.7029 | 15.9462 | 519.8520 | 1860.6739 | 2208.1872 | 193.1177 | 7438.3431 | 6787.1441 | 90230.3813 | 527.8323 |

**Table 10: Raw data for each sample number and name. For further information about the different samples see Table 7 .Results presented in 4.1 and discussed in section 5.**

| Nr | Tea | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Sr | Ru |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C12 | Ceylon | 0.1642 | 0.0767 | 0.7368 | 291.3539 | 7.0572 | 0.1355 | 11.4027 | 42.9554 | 97.7684 | 1.4526 | 0.0072 |
| C15 | Scottish Breakfast | 0.1672 | 0.0813 | 0.1478 | 278.9666 | 2.7726 | 0.1244 | 4.8699 | 12.5920 | 51.8922 | 0.7928 | 0.0031 |
| C49 | Black Tea | 0.1469 | 0.1782 | 2.8789 | 1552.6468 | 6.7773 | 0.9161 | 26.1047 | 39.2217 | 119.6682 | 12.2778 | 0.0031 |
| C50 | Darjeeling | 0.1364 | 0.0629 | 0.3898 | 641.0166 | 7.8131 | 0.4394 | 25.8601 | 32.2696 | 78.4659 | 2.2818 | 0.0031 |
| C54 | Black Tea | 0.1226 | 0.0668 | 6.9725 | 2007.9742 | 6.5699 | 1.0712 | 26.4071 | 38.5423 | 57.5878 | 8.8841 | 0.0031 |
| C61 | Intensive Tea | 0.0990 | 0.0533 | 2.6006 | 2141.5799 | 4.2559 | 0.3346 | 14.4244 | 25.8675 | 74.0224 | 8.1543 | 0.0031 |
| C66 | Darjeeling Tea | 0.1725 | 0.1220 | 0.3540 | 839.9215 | 8.8935 | 0.4166 | 29.5896 | 50.2982 | 98.7935 | 2.6041 | 0.0031 |
| C67 | Earl Grey | 0.1074 | 0.0460 | 5.4974 | 2474.4608 | 5.4367 | 0.9654 | 29.4627 | 41.2322 | 45.8391 | 8.3527 | 0.0031 |
| C68 | Prince of Wales | 0.1620 | 0.1305 | 1.2570 | 1419.7838 | 32.9155 | 0.6812 | 22.3626 | 37.6226 | 45.3045 | 9.0169 | 0.0031 |
| C71 | Black Tea | 0.0390 | 0.0595 | 1.1242 | 895.0750 | 11.1294 | 0.4077 | 13.1737 | 22.2365 | 73.5584 | 1.2131 | 0.0031 |
| C76 | Kenia GFOP „Milima | 0.0824 | 0.0237 | 2.1943 | 952.3858 | 4.6088 | 0.6052 | 11.0098 | 14.3872 | 36.6108 | 3.5471 | 0.0031 |
| C83 | Earl Grey | 0.1482 | 0.0464 | 0.5856 | 965.6504 | 4.7421 | 0.6745 | 17.9030 | 27.9416 | 66.6422 | 2.2494 | 0.0031 |
| C84 | Kenia TGFOP Golden Tipped | 0.1341 | 0.0262 | 3.7826 | 1777.1520 | 5.7583 | 1.1492 | 19.9088 | 22.0738 | 65.1622 | 5.3800 | 0.0063 |
| C85 | Kenia Marinyn | 0.1442 | 0.0346 | 0.3796 | 1374.3605 | 5.9738 | 0.3264 | 12.1650 | 26.6494 | 66.8275 | 2.4277 | 0.0031 |
| C91 | Assam Marangi FTGFOP1 | 0.0907 | 0.0100 | 0.1240 | 290.3179 | 2.9640 | 0.2697 | 6.6940 | 17.5684 | 34.3098 | 0.3725 | 0.0031 |
| C101 | Lapsang Souchong | 0.1084 | 0.0586 | 0.3645 | 599.5263 | 12.0283 | 0.5089 | 6.6276 | 18.5397 | 56.4578 | 1.4214 | 0.0063 |
| C104 | China Black Golden Monkey | 0.1288 | 0.0279 | 0.3254 | 533.6151 | 3.3462 | 0.2642 | 8.3890 | 17.3270 | 90.2887 | 0.0834 | 0.0079 |
| C111 | Ceylon High Grown | 0.1089 | 0.0228 | 0.1994 | 446.5214 | 11.8671 | 0.2117 | 7.8289 | 19.8015 | 37.0126 | 1.4068 | 0.0031 |
| C113 | China Keemun Congu | 0.1584 | 0.0867 | 0.4915 | 811.4876 | 15.0628 | 0.4834 | 17.0671 | 26.9276 | 58.4062 | 2.4663 | 0.0031 |
| C41 | Yellow Label Tea | 0.1269 | 0.0319 | 2.7231 | 2429.0695 | 4.4493 | 0.2854 | 16.2178 | 26.3524 | 69.7033 | 5.0173 | 0.0067 |
| N1 | Lipton Yellow Label | 0.1557 | 0.0239 | 0.2912 | 592.2992 | 2.7885 | 0.3184 | 9.7786 | 19.8632 | 41.8726 | 1.2655 | 0.0065 |
| N2 | Lipton Yellow Label | 0.3187 | 0.0323 | 3.0373 | 4306.6828 | 6.6915 | 1.1032 | 45.4676 | 83.2211 | 181.4036 | 13.5434 | 0.0196 |
| N3 | Russian Earl Grey | 0.0912 | 0.0309 | 0.3025 | 464.1728 | 5.5249 | 0.2694 | 6.6856 | 9.5438 | 24.2713 | 9.1896 | 0.0031 |
| N4 | Green Tea Mandarin Orange | 0.2418 | 0.0434 | 1.6468 | 5120.8306 | 24.1073 | 1.4056 | 38.3353 | 61.0300 | 225.2502 | 22.2814 | 0.0204 |
| N5 | White tea Raspberry | 0.1898 | 0.0681 | 1.7986 | 5707.9858 | 19.6850 | 1.3111 | 47.7261 | 32.6315 | 135.5016 | 26.2858 | 0.0110 |
| N7 | Greeen Gunpowder | 0.1625 | 0.0247 | 0.3905 | 1461.6459 | 61.3812 | 0.7312 | 14.9450 | 46.0961 | 79.5811 | 4.8218 | 0.0124 |
| N8 | Green tea | 0.4211 | 0.0100 | 0.1908 | 743.7337 | 28.0494 | 0.5870 | 7.6434 | 14.9323 | 57.1974 | 2.5113 | 0.0031 |
| N9 | Peach & Mango | 0.2042 | 0.0825 | 2.4387 | 2161.9067 | 9.1156 | 2.3685 | 54.2333 | 47.9895 | 99.1615 | 6.7070 | 0.0132 |
| N10 | Forest Fruit | 0.2041 | 0.0752 | 1.7980 | 2219.7738 | 6.8810 | 2.2039 | 48.8473 | 36.6583 | 107.8077 | 7.0342 | 0.0089 |
| N11 | Blue Fruit | 0.1849 | 0.0763 | 2.0010 | 2084.9586 | 15.0016 | 1.9427 | 40.4453 | 34.4160 | 83.4996 | 4.6759 | 0.0137 |

| Nr | Tea | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Sr | Ru |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N12 | Russian Earl Grey | 0.2397 | 0.0620 | 4.2272 | 1613.8636 | 5.7673 | 1.1763 | 35.8633 | 83.0044 | 126.7161 | 24.2259 | 0.0122 |
| N13 | Earl Grey | 0.2998 | 0.0947 | 2.4214 | 2283.8841 | 6.9989 | 2.3917 | 54.0261 | 53.6760 | 95.7359 | 5.8597 | 0.0145 |
| N14 | Prince of Wales | 0.1067 | 0.0398 | 0.2305 | 679.0754 | 8.3819 | 0.4498 | 17.7515 | 22.2221 | 45.3330 | 1.8896 | 0.0080 |
| N15 | Prince of Wales | 0.2514 | 0.2547 | 3.0889 | 3314.3905 | 58.9050 | 1.8714 | 55.1068 | 74.8928 | 115.0943 | 26.6693 | 0.0110 |
| N17 | Earl Grey | 0.2276 | 0.1069 | 2.7629 | 2152.7482 | 29.2074 | 0.9772 | 30.8930 | 39.5458 | 63.9874 | 17.4728 | 0.0178 |
| N18 | Lady Grey | 0.1303 | 0.0708 | 0.5920 | 444.3646 | 11.4472 | 0.4334 | 16.0005 | 17.3547 | 35.9755 | 4.2013 | 0.0113 |
| N19 | Lady Grey | 0.2890 | 0.1937 | 4.2933 | 3559.7250 | 45.5011 | 1.7250 | 48.2009 | 58.2712 | 132.3080 | 27.0331 | 0.0064 |
| N6 | Indian Chai | 0.2310 | 0.1107 | 3.0523 | 2080.9122 | 8.9863 | 0.7797 | 25.3071 | 41.2047 | 108.8869 | 3.4847 | 0.0100 |
| N20 | English Breakfast tea | 0.1746 | 0.0100 | 0.4067 | 818.3628 | 4.5226 | 0.5167 | 15.0605 | 34.4812 | 53.2371 | 3.2929 | 0.0110 |
| N21 | English Breakfast tea | 0.3096 | 0.1044 | 8.8555 | 3982.5912 | 14.4067 | 1.9414 | 50.9701 | 81.5823 | 149.2614 | 24.0277 | 0.0208 |
| N22 | Green tea& Cranberry | 1.1222 | 0.3609 | 1.8538 | 4754.8009 | 73.6885 | 3.1118 | 74.5952 | 120.9490 | 176.9707 | 25.7443 | 0.0156 |
| N23 | Green tea & apple | 0.3621 | 0.1278 | 0.8319 | 4510.3580 | 61.1980 | 2.8696 | 87.1244 | 118.9114 | 194.4258 | 20.4570 | 0.0106 |
| N24 | Pure green tea | 0.3169 | 0.1161 | 1.1445 | 4579.9600 | 49.3055 | 2.9093 | 78.2162 | 107.9080 | 141.0109 | 22.6913 | 0.0128 |
| N25 | Green tea & orange | 0.5150 | 0.1340 | 1.0032 | 4594.0440 | 57.0531 | 2.7745 | 77.2031 | 127.5950 | 168.4051 | 28.7721 | 0.0102 |
| N26 | Green tea & lemon | 0.4109 | 0.1732 | 1.5012 | 4550.9675 | 58.1122 | 3.0368 | 68.3688 | 114.5101 | 177.4317 | 34.3038 | 0.0172 |
| N27 | Green tea & lemon eco. | 0.7416 | 0.0881 | 1.2324 | 1584.4897 | 45.6510 | 1.4393 | 87.8364 | 63.0377 | 132.0099 | 47.2877 | 0.0200 |
| N28 | Voyage Indian Chai | 0.3225 | 0.1109 | 2.4786 | 3307.6954 | 26.9249 | 2.4852 | 69.2761 | 98.0651 | 167.6375 | 21.3760 | 0.0119 |
| N29 | Voyage Brazilian Baia | 0.3361 | 0.0624 | 1.2781 | 1740.7791 | 7.0964 | 1.2098 | 37.6761 | 65.9248 | 129.7991 | 20.8629 | 0.0172 |
| N30 | White tea & pomegranate | 0.3395 | 0.0804 | 0.8391 | 3166.4550 | 38.0585 | 2.0412 | 51.4988 | 83.6876 | 143.3518 | 25.8507 | 0.0132 |
| N32 | Blackcurrant | 0.3176 | 0.2185 | 4.2649 | 3225.7124 | 54.0619 | 1.5275 | 46.0865 | 69.0771 | 85.0622 | 24.0790 | 0.0127 |
| N33 | Four Red Fruits | 0.4212 | 0.1613 | 4.8109 | 3475.0774 | 49.1745 | 1.7429 | 53.8481 | 64.6832 | 102.5372 | 26.2871 | 0.0096 |
| N34 | Passionfruit, Mango, Orange | 0.4221 | 0.2609 | 4.1242 | 3657.6158 | 59.1343 | 1.9551 | 54.1224 | 65.8527 | 107.1926 | 30.8388 | 0.0167 |
| N35 | Darjeeling tea | 0.3703 | 0.1138 | 0.9054 | 2463.3511 | 16.9794 | 1.1563 | 77.2886 | 122.1017 | 262.0409 | 9.9212 | 0.0116 |
| N36 | Earl Grey tea eco. | 0.3134 | 0.0587 | 3.4200 | 2677.1559 | 5.7291 | 1.0961 | 80.5601 | 105.9052 | 131.5990 | 17.7894 | 0.0174 |
| N37 | Earl Grey Fair trade | 0.3590 | 0.0447 | 1.4065 | 1907.1419 | 6.0134 | 1.2455 | 49.4154 | 110.6799 | 151.4736 | 16.8681 | 0.0104 |
| N38 | Earl Grey | 0.3042 | 0.0376 | 0.5178 | 1859.5866 | 6.8215 | 1.9947 | 38.6899 | 68.2694 | 222.5012 | 3.0553 | 0.0129 |
| N39 | Earl Grey | 0.2704 | 0.0767 | 1.0718 | 2074.4035 | 21.0026 | 0.9387 | 26.3491 | 52.1976 | 114.7215 | 10.3251 | 0.0118 |
| N40 | Earl Grey | 0.3003 | 0.1032 | 0.5783 | 1515.1777 | 13.2327 | 0.6866 | 21.9319 | 49.8798 | 129.2653 | 12.5755 | 0.0113 |
| N31 | Apple, cinnamon & raisins | 0.3004 | 0.1724 | 4.8054 | 3673.5934 | 41.2340 | 1.7479 | 52.7024 | 63.0084 | 100.6973 | 22.1722 | 0.0142 |
| N41 | Darjeeling green tea | 0.2886 | 0.0463 | 0.1038 | 781.8887 | 19.8052 | 0.6514 | 34.1970 | 23.7902 | 105.4543 | 3.8742 | 0.0080 |
| N42 | Ceylon Breakfast | 0.2054 | 0.0235 | 0.9224 | 2491.3891 | 4.8935 | 2.9157 | 40.6142 | 80.6841 | 121.2268 | 4.7698 | 0.0131 |
| N43 | Tanzania | 0.2185 | 0.0100 | 3.3649 | 5142.0167 | 4.2579 | 0.4268 | 27.3723 | 35.2209 | 74.3960 | 7.9620 | 0.0083 |
| N44 | White China tea eco | 0.2048 | 0.0513 | 0.0790 | 699.7268 | 4.9855 | 0.6001 | 15.1083 | 19.7720 | 73.4782 | 3.0198 | 0.0031 |

| Nr | Tea | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Sr | Ru |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N45 | Krydder te | 0.1063 | 0.0676 | 0.8188 | 811.3102 | 10.3865 | 0.4776 | 12.0559 | 29.0286 | 49.5965 | 5.3683 | 0.0088 |
| N46 | Jasmin tea | 0.2626 | 0.0326 | 0.2181 | 1454.0427 | 14.9066 | 1.2708 | 23.6941 | 65.6224 | 146.8117 | 3.5972 | 0.0120 |
| N47 | Lapsang Souchong | 0.1784 | 0.0391 | 0.2367 | 395.4476 | 10.1936 | 0.4529 | 16.4862 | 16.4865 | 32.1883 | 2.6910 | 0.0077 |
| N48 | Keemun eco | 0.2698 | 0.0787 | 0.2348 | 640.5008 | 20.5993 | 0.3590 | 20.2762 | 24.8474 | 53.5242 | 3.2163 | 0.0031 |
| N49 | Japan Kukicha | 0.2509 | 0.0273 | 0.1143 | 1280.4671 | 15.6743 | 0.2716 | 24.0962 | 12.0287 | 103.0310 | 2.0533 | 0.0031 |
| N50 | Søndags te | 0.1081 | 0.0100 | 0.8735 | 417.1211 | 4.8594 | 0.1869 | 7.7181 | 7.5244 | 23.1710 | 2.0013 | 0.0031 |
| N51 | Assam Gbop | 0.1659 | 0.0554 | 0.2701 | 975.7665 | 2.7896 | 0.7699 | 15.9559 | 47.0274 | 116.9101 | 3.5825 | 0.0104 |
| N52 | Japan Bancha eco | 0.2709 | 0.0838 | 0.5646 | 1859.7555 | 35.5602 | 2.3338 | 18.6128 | 8.5693 | 72.2165 | 3.5082 | 0.0163 |
| N53 | Assam Tgfop 1 | 0.2390 | 0.0286 | 0.2141 | 1374.7073 | 22.8344 | 0.9880 | 32.7167 | 23.4180 | 121.4847 | 4.3313 | 0.0168 |
| N54 | Kaktus te | 0.2098 | 0.0632 | 0.8802 | 2067.0375 | 25.4449 | 2.0455 | 32.1278 | 39.4045 | 73.2678 | 8.5768 | 0.0201 |
| N55 | Blå blomst te | 0.1728 | 0.0342 | 0.5106 | 1305.0986 | 9.5533 | 0.6402 | 19.8984 | 43.9173 | 77.7410 | 5.4783 | 0.0064 |
| N56 | Darjeeling | 0.2588 | 0.0418 | 0.1509 | 995.1471 | 11.8258 | 0.5157 | 31.4058 | 44.6382 | 110.5823 | 2.4113 | 0.0101 |
| N57 | Ceylon Bop | 0.2245 | 0.0423 | 0.1134 | 651.6923 | 29.1565 | 0.2803 | 9.8095 | 3.9256 | 49.3621 | 3.0303 | 0.0161 |
| N58 | Samowar Douchka | 0.1851 | 0.0736 | 0.7599 | 1148.9218 | 13.2145 | 0.7770 | 26.3800 | 35.2250 | 69.5369 | 3.6692 | 0.0125 |
| N59 | Skomakerens julete | 0.1744 | 0.1158 | 0.3309 | 273.4518 | 51.6891 | 0.3245 | 7.2202 | 14.6201 | 25.7670 | 10.1370 | 0.0087 |
| N60 | Formosa Oolong | 0.1637 | 0.0388 | 0.7939 | 880.0064 | 13.4703 | 0.6465 | 20.3546 | 28.9370 | 45.9261 | 3.9167 | 0.0104 |
| N61 | Golden Nepal | 0.1895 | 0.0393 | 0.6797 | 803.4533 | 10.5585 | 0.4989 | 28.2989 | 31.3153 | 90.2117 | 1.9813 | 0.0149 |
| N62 | Yunnan Pu Erh | 0.3032 | 0.0424 | 0.3565 | 871.9147 | 36.0189 | 0.2701 | 11.5800 | 1.3987 | 56.2307 | 5.5402 | 0.0120 |
| N63 | Mango te | 0.1837 | 0.0855 | 0.3583 | 1014.7244 | 9.2061 | 0.4197 | 11.8740 | 34.5092 | 60.3981 | 6.4764 | 0.0063 |
| N64 | Gunpowder eco | 0.1499 | 0.0344 | 0.1813 | 1095.7322 | 16.9590 | 0.7173 | 19.8932 | 36.0115 | 58.1686 | 3.0290 | 0.0099 |
| N65 | Mexican Mango | 0.1754 | 0.0336 | 5.5998 | 1927.9061 | 6.9067 | 0.8905 | 22.5290 | 33.9854 | 40.6843 | 11.0446 | 0.0082 |
| N66 | Advents te | 0.1108 | 0.0327 | 0.3228 | 629.8878 | 5.8141 | 0.3915 | 11.0539 | 24.5058 | 39.9145 | 4.2801 | 0.0031 |
| N67 | Choui Fong | 0.1955 | 0.0100 | 0.9909 | 898.8393 | 10.5648 | 0.5785 | 14.3992 | 28.1338 | 125.7713 | 2.1369 | 0.0111 |
| N68 | Bengal Fire | 0.1747 | 0.0254 | 0.3458 | 895.4408 | 11.7518 | 0.3007 | 7.4322 | 35.4043 | 46.4740 | 8.1595 | 0.0031 |
| N69 | Rwanda Grønn | 0.2180 | 0.0100 | 0.0650 | 2343.8187 | 9.9740 | 0.7007 | 18.4491 | 21.4878 | 116.0680 | 5.4209 | 0.0031 |
| N70 | Bjørnebær te | 0.1588 | 0.0275 | 0.5026 | 1116.4602 | 10.9186 | 0.5510 | 18.5459 | 39.0656 | 63.5555 | 6.3293 | 0.0196 |
| N16 | Earl Grey Twinings | 0.2051 | 0.0615 | 0.4439 | 522.4462 | 12.5616 | 0.5001 | 21.6764 | 25.1673 | 39.3463 | 3.0069 | 0.0063 |

**Table 11: Raw data for each sample number and name. For further information about the different samples see Table 7. Results presented in 4.1 and discussed in section 5.**

| Nr | Tea | Ba | La | Nb | Rb |
|---|---|---|---|---|---|
| C12 | Ceylon | 1.6856 | 0.0280 | 0.0026 | 154.5158 |
| C15 | Scottish Breakfast | 0.8221 | 0.0067 | 0.0027 | 166.2014 |
| C49 | Black Tea | 33.0024 | 0.1419 | 0.0042 | 481.2574 |
| C50 | Darjeeling | 8.5175 | 0.0254 | 0.0051 | 356.2035 |
| C54 | Black Tea | 30.3618 | 0.1802 | 0.0033 | 535.9369 |
| C61 | Intensive Tea | 11.6296 | 0.1631 | 0.0018 | 508.2700 |
| C66 | Darjeeling Tea | 7.6181 | 0.0475 | 0.0029 | 343.2989 |
| C67 | Earl Grey | 49.6740 | 0.2201 | 0.0009 | 589.5576 |
| C68 | Prince of Wales | 41.8927 | 0.3206 | 0.0025 | 365.3807 |
| C71 | Black Tea | 3.0293 | 0.0644 | 0.0009 | 497.0148 |
| C76 | Kenia GFOP „Milima | 5.4873 | 0.0629 | 0.0009 | 224.7590 |
| C83 | Earl Grey | 6.4150 | 0.0635 | 0.0022 | 326.0341 |
| C84 | Kenia TGFOP Golden Tipped | 9.3676 | 0.0942 | 0.0051 | 397.8101 |
| C85 | Kenia Marinyn | 2.4075 | 0.0890 | 0.0021 | 290.7961 |
| C91 | Assam Marangi FTGFOP1 | 1.5017 | 0.0067 | 0.0009 | 114.3240 |
| C101 | Lapsang Souchong | 3.0056 | 0.0542 | 0.0009 | 553.8285 |
| C104 | China Black Golden Monkey | 0.5898 | 0.0067 | 0.0009 | 192.5035 |
| C111 | Ceylon High Grown | 2.2145 | 0.0322 | 0.0033 | 217.6132 |
| C113 | China Keemun Congu | 7.8182 | 0.0775 | 0.0009 | 396.4684 |
| C41 | Yellow Label Tea | 4.5638 | 0.2670 | 0.0009 | 555.3381 |
| N1 | Lipton Yellow Label | 2.2157 | 0.0273 | 0.0009 | 246.7610 |
| N2 | Lipton Yellow Label | 22.5609 | 0.2567 | 0.0059 | 777.1636 |
| N3 | Russian Earl Grey | 10.5376 | 0.1313 | 0.0024 | 246.5452 |
| N4 | Green Tea Mandarin Orange | 22.5108 | 0.3238 | 0.0109 | 555.0970 |
| N5 | White tea Raspberry | 23.5914 | 0.9024 | 0.0091 | 540.4638 |
| N7 | Greeen Gunpowder | 4.7367 | 0.0540 | 0.0044 | 295.5113 |
| N8 | Green tea | 2.3790 | 0.0337 | 0.0095 | 169.6268 |
| N9 | Peach & Mango | 17.7325 | 0.1593 | 0.0009 | 659.7115 |
| N10 | Forest Fruit | 20.7511 | 0.1743 | 0.0045 | 431.2599 |
| N11 | Blue Fruit | 15.4916 | 0.1390 | 0.0059 | 423.5918 |
| N12 | Russian Earl Grey | 33.6476 | 0.2153 | 0.0069 | 555.5477 |
| N13 | Earl Grey | 23.1420 | 0.1874 | 0.0048 | 488.6017 |
| N14 | Prince of Wales | 5.4948 | 0.0529 | 0.0009 | 273.7501 |
| N15 | Prince of Wales | 90.4107 | 0.6524 | 0.0060 | 685.4707 |
| N17 | Earl Grey | 51.2014 | 0.3343 | 0.0054 | 482.1534 |
| N18 | Lady Grey | 13.1954 | 0.1370 | 0.0035 | 362.4397 |
| N19 | Lady Grey | 70.3321 | 0.4806 | 0.0043 | 744.6411 |
| N6 | Indian Chai | 8.0985 | 0.0617 | 0.0061 | 505.4822 |
| N20 | English Breakfast tea | 7.5319 | 0.0683 | 0.0038 | 268.4446 |
| N21 | English Breakfast tea | 58.9195 | 0.3455 | 0.0052 | 878.9665 |
| N22 | Green tea& Cranberry | 64.1128 | 0.4728 | 0.0077 | 653.2913 |
| N23 | Green tea & apple | 39.5994 | 0.1715 | 0.0076 | 882.4192 |
| N24 | Pure green tea | 54.3575 | 0.2788 | 0.0064 | 526.2564 |
| N25 | Green tea & orange | 70.5430 | 0.2414 | 0.0071 | 685.0353 |
| N26 | Green tea & lemon | 56.0445 | 0.2366 | 0.0041 | 819.0237 |
| N27 | Green tea & lemon eco. | 72.2175 | 0.1800 | 0.0043 | 274.1740 |
| N28 | Voyage Indian Chai | 59.7149 | 0.1788 | 0.0094 | 302.2958 |
| N29 | Voyage Brazilian Baia | 35.5546 | 0.0625 | 0.0090 | 208.9593 |
| N30 | White tea & pomegranate | 49.2790 | 0.1727 | 0.0059 | 590.1852 |

| Nr | Tea | Ba | La | Nb | Rb |
|---|---|---|---|---|---|
| N32 | Blackcurrant | 82.1773 | 0.6025 | 0.0035 | 681.3080 |
| N33 | Four Red Fruits | 76.5697 | 0.4834 | 0.0103 | 806.7678 |
| N34 | Passionfruit, Mango, Orange | 75.7438 | 0.5222 | 0.0072 | 819.3122 |
| N35 | Darjeeling tea | 19.4772 | 0.0951 | 0.0074 | 812.8823 |
| N36 | Earl Grey tea eco. | 50.5165 | 0.3417 | 0.0037 | 621.7004 |
| N37 | Earl Grey Fair trade | 63.8300 | 0.2173 | 0.0094 | 557.0678 |
| N38 | Earl Grey | 9.0019 | 0.1849 | 0.0077 | 430.6208 |
| N39 | Earl Grey | 15.5517 | 0.0899 | 0.0085 | 483.3042 |
| N40 | Earl Grey | 16.4381 | 0.0873 | 0.0089 | 431.3780 |
| N31 | Apple, cinnamon & raisins | 78.0706 | 0.5005 | 0.0065 | 795.8844 |
| N41 | Darjeeling green tea | 8.2624 | 0.0185 | 0.0033 | 317.4047 |
| N42 | Ceylon Breakfast | 18.2858 | 0.1664 | 0.0048 | 330.1349 |
| N43 | Tanzania | 6.5571 | 0.5137 | 0.0024 | 769.3994 |
| N44 | White China tea eco | 1.3642 | 0.0311 | 0.0030 | 309.7522 |
| N45 | Krydder te | 9.6856 | 0.0617 | 0.0009 | 202.9079 |
| N46 | Jasmin tea | 3.5872 | 0.0835 | 0.0042 | 692.4086 |
| N47 | Lapsang Souchong | 9.3178 | 0.0285 | 0.0067 | 261.3904 |
| N48 | Keemun eco | 10.6916 | 0.0705 | 0.0050 | 275.5839 |
| N49 | Japan Kukicha | 2.6678 | 0.0754 | 0.0036 | 140.8261 |
| N50 | Søndags te | 1.5288 | 0.0265 | 0.0032 | 125.6748 |
| N51 | Assam Gbop | 8.5707 | 0.0423 | 0.0041 | 670.1724 |
| N52 | Japan Bancha eco | 8.4265 | 0.1198 | 0.0035 | 302.9186 |
| N53 | Assam Tgfop 1 | 7.6356 | 0.0221 | 0.0072 | 390.8295 |
| N54 | Kaktus te | 16.8707 | 0.1287 | 0.0035 | 387.6956 |
| N55 | Blå blomst te | 10.1937 | 0.0712 | 0.0021 | 303.5637 |
| N56 | Darjeeling | 4.8883 | 0.0399 | 0.0024 | 426.4060 |
| N57 | Ceylon Bop | 3.7944 | 0.0408 | 0.0035 | 273.3915 |
| N58 | Samowar Douchka | 17.8301 | 0.0856 | 0.0044 | 391.0029 |
| N59 | Skomakerens julete | 7.0313 | 0.0644 | 0.0020 | 156.8006 |
| N60 | Formosa Oolong | 11.0346 | 0.0993 | 0.0047 | 484.0769 |
| N61 | Golden Nepal | 7.7167 | 0.0350 | 0.0029 | 536.0010 |
| N62 | Yunnan Pu Erh | 5.9762 | 0.0359 | 0.0118 | 367.7935 |
| N63 | Mango te | 6.7299 | 0.0613 | 0.0053 | 258.9245 |
| N64 | Gunpowder eco | 7.1919 | 0.1116 | 0.0067 | 493.7560 |
| N65 | Mexican Mango | 23.0106 | 0.1702 | 0.0059 | 594.7942 |
| N66 | Advents te | 7.8795 | 0.0527 | 0.0032 | 218.3167 |
| N67 | Choui Fong | 2.7629 | 0.0769 | 0.0042 | 809.8624 |
| N68 | Bengal Fire | 8.1351 | 0.0952 | 0.0035 | 264.4366 |
| N69 | Rwanda Grønn | 3.8124 | 0.0141 | 0.0055 | 240.6863 |
| N70 | Bjørnebær te | 10.0780 | 0.0741 | 0.0048 | 323.5968 |
| N16 | Earl Grey Twinings | 19.7984 | 0.0495 | 0.0039 | 365.3399 |

## Appendix 2

Table 12: Method detection limits (MDLs) for all the detected elements in the tea samples.

| Element | MDL | Element | MDL |
|---|---|---|---|
| Ag | 0.334 | Na | 0.534 |
| Al | 0.00267 | Nb | 66.7 |
| As | 0.0133 | Nd | 2.33 |
| Au | 0.133 | Ni | 1.33 |
| B | 0.00667 | P | 32.1 |
| Ba | 0.00334 | Pb | 2.67 |
| Be | 0.00334 | Pr | 133 |
| Bi | 0.00133 | Pt | 33.4 |
| Ca | 0.002 | Rb | 66.7 |
| Cd | 0.00133 | Rh | 0.0267 |
| Ce | 0.00334 | Ru | 0.078 |
| Co | 0.00133 | S | 0.02 |
| Cr | 0.0133 | Sb | 0.0584 |
| Cs | 0.00133 | Sc | 0.225 |
| Cu | 0.002 | Se | 0.8 |
| Dy | 0.00334 | Si | 0.0267 |
| Er | 0.00267 | Sm | 0.1 |
| Fe | 0.00133 | Sn | 0.2 |
| Ga | 0.00133 | Sr | 0.167 |
| Ge | 0.000972 | Ta | 0.0467 |
| Hf | 0.00334 | Tb | 0.167 |
| Hg | 0.00667 | Th | 0.00616 |
| Ho | 0.00138 | Ti | 0.133 |
| In | 0.00667 | Tl | 0.0133 |
| Ir | 0.0102 | Tm | 0.0867 |
| K | 0.00167 | U | 0.0133 |
| La | 0.0133 | V | 0.133 |
| Li | 0.0104 | W | 0.167 |
| Lu | 0.00334 | Y | 0.167 |
| Mg | 0.00167 | Yb | 0.00177 |
| Mn | 0.2 | Zn | 0.08 |
| Mo | 0.0534 | Zr | 0.296 |

## Appendix 3

**Table 13:Thermo Finnigan Element 2 instrument conditions**

| Parameter | Value |
|---|---|
| Sample flow/pumping speed | 200 µL/min |
| Sample loop | 500 µL |
| Equipment | Type |
| Nebulizer | PFA-ST with approx. volume range from 50-700µl/min |
| Spray Chamber | Quarts baffled micro cyclonic, with dual gas inlet type ESI – ES-3452-111-11 |
| Torch | Quarts Demountable with o-rings |
| Injector | Quarts 2.5 mm with o-rings, ES-1024-0250 |
| Sample cones | Aluminium ES-3000-18032 |
| Skimmer cones | Aluminium type X-skimmer ES-3000-1805 X |
| Gas flows | Value |
| Cooling gas | 15.5 L/min |
| Auxiliary gas | 1.1 L/min |
| Sample gas 1 (nebulizer) | 0.75 L/min |
| Sample gas 2 (T-connection) | 0.55 L/min |
| Additional gas | Approx 0.0004 $CH_4$, corresponds to approx. 0.04% in the sample gas. |
| Determination | Value |
| Resolutions | Low (400), Medium (5 500) and High (10 000), |

## Appendix 4

**Table 14: RSDs calculated for each of the detected element in the four triplicates. These values are discussed in chapter 5.2.**

| | C41 | N6 | N16 | N31 |
|---|---|---|---|---|
| Y | 19.8 | 6.4 | 25.8 | 6.6 |
| Cd | 21.6 | 22.8 | 24.8 | 3.4 |
| Sn | 104.4 | 23.1 | 15.2 | 24.8 |
| Cs | 19.3 | 3.7 | 17.6 | 2.3 |
| Ce | 19.3 | 4.3 | 20.1 | 5.6 |
| Pr | 20.5 | 2.1 | 28.0 | 6.8 |
| Nd | 16.4 | 6.4 | 20.0 | 6.4 |
| Sm | 13.6 | 26.5 | 26.2 | 0.6 |
| Tb | 21.6 | 9.9 | 15.5 | 9.2 |
| Dy | 13.3 | 15.9 | 15.3 | 10.8 |
| Ho | 25.2 | 10.3 | 17.3 | 4.9 |
| Er | 21.8 | 6.3 | 30.6 | 7.3 |
| Tm | 16.8 | 12.4 | 48.4 | 4.2 |
| Yb | 13.4 | 9.0 | 34.1 | 1.1 |
| Lu | 19.1 | 21.8 | 26.3 | 7.9 |
| Hf | 53.1 | 28.5 | 68.4 | 74.8 |
| Tl | 16.2 | 13.2 | 21.3 | 20.6 |
| Pb | 12.1 | 22.0 | 9.5 | 12.6 |
| Th | 17.9 | 38.1 | 16.9 | 8.0 |
| U | 6.1 | 2.9 | 10.1 | 3.8 |
| Li | 32.1 | 8.6 | 11.0 | 3.9 |
| B | 15.3 | 23.6 | 21.3 | 14.1 |
| Na | 9.8 | 4.9 | 12.2 | 6.8 |
| Mg | 18.1 | 14.2 | 13.8 | 10.1 |
| Al | 21.2 | 7.0 | 12.8 | 7.8 |
| Si | 35.9 | 32.9 | 20.4 | 20.9 |
| P | 18.9 | 3.3 | 10.1 | 6.2 |
| S | 20.0 | 2.8 | 9.2 | 3.4 |
| K | 19.2 | 6.4 | 8.9 | 3.6 |
| Ca | 16.3 | 29.0 | 7.4 | 11.3 |
| Ti | 29.8 | 5.2 | 17.6 | 15.4 |
| V | 52.8 | 8.6 | 27.0 | 4.5 |
| Cr | 21.3 | 13.6 | 19.7 | 7.4 |
| Mn | 18.2 | 15.7 | 12.7 | 7.1 |
| Fe | 11.4 | 34.6 | 15.6 | 5.9 |
| Co | 15.6 | 29.1 | 3.1 | 13.6 |
| Ni | 14.4 | 25.6 | 10.5 | 7.0 |
| Cu | 13.0 | 8.5 | 8.5 | 4.9 |
| Zn | 38.5 | 3.1 | 26.1 | 5.3 |
| Sr | 15.9 | 25.6 | 21.5 | 7.8 |
| Ru | 50.0 | 37.3 | 59.2 | 60.7 |
| Ba | 11.5 | 30.9 | 20.0 | 4.9 |
| La | 17.7 | 6.9 | 22.9 | 8.2 |
| Nb | 225.5 | 41.9 | 67.1 | 20.8 |
| Rb | 19.0 | 5.8 | 9.8 | 2.2 |

## Appendix 5

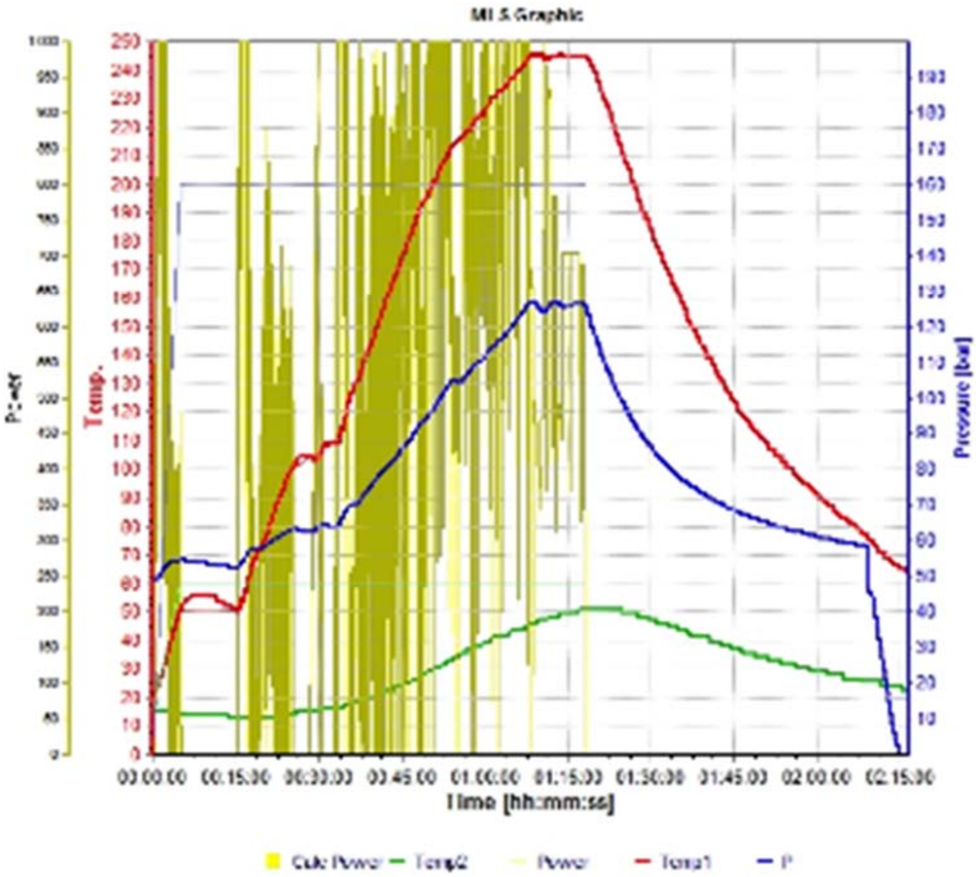


**Figure 4: Temperature profile for the digestion with Ultra Clave. 6 mL 50% $HNO_3$ was added to the sample, before digestion, and then diluted to 60 mL with ultrapure water.**

**Table 15: Programme for digestion with Ultra Clave.**

**MW Program**

| Step | Time [hh:mm:ss] | Temp 1 [°C] | Temp 2 [°C] | Press [bar] | Engery [Watt] |
|---|---|---|---|---|---|
| 1 | 00:05:00 | 50 | 60 | 160 | 1 000 |
| 2 | 00:10:00 | 50 | 60 | 160 | 1 000 |
| 3 | 00:10:00 | 100 | 60 | 160 | 1 000 |
| 4 | 00:08:00 | 110 | 60 | 160 | 1 000 |
| 5 | 00:15:00 | 190 | 60 | 160 | 1 000 |
| 6 | 00:05:00 | 210 | 60 | 160 | 1 000 |
| 7 | 00:15:00 | 245 | 60 | 160 | 1 000 |
| 8 | 00:10:00 | 245 | 60 | 160 | 1 000 |

## Appendix 6

**Table 16: Reference material from tea leaves GBW-07605 was used to determine the accuracy of the analysis of tea infusions by ICP-MS. Certified values for the elements are listed as well as the percent of measured mean concentrations. Empty rows are listed where no certified values are given. The values are given in µg/g. These values are further discussed in chapter 5.1.**

| Element | Isotope | Average (min-max) | Standard deviation | Certified values | Accuracy (%) |
|---|---|---|---|---|---|
| Ag | 109 | 0.0102 (0.00936-0.011) | 0.000699 | 0.018 | 56.5 |
| Al | 27 | 2680 (2470-2820) | 123 | 3000 | 89.2 |
| As | 75 | 0.256 (0.251-0.263) | 0.00403 | 0.28 | 91.4 |
| Au | 197 | 0.0000641 (0.0000328-0.000128) | 0.0000344 | | |
| B | 11 | 13.5 (12.5-14.1) | 0.626 | 15 | 90.3 |
| Ba | 137 | 56.7 (55.7-57.8) | 0.704 | 58 | 97.8 |
| Be | 9 | 0.0241 (0.0233-0.0255) | 0.000846 | 0.034 | 70.8 |
| Bi | 209 | 0.0552 (0.0528-0.06) | 0.00248 | 0.063 | 87.6 |
| Ca | 43 | 4360 (4030-4570) | 195 | 4300 | 101 |
| Cd | 114 | 0.0598 (0.058-0.0613) | 0.00124 | 0.057 | 105 |
| Ce | 140 | 0.874 (0.85-0.905) | 0.0232 | 1 | 87.4 |
| Co | 59 | 0.176 (0.17-0.18) | 0.00394 | 0.18 | 97.6 |
| Cr | 52 | 0.715 (0.681-0.738) | 0.0212 | 0.8 | 89.3 |
| Cs | 133 | 0.248 (0.238-0.252) | 0.00569 | 0.29 | 85.4 |
| Cu | 63 | 16.7 (15.7-17.4) | 0.57 | 17.3 | 96.8 |
| Dy | 163 | 0.0573 (0.0532-0.0608) | 0.00252 | 0.074 | 77.4 |
| Er | 166 | 0.0366 (0.0336-0.0379) | 0.00158 | | |
| Fe | 57 | 254 (242-264) | 8.3 | 264 | 96.1 |
| Ga | 69 | 0.192 (0.179-0.203) | 0.00845 | | |
| Ge | 72 | 0.0124 (0.0109-0.0159) | 0.00186 | | |
| Hf | 178 | 0.00399 (0.00313-0.00426) | 0.000427 | 0.033 | 12.1 |
| Hg | 202 | 0.00959 (0.00859-0.00998) | 0.000536 | 0.019 | 50.5 |
| Ho | 165 | 0.012 (0.0108-0.0127) | 0.000624 | 0.019 | 63.1 |
| In | 115 | 0.0017 (0.00167-0.00173) | 0.0000217 | | |
| Ir | 193 | 0.0000105 (-0.000000399-0.0000359) | 0.0000135 | | |
| K | 39 | 15900 (15300-16300) | 337 | 16600 | 95.8 |
| La | 139 | 0.506 (0.489-0.528) | 0.0155 | 0.6 | 84.3 |
| Li | 7 | 0.328 (0.314-0.342) | 0.0101 | 0.36 | 91 |
| Lu | 175 | 0.00526 (0.00501-0.00549) | 0.000185 | 0.007 | 75.2 |
| Mg | 25 | 1600 (1530-1690) | 56.5 | 1700 | 94.1 |
| Mn | 55 | 1170 (1150-1180) | 16 | 1240 | 94.5 |
| Mo | 98 | 0.0386 (0.0359-0.0436) | 0.00277 | 0.038 | 102 |
| Na | 23 | 44.5 (42.6-46.4) | 1.27 | 44 | 101 |
| Nb | 93 | 0.0355 (0.0284-0.0397) | 0.00394 | | |
| Nd | 146 | 0.366 (0.351-0.384) | 0.0111 | 0.44 | 83.2 |
| Ni | 60 | 4.46 (4.21-4.78) | 0.2 | 4.6 | 96.9 |
| P | 31 | 2970 (2890-3120) | 80.2 | 2840 | 105 |
| Pb | 208 | 3.79 (3.7-3.85) | 0.0534 | 4.4 | 86.1 |
| Pr | 141 | 0.0971 (0.0934-0.103) | 0.00321 | 0.12 | 80.9 |
| Pt | 195 | 0.0000614 (0.0000315-0.000126) | 0.0000403 | | |
| Rb | 85 | 70.2 (67.8-73) | 1.89 | 74 | 94.9 |
| Rh | 103 | -0.000241 (-0.000345--0.0000867) | 0.0000943 | | |
| S | 34 | 2620 (2460-2780) | 107 | 2450 | 107 |
| Sb | 121 | 0.0531 (0.0496-0.0614) | 0.00429 | 0.056 | 94.9 |

| Element | Isotope | Average (min-max) | Standard deviation | Certified values | Accuracy (%) |
|---|---|---|---|---|---|
| Sc | 45 | 0.0867 (0.0816-0.0893) | 0.00284 | 0.085 | 102 |
| Se | 78 | 0.0749 (0.0685-0.0869) | 0.00625 | 0.072 | 104 |
| Si | 30 | 653 (621-672) | 17.2 | 2100 | 31.1 |
| Sm | 147 | 0.0687 (0.066-0.0721) | 0.00194 | 0.085 | 80.8 |
| Sn | 118 | 0.138 (0.134-0.143) | 0.00327 | | |
| Sr | 88 | 14.2 (13.6-14.6) | 0.368 | 15.2 | 93.6 |
| Ta | 181 | 0.00139 (0.000858-0.00164) | 0.000273 | | |
| Tb | 159 | 0.0102 (0.00969-0.0109) | 0.000424 | 0.011 | 92.6 |
| Th | 232 | 0.0522 (0.0496-0.0548) | 0.00177 | 0.061 | 85.6 |
| Ti | 47 | 9.36 (7.51-10.7) | 1.13 | 24 | 39 |
| Tl | 205 | 0.026 (0.0253-0.0264) | 0.000412 | | |
| Tm | 169 | 0.0056 (0.00521-0.00575) | 0.000205 | | |
| U | 238 | 0.0142 (0.0136-0.0145) | 0.000341 | | |
| V | 51 | 0.447 (0.425-0.474) | 0.0179 | 0.86 | 52 |
| W | 182 | 0.0255 (0.0202-0.0404) | 0.0077 | | |
| Y | 89 | 0.333 (0.32-0.362) | 0.0157 | 0.36 | 92.4 |
| Yb | 172 | 0.0355 (0.0334-0.0365) | 0.0011 | 0.044 | 80.7 |
| Zn | 67 | 27 (26.1-27.9) | 0.638 | 26.3 | 103 |
| Zr | 90 | 0.125 (0.1-0.135) | 0.0128 | | |

**Table 17 Certified reference material from Institute of Nuclear Chemistry and Technology Warzawa-Poland, Polish Virginia Tobacco Leaves was used to determine the accuracy of the analysis of tea infusions by ICP-MS. Certified values for the elements are listed as well as the percent of measured mean concentrations. Empty rows are listed where no certified values are given. The values are given in µg/g. See discussion in chapter 5.1.**

| Elements | Isotopes | Average (min-max) | Standard deviation | Certified value | Accuracy (%) |
|---|---|---|---|---|---|
| Ag | 109 | 0.0189 (0.0164-0.0209) | 0.00147 | 0.0191 | 98.8 |
| Al | 27 | 347 (305-422) | 41.3 | 252 | 137.6 |
| As | 75 | 0.13 (0.116-0.156) | 0.0141 | 0.138 | 94.1 |
| Au | 197 | 0.000729 (0.000555-0.00114) | 0.000216 | | |
| B | 11 | 34.8 (30-41.4) | 3.8 | 33.4 | 104.2 |
| Ba | 137 | 42.2 (36.2-51.1) | 4.88 | 41.6 | 101.5 |
| Be | 9 | 0.0233 (0.0197-0.0295) | 0.0037 | | |
| Bi | 209 | 0.145 (0.122-0.215) | 0.0348 | 0.14 | 103.3 |
| Ca | 43 | 24400 (20700-29800) | 3020 | 22970 | 106.4 |
| Cd | 114 | 2.21 (1.91-2.64) | 0.235 | 2.23 | 99.0 |
| Ce | 140 | 0.718 (0.634-0.816) | 0.0819 | 0.743 | 96.6 |
| Co | 59 | 0.137 (0.118-0.166) | 0.016 | 0.154 | 88.7 |
| Cr | 52 | 0.643 (0.574-0.791) | 0.0806 | 0.911 | 70.6 |
| Cs | 133 | 0.0225 (0.0198-0.027) | 0.00249 | 0.0266 | 84.8 |
| Cu | 63 | 4.49 (3.95-5.48) | 0.528 | 5.12 | 87.7 |
| Dy | 163 | 0.0379 (0.0341-0.0414) | 0.00287 | | |
| Er | 166 | 0.0204 (0.0176-0.0237) | 0.00228 | 0.0185 | 110.4 |
| Fe | 57 | 277 (245-334) | 30.4 | 258 | 107.3 |
| Ga | 69 | 0.0695 (0.0624-0.0843) | 0.00818 | | |
| Ge | 72 | 0.0121 (0.00932-0.0162) | 0.00239 | | |
| Hf | 178 | 0.00417 (0.00299-0.00488) | 0.000832 | 0.161 | 2.6 |
| Hg | 202 | 0.0224 (0.0202-0.0269) | 0.0024 | 0.0232 | 96.5 |
| Ho | 165 | 0.00733 (0.00659-0.00828) | 0.000686 | | |

| Elements | Isotopes | Average (min-max) | Standard deviation | Certified value | Accuracy (%) |
|---|---|---|---|---|---|
| In | 115 | 0.000466 (0.00039-0.000527) | 0.0000509 | | |
| Ir | 193 | 0.0000292 (-0.000000129-0.000135) | 0.0000526 | | |
| K | 39 | 23900 (21400-29100) | 2810 | 26400 | 90.5 |
| La | 139 | 0.488 (0.441-0.563) | 0.0477 | 0.54 | 90.4 |
| Li | 7 | 3.82 (3.31-4.61) | 0.445 | 3.35 | 114.1 |
| Lu | 175 | 0.00215 (0.00185-0.00242) | 0.000239 | | |
| Mg | 25 | 2250 (1930-2700) | 260 | 2410 | 93.2 |
| Mn | 55 | 128 (110-157) | 15.4 | 136 | 94.4 |
| Mo | 98 | 0.403 (0.351-0.495) | 0.0488 | 0.396 | 101.8 |
| Na | 23 | 70.2 (62.1-87.1) | 9.88 | 62.4 | 112.4 |
| Nb | 93 | 0.0418 (0.0341-0.0467) | 0.00501 | | |
| Nd | 146 | 0.305 (0.271-0.344) | 0.0306 | 0.322 | 94.7 |
| Ni | 60 | 1.22 (1.07-1.47) | 0.136 | 1.49 | 81.9 |
| P | 31 | 2700 (2320-3190) | 283 | 2420 | 111.4 |
| Pb | 208 | 0.662 (0.562-0.793) | 0.0855 | 0.972 | 68.1 |
| Pr | 141 | 0.0815 (0.0715-0.093) | 0.00906 | 0.0829 | 98.4 |
| Pt | 195 | 0.00034 (0.0000978-0.000525) | 0.000148 | | |
| Rb | 85 | 5.49 (4.71-6.76) | 0.695 | 5.97 | 92.0 |
| Rh | 103 | 0.000902 (0.000649-0.00105) | 0.000162 | | |
| S | 34 | 3860 (3250-4790) | 518 | 3780 | 102.0 |
| Sb | 121 | 0.0263 (0.0221-0.0345) | 0.00427 | 0.0372 | 70.6 |
| Sc | 45 | 0.05 (0.0446-0.0602) | 0.00554 | 0.0595 | 84.1 |
| Se | 82 | 0.0303 (0.0266-0.0394) | 0.00474 | | |
| Si | 30 | 982 (880-1170) | 102 | | |
| Sm | 147 | 0.0503 (0.0446-0.0567) | 0.00471 | 0.058 | 86.7 |
| Sn | 118 | 0.0367 (0.0303-0.0434) | 0.00512 | 0.0311 | 118.0 |
| Sr | 88 | 125 (110-153) | 14.8 | 133 | 94.2 |
| Ta | 181 | 0.000937 (0.000614-0.00118) | 0.000246 | 0.0109 | 8.6 |
| Tb | 159 | 0.00692 (0.0065-0.00758) | 0.000488 | 0.0081 | 85.5 |
| Th | 232 | 0.075 (0.0656-0.0928) | 0.00968 | 0.0888 | 84.5 |
| Ti | 47 | 14.1 (11.9-15.5) | 1.62 | 12.3 | 114.9 |
| Tl | 205 | 0.0221 (0.0196-0.0268) | 0.00254 | 0.0228 | 96.8 |
| Tm | 169 | 0.00266 (0.00227-0.00312) | 0.000332 | | |
| U | 238 | 0.0141 (0.0127-0.0159) | 0.0012 | 0.022 | 64.1 |
| V | 51 | 0.396 (0.347-0.486) | 0.0475 | 0.405 | 97.7 |
| W | 182 | 0.0149 (0.0131-0.0179) | 0.00181 | | |
| Y | 89 | 0.249 (0.221-0.292) | 0.0251 | 0.218 | 114.0 |
| Yb | 172 | 0.0155 (0.0132-0.0174) | 0.0017 | 0.0283 | 54.9 |
| Zn | 66 | 40.8 (35-49.8) | 4.93 | 43.6 | 93.5 |
| Zr | 90 | 0.156 (0.117-0.179) | 0.0247 | | |

## Appendix 7

**In Table 18 the average concentrations of F in the standard solutions are given, with the drawn calibration curve in Figure 5. In Table 19 the data from each of the 70 Norwegian infusions are listed, together with calculated concentrations of F before and after corrections, tea in grams and final volume.**

Table 20 shows the concentrations of F in infusions infused for 30 minutes. The calculated RSDs for the triplicates N16 and N31 was 33.1 and 5.4, respectively.

**Table 18: Results from the calculation of the standard curve. Standard solutions of NaF were used.**

| C ($F^-$) | log C | Average (mV) |
|---|---|---|
| 0.0000491 | -4.308918508 | 155 |
| 0.0000982 | -4.007888512 | 147 |
| 0.0002455 | -3.609948504 | 129 |
| 0.0003437 | -3.463820468 | 119 |
| 0.000491 | -3.308918508 | 114 |
| 0.002455 | -2.609948504 | 71 |
| 0.007365 | -2.132827249 | 42 |
| 0.02455 | -1.609948504 | 12 |

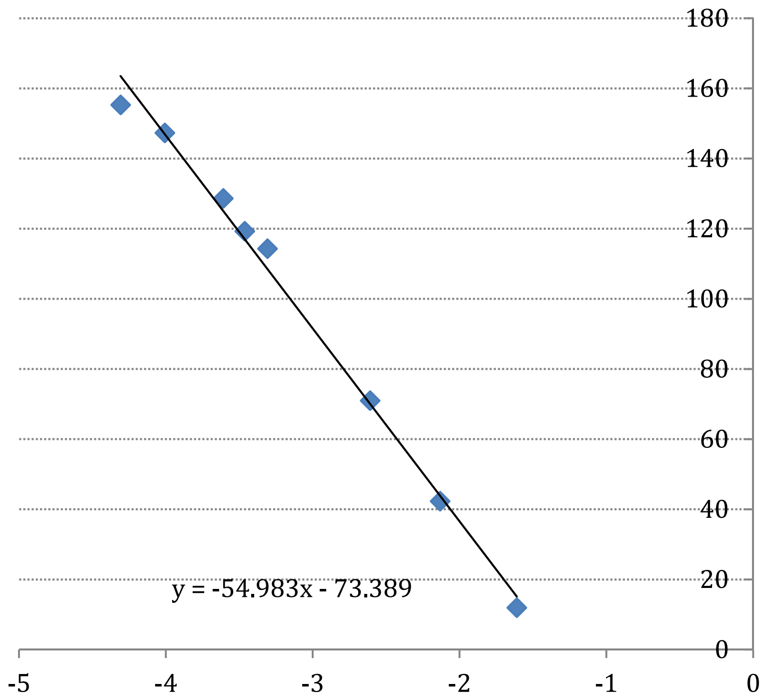


**Figure 5: Standard curve from standard solutions of NaF. Used for calibrations of F level in Norwegian tea infusions.**

**Table 19: Raw data from determination of fluoride in the Norwegian tea infusions. Number of the infusions, name, loose tea (L) or tea bag (T), amount of F before corrections and after corrected for gram of tea and final volume. Presented average results can be seen in 4.3 Fluoride and discussions in section 5.22.**

| Number | Tea | L/ T | $F^-$(mg/L) | Tea (g) | Final volume | F- (mg/L)/g |
|---|---|---|---|---|---|---|
| N1 | Lipton Yellow Label | L | 1.08 | 1.029 | 101.505 | 1.06 |
| N2 | Lipton Yellow Label | T | 7.32 | 2.453 | 100.844 | 3.01 |
| N3 | Russian Earl Grey | L | 1.18 | 1.081 | 100.885 | 1.1 |
| N4 | Green Tea Mandarin Orange | T | 6.18 | 1.92 | 103.168 | 3.32 |
| N5 | White tea Raspberry | T | 6.73 | 1.627 | 104.34 | 4.31 |
| N6 | Indian Chai | T | 3.11 | 1.639 | 100.452 | 1.91 |
| N7 | Greeen Gunpowder | T | 6.45 | 2.022 | 104.843 | 3.34 |
| N8 | Green tea | T | 3.70 | 1.983 | 103.61 | 1.93 |
| N9 | Peach & Mango | T | 3.86 | 1.99 | 100.215 | 1.94 |
| N10 | Forest Fruit | T | 3.11 | 1.9 | 101.649 | 1.67 |
| N11 | Blue Fruit | T | 3.39 | 1.992 | 100.594 | 1.71 |
| N12 | Russian Earl Grey | T | 5.67 | 2.372 | 101.131 | 2.42 |
| N13 | Earl Grey | T | 4.99 | 2.078 | 100.163 | 2.41 |
| N14 | Prince of Wales | L | 1.61 | 1.059 | 100.317 | 1.53 |
| N15 | Prince of Wales | T | 1.76 | 2.277 | 100.412 | 0.778 |
| N16 | Earl Grey | L | 0.78 | 1.049 | 100.149 | 1.18 |
| N17 | Earl Grey | T | 2.10 | 2.239 | 103.738 | 0.975 |
| N18 | Lady Grey | L | 0.85 | 1.087 | 100.948 | 0.793 |
| N19 | Lady Grey | T | 2.30 | 2.345 | 109.965 | 1.08 |
| N20 | English Breakfast tea | L | 2.62 | 1.048 | 102.214 | 2.55 |
| N21 | English Breakfast tea | T | 4.58 | 2.331 | 99.754 | 1.96 |
| N22 | Green tea& Cranberry | T | 3.39 | 2.3 | 100.58 | 1.48 |
| N23 | Green tea & apple | T | 1.76 | 2.34 | 102.11 | 0.77 |
| N24 | Pure green tea | T | 2.62 | 2.304 | 100.014 | 1.14 |
| N25 | Green tea & orange | T | 2.20 | 2.313 | 100.292 | 0.953 |
| N26 | Green tea & lemon | T | 2.01 | 2.35 | 100.867 | 0.864 |
| N27 | Green tea & lemon eco. | T | 4.39 | 1.762 | 101.035 | 2.52 |
| N28 | Voyage Indian Chai | T | 4.58 | 2.309 | 100.275 | 1.99 |
| N29 | Voyage Brazilian Baia | T | 3.86 | 2.598 | 106.382 | 1.58 |
| N30 | White tea & pomegranate | T | 2.62 | 1.872 | 100.486 | 1.4 |
| N31 | Apple, cinnamon & raisins | T | 3.54 | 2.319 | 105.448 | 1.71 |
| N32 | Blackcurrant | T | 2.85 | 2.279 | 127.975 | 1.6 |
| N33 | Four Red Fruits | T | 4.21 | 2.249 | 101.973 | 1.91 |
| N34 | Passionfruit, Mango, Orange | T | 3.54 | 2.244 | 99.763 | 1.58 |
| N35 | Darjeeling tea | T | 3.70 | 2.265 | 101.484 | 1.66 |
| N36 | Earl Grey tea eco. | T | 6.18 | 2.219 | 100.201 | 2.79 |
| N37 | Earl Grey Fair trade | T | 3.39 | 2.727 | 100.999 | 1.26 |
| N38 | Earl Grey | T | 11.19 | 2.116 | 107.232 | 5.67 |
| N39 | Earl Grey | T | 7.32 | 2.457 | 102.397 | 3.05 |
| N40 | Earl Grey | T | 4.58 | 2.495 | 113.147 | 2.08 |
| N41 | Darjeeling tea | L | 2.73 | 1.121 | 100.735 | 2.46 |
| N42 | Ceylon Breakfast | L | 2.98 | 1.11 | 102.447 | 2.75 |
| N43 | Tanzania | L | 10.72 | 1.003 | 100.331 | 10.7 |
| N44 | White China tea eco | L | 1.69 | 1 | 103.029 | 1.74 |
| N45 | Krydder te | L | 2.20 | 0.992 | 103.137 | 2.29 |
| N46 | Jasmin tea | L | 1.93 | 1.073 | 104.477 | 1.88 |
| N47 | Lapsang Souchong | L | 1.23 | 1.005 | 103.191 | 1.27 |

| | | | | | | |
|---|---|---|---|---|---|---|
| N48 | Keemun eco | L | 2.62 | 1.084 | 100.103 | 2.42 |
| N49 | Japan Kukicha | L | 1.48 | 1.091 | 101.383 | 1.37 |
| N50 | Søndags te | L | 0.61 | 1.065 | 100.875 | 0.579 |
| N51 | Assam Gbop | L | 4.03 | 1.03 | 102.715 | 4.02 |
| N52 | Japan Bancha eco | L | 1.84 | 1.037 | 102.015 | 1.81 |
| N53 | Assam Tgfop 1 | L | 1.93 | 1.02 | 100.622 | 1.9 |
| N54 | Kaktus te | L | 2.51 | 1.162 | 100.103 | 2.16 |
| N55 | Blå blomst te | L | 2.51 | 1.023 | 102.63 | 2.51 |
| N56 | Darjeeling | L | 7.32 | 1.052 | 99.999 | 6.96 |
| N57 | Ceylon Bop | L | 5.21 | 1.047 | 100.095 | 4.98 |
| N58 | Samowar Douchka | L | 6.45 | 1.038 | 102.167 | 6.35 |
| N59 | Skomakerens julete | L | 3.39 | 1.018 | 100.09 | 3.34 |
| N60 | Formosa Oolong | L | 6.45 | 1.061 | 102.658 | 6.24 |
| N61 | Golden Nepal | L | 8.68 | 1.155 | 100.839 | 7.58 |
| N62 | Yunnan Pu Erh | L | 6.45 | 1.013 | 102.808 | 6.54 |
| N63 | Mango te | L | 14.41 | 1.212 | 103.467 | 16.8 |
| N64 | Gunpowder eco | L | 9.85 | 1.099 | 103.503 | 9.28 |
| N65 | Mexican Mango | L | 21.95 | 1.021 | 99.957 | 34.6 |
| N66 | Advents te | L | 12.17 | 1.064 | 104.223 | 11.9 |
| N67 | Choui Fong | L | 8.68 | 1.063 | 100.957 | 8.24 |
| N68 | Bengal Fire | L | 9.05 | 1.035 | 101.382 | 8.87 |
| N69 | Rwanda Grønn | L | 7.97 | 1.046 | 101.574 | 7.74 |
| N70 | Bjørnebær te | L | 5.67 | 1.093 | 100.028 | 5.19 |
| **Average** | | | | | | **3.74** |
| **Min** | | | | | | **0.579** |
| **Maks** | | | | | | **34.6** |
| **Std.deviation** | | | | | | **4.82** |

**Table 20: Fluoride content in tea infused in 30 minutes.. Number, name of the tea, loose tea (L) or tea bag (T), Fluoride content before and after corrections are given here. Presented average results can be seen in 4.3 Fluoride and discussions in section 5.22.**

| Number | Tea | L/T | F- (mg/L) | Tea (g) | Final volume | F-(mg/L)/g tea |
|---|---|---|---|---|---|---|
| N1 | Lipton Yellow Label | L | 1.35 | 1.237 | 100.102 | 1.09 |
| N2 | Lipton Yellow Label | T | 11.67 | 2.43 | 100.118 | 4.81 |
| N16 | Earl Grey | L | 2.62 | 1.124 | 103.648 | 2.41 |
| N17 | Earl Grey | Te | 8.32 | 2.2 | 102.589 | 3.88 |

## Appendix 8

### Table 21: Raw data from the PCA modelling.

| A | R2X | R2X(cum) | Eigenvalue | Q2 | Limit | Q2(cum) | Significance | Iterations |
|---|---|---|---|---|---|---|---|---|
| **0** | Cent. | | | | | | | |
| **1** | 0.566 | 0.566 | 25.5 | 0.535 | 0.0326 | 0.535 | R1 | 7 |
| **2** | 0.0973 | 0.663 | 4.38 | 0.148 | 0.0332 | 0.604 | R1 | 28 |
| **3** | 0.0776 | 0.741 | 3.49 | 0.141 | 0.0338 | 0.66 | R1 | 25 |
| **4** | 0.0381 | 0.779 | 1.72 | -0.0643 | 0.0345 | 0.638 | R2 | 35 |

Type: PCA-X   Observations (N)=90, Variables (K)=45 (X=45, Y=0)

## Appendix 9

**Table 22: Results from Student T-test between Norwegian and Polish tea infusions. Discussed in chapter 5.**

| | Mean (Pol) | Mean (Nor) | t-value | df | p | Valid N (Pol) | Valid N (Nor) | Std.Dev. (Pol) | Std.Dev. (Nor) | F-ratio (Variances) | p (Variances) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Y | 0.201 | 0.365 | -2.30804 | 88 | 0.02334187589881450 | 20 | 70 | 0.182 | 0.301 | 2.7278 | 0.016884 |
| Cd | 0.017 | 0.043 | -2.07901 | 88 | 0.04052738123421200 | 20 | 70 | 0.016 | 0.057 | 13.1965 | 0.000000 |
| Sn | 0.008 | 0.036 | -0.76955 | 88 | 0.44362851020500800 | 20 | 70 | 0.007 | 0.160 | 483.6448 | 0.000000 |
| Cs | 4.137 | 4.954 | -0.50471 | 88 | 0.61502471039755900 | 20 | 70 | 9.115 | 5.386 | 2.8636 | 0.001506 |
| Ce | 0.122 | 0.230 | -1.72843 | 88 | 0.08741765420923050 | 20 | 70 | 0.156 | 0.266 | 2.8960 | 0.011745 |
| Pr | 0.024 | 0.040 | -1.83982 | 88 | 0.06916643272023030 | 20 | 70 | 0.021 | 0.038 | 3.2343 | 0.005848 |
| Nd | 0.092 | 0.165 | -2.07931 | 88 | 0.04049908140777170 | 20 | 70 | 0.082 | 0.151 | 3.3684 | 0.004488 |
| Sm | 0.022 | 0.039 | -2.08612 | 88 | 0.03986190693089410 | 20 | 70 | 0.018 | 0.035 | 3.6459 | 0.002646 |
| Tb | 0.005 | 0.008 | -2.12892 | 88 | 0.03605488235292510 | 20 | 70 | 0.004 | 0.007 | 2.8518 | 0.012907 |
| Dy | 0.029 | 0.051 | -2.26125 | 88 | 0.02620883373262040 | 20 | 70 | 0.025 | 0.042 | 2.8604 | 0.012672 |
| Ho | 0.007 | 0.012 | -2.15746 | 88 | 0.03369501707327080 | 20 | 70 | 0.006 | 0.010 | 2.3958 | 0.035713 |
| Er | 0.020 | 0.038 | -2.33613 | 88 | 0.02175704650944070 | 20 | 70 | 0.019 | 0.032 | 2.8477 | 0.013022 |
| Tm | 0.004 | 0.006 | -2.15381 | 88 | 0.03398864415010130 | 20 | 70 | 0.003 | 0.005 | 2.6311 | 0.020909 |
| Yb | 0.021 | 0.042 | -2.55242 | 88 | 0.01242226388595620 | 20 | 70 | 0.021 | 0.035 | 2.7160 | 0.017326 |
| Lu | 0.004 | 0.007 | -2.03333 | 88 | 0.04503202762948840 | 20 | 70 | 0.004 | 0.006 | 2.1775 | 0.059831 |
| Hf | 0.001 | 0.001 | 0.96913 | 88 | 0.33513817983928800 | 20 | 70 | 0.001 | 0.001 | 1.1575 | 0.637231 |
| Tl | 0.272 | 0.395 | -1.59197 | 88 | 0.11497689513659200 | 20 | 70 | 0.287 | 0.311 | 1.1722 | 0.722980 |
| Pb | 0.467 | 0.569 | -0.63090 | 88 | 0.52974029759616500 | 20 | 70 | 0.893 | 0.544 | 2.6984 | 0.002816 |
| Th | 0.003 | 0.009 | -2.00618 | 88 | 0.04790780268473920 | 20 | 70 | 0.003 | 0.013 | 20.7422 | 0.000000 |
| U | 0.008 | 0.015 | -1.63106 | 88 | 0.10645181965449100 | 20 | 70 | 0.012 | 0.017 | 1.7864 | 0.156959 |
| Li | 0.314 | 0.791 | -2.96054 | 88 | 0.00394637898443970 | 20 | 70 | 0.279 | 0.703 | 6.3609 | 0.000044 |
| B | 32.671 | 53.901 | -2.75780 | 88 | 0.00707605467261998 | 20 | 70 | 24.693 | 31.746 | 1.6529 | 0.219916 |
| Na | 423.140 | 2480.975 | -2.03331 | 88 | 0.04503405397114340 | 20 | 70 | 1152.426 | 4467.073 | 15.0252 | 0.000000 |
| Mg | 3961.546 | 7103.114 | -3.74657 | 88 | 0.00031978010399350 | 20 | 70 | 1436.587 | 3657.971 | 6.4836 | 0.000038 |
| Al | 2055.851 | 3783.172 | -2.74697 | 88 | 0.00729448346500683 | 20 | 70 | 1571.190 | 2676.672 | 2.9022 | 0.011591 |
| Si | 103.500 | 276.291 | -3.51184 | 88 | 0.00070453095107239 | 20 | 70 | 100.833 | 212.668 | 4.4484 | 0.000657 |
| P | 8551.828 | 11712.625 | -2.89265 | 88 | 0.00481348352332710 | 20 | 70 | 2033.133 | 4748.615 | 5.4551 | 0.000144 |
| S | 6656.824 | 11161.070 | -3.36165 | 88 | 0.00114802061381252 | 20 | 70 | 1775.917 | 5894.787 | 11.0177 | 0.000000 |
| K | 102263.785 | 148021.831 | -3.65215 | 88 | 0.00044107304487797 | 20 | 70 | 20492.469 | 54759.764 | 7.1406 | 0.000018 |
| Ca | 678.809 | 1939.684 | -2.82773 | 88 | 0.00580337068341468 | 20 | 70 | 448.778 | 1972.051 | 19.3096 | 0.000000 |

| | Mean (Pol) | Mean (Nor) | t-value | df | p | Valid N (Pol) | Valid N (Nor) | Std.Dev. (Pol) | Std.Dev. (Nor) | F-ratio (Variances) | p (Variances) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ti | 0.127 | 0.264 | -4.08886 | 88 | 0.00009561520125703 | 20 | 70 | 0.034 | 0.148 | 19.4103 | 0.000000 |
| V | 0.062 | 0.077 | -0.94076 | 88 | 0.34940150637820800 | 20 | 70 | 0.042 | 0.065 | 2.4390 | 0.032319 |
| Cr | 1.656 | 1.476 | 0.41406 | 88 | 0.67983765258491700 | 20 | 70 | 1.923 | 1.662 | 1.3379 | 0.378836 |
| Mn | 1136.143 | 2041.120 | -2.73358 | 88 | 0.00757319838930896 | 20 | 70 | 718.367 | 1425.572 | 3.9381 | 0.001559 |
| Fe | 8.221 | 21.874 | -3.19214 | 88 | 0.00195893443192766 | 20 | 70 | 6.707 | 18.722 | 7.7917 | 0.000009 |
| Co | 0.514 | 1.189 | -3.54325 | 88 | 0.00063505240608641 | 20 | 70 | 0.308 | 0.834 | 7.3460 | 0.000014 |
| Ni | 16.373 | 34.542 | -3.59543 | 88 | 0.00053375875719667 | 20 | 70 | 8.031 | 22.109 | 7.5780 | 0.000011 |
| Cu | 28.020 | 49.722 | -2.93515 | 88 | 0.00425220363622437 | 20 | 70 | 10.575 | 32.461 | 9.4235 | 0.000002 |
| Zn | 66.216 | 101.182 | -2.91353 | 88 | 0.00452971177435823 | 20 | 70 | 22.720 | 52.107 | 5.2599 | 0.000190 |
| Sr | 3.970 | 11.462 | -3.18695 | 88 | 0.00199067948979011 | 20 | 70 | 3.525 | 10.306 | 8.5479 | 0.000004 |
| Ru | 0.004 | 0.011 | -6.53041 | 88 | 0.00000000408399688 | 20 | 70 | 0.002 | 0.005 | 7.8851 | 0.000008 |
| Ba | 11.580 | 25.209 | -2.30051 | 88 | 0.02378390500016080 | 20 | 70 | 14.678 | 25.237 | 2.9564 | 0.010339 |
| La | 0.098 | 0.177 | -1.92070 | 88 | 0.05800721758291630 | 20 | 70 | 0.090 | 0.179 | 3.9599 | 0.001500 |
| Nb | 0.002 | 0.005 | -5.13665 | 88 | 0.00000166376473023 | 20 | 70 | 0.001 | 0.003 | 3.1202 | 0.007365 |
| Rb | 363.356 | 466.556 | -2.04996 | 88 | 0.04334463419279380 | 20 | 70 | 150.507 | 209.863 | 1.9443 | 0.105773 |

**Table 23: Results from Student T-test between infusions made of loose tea or tea bag. Discussed in chapter 5.**

| | Mean (Tea bag) | Mean (Loose tea) | t-value | df | p | Valid N (Tea bag) | Valid N (Loose tea) | Std.Dev. (Tea bag) | Std.Dev. (Loose tea) | F-ratio (Variances) | p (Variances) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Y | 0.518 | 0.163 | 7.46171 | 88 | 0.00000000005743599 | 42 | 48 | 0.280 | 0.162 | 2.9814 | 0.000372 |
| Cd | 0.058 | 0.019 | 3.87648 | 88 | 0.00020375831806906 | 42 | 48 | 0.069 | 0.013 | 27.9173 | 0.000000 |
| Sn | 0.049 | 0.013 | 1.21203 | 88 | 0.22874590170632200 | 42 | 48 | 0.206 | 0.018 | 134.8285 | 0.000000 |
| Cs | 6.816 | 2.984 | 2.97852 | 88 | 0.00374223534828911 | 42 | 48 | 7.486 | 4.530 | 2.7303 | 0.001032 |
| Ce | 0.347 | 0.082 | 5.90149 | 88 | 0.00000006590515839 | 42 | 48 | 0.307 | 0.044 | 47.8252 | 0.000000 |
| Pr | 0.058 | 0.017 | 6.82140 | 88 | 0.00000000109469814 | 42 | 48 | 0.038 | 0.017 | 5.3896 | 0.000000 |
| Nd | 0.239 | 0.070 | 6.99513 | 88 | 0.00000000049507450 | 42 | 48 | 0.150 | 0.068 | 4.9525 | 0.000000 |
| Sm | 0.057 | 0.016 | 7.69684 | 88 | 0.00000000001919499 | 42 | 48 | 0.034 | 0.014 | 6.2699 | 0.000000 |
| Tb | 0.011 | 0.004 | 7.30748 | 88 | 0.00000000011745175 | 42 | 48 | 0.006 | 0.003 | 3.1855 | 0.000166 |
| Dy | 0.074 | 0.022 | 7.81795 | 88 | 0.00000000001089080 | 42 | 48 | 0.040 | 0.020 | 3.8078 | 0.000016 |
| Ho | 0.017 | 0.005 | 7.53882 | 88 | 0.00000000004012061 | 42 | 48 | 0.009 | 0.005 | 3.2609 | 0.000123 |
| Er | 0.053 | 0.017 | 7.26606 | 88 | 0.00000000014225736 | 42 | 48 | 0.030 | 0.017 | 3.1662 | 0.000179 |
| Tm | 0.009 | 0.003 | 7.14759 | 88 | 0.00000000024574185 | 42 | 48 | 0.005 | 0.003 | 3.1599 | 0.000183 |
| Yb | 0.059 | 0.019 | 6.94768 | 88 | 0.00000000061520565 | 42 | 48 | 0.033 | 0.020 | 2.7036 | 0.001152 |
| Lu | 0.010 | 0.003 | 7.08782 | 88 | 0.00000000032353735 | 42 | 48 | 0.006 | 0.003 | 2.8187 | 0.000718 |

| | Mean (Tea bag) | Mean (Loose tea) | t-value | df | p | Valid N (Tea bag) | Valid N (Loose tea) | Std.Dev. (Tea bag) | Std.Dev. (Loose tea) | F-ratio (Variances) | p (Variances) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hf | 0.002 | 0.001 | 2.46199 | 88 | 0.01576630601069790 | 42 | 48 | 0.001 | 0.001 | 2.3708 | 0.004630 |
| Tl | 0.485 | 0.265 | 3.59577 | 88 | 0.00053315431283767 | 42 | 48 | 0.355 | 0.217 | 2.6817 | 0.001261 |
| Pb | 0.686 | 0.424 | 1.98589 | 88 | 0.05015782186683010 | 42 | 48 | 0.646 | 0.603 | 1.1495 | 0.641309 |
| Th | 0.013 | 0.003 | 4.14080 | 88 | 0.00007917452512575 | 42 | 48 | 0.016 | 0.002 | 47.7931 | 0.000000 |
| U | 0.022 | 0.006 | 5.26468 | 88 | 0.00000098263798985 | 42 | 48 | 0.020 | 0.006 | 10.4185 | 0.000000 |
| Li | 1.085 | 0.334 | 6.48398 | 88 | 0.00000000503075500 | 42 | 48 | 0.773 | 0.204 | 14.3887 | 0.000000 |
| B | 71.843 | 29.357 | 8.63665 | 88 | 0.00000000000022965 | 42 | 48 | 27.640 | 18.668 | 2.1923 | 0.009883 |
| Na | 4093.103 | 212.932 | 5.12313 | 88 | 0.00000175824428551 | 42 | 48 | 5245.830 | 229.123 | 524.1912 | 0.000000 |
| Mg | 9079.493 | 4064.795 | 9.47024 | 88 | 0.00000000000000441 | 42 | 48 | 3081.386 | 1864.671 | 2.7308 | 0.001030 |
| Al | 5403.179 | 1645.949 | 10.12473 | 88 | 0.00000000000000020 | 42 | 48 | 2307.055 | 1064.250 | 4.6993 | 0.000001 |
| Si | 373.013 | 119.663 | 7.35234 | 88 | 0.00000000009541757 | 42 | 48 | 217.049 | 93.290 | 5.4131 | 0.000000 |
| P | 12911.460 | 9346.645 | 4.07949 | 88 | 0.00009890931007479 | 42 | 48 | 4812.458 | 3438.353 | 1.9590 | 0.026721 |
| S | 14177.065 | 6645.304 | 8.62698 | 88 | 0.00000000000024040 | 42 | 48 | 5692.950 | 1922.293 | 8.7707 | 0.000000 |
| K | 172122.570 | 107867.832 | 7.24675 | 88 | 0.00000000015553315 | 42 | 48 | 54660.977 | 26284.743 | 4.3246 | 0.000003 |
| Ca | 2741.074 | 713.103 | 6.29203 | 88 | 0.00000001185229943 | 42 | 48 | 2183.807 | 443.481 | 24.2482 | 0.000000 |
| Ti | 0.303 | 0.173 | 4.77015 | 88 | 0.00000725213320091 | 42 | 48 | 0.177 | 0.059 | 9.1430 | 0.000000 |
| V | 0.108 | 0.043 | 5.89830 | 88 | 0.00000006682431059 | 42 | 48 | 0.072 | 0.024 | 8.6347 | 0.000000 |
| Cr | 2.455 | 0.694 | 5.63855 | 88 | 0.00000020429089377 | 42 | 48 | 1.864 | 1.027 | 3.2956 | 0.000108 |
| Mn | 2744.543 | 1048.551 | 7.59321 | 88 | 0.00000000003113900 | 42 | 48 | 1290.886 | 799.168 | 2.6092 | 0.001703 |
| Fe | 26.369 | 12.251 | 4.09108 | 88 | 0.00009484854735767 | 42 | 48 | 21.502 | 9.805 | 4.8086 | 0.000001 |
| Co | 1.507 | 0.629 | 6.19367 | 88 | 0.00000001832518841 | 42 | 48 | 0.799 | 0.534 | 2.2422 | 0.007993 |
| Ni | 45.399 | 17.471 | 8.24524 | 88 | 0.00000000000146044 | 42 | 48 | 21.683 | 8.430 | 6.6164 | 0.000000 |
| Cu | 65.797 | 26.614 | 7.95997 | 88 | 0.00000000000559373 | 42 | 48 | 30.400 | 14.495 | 4.3986 | 0.000002 |
| Zn | 124.005 | 66.642 | 6.74748 | 88 | 0.00000000153181740 | 42 | 48 | 49.214 | 30.305 | 2.6373 | 0.001516 |
| Sr | 16.515 | 3.918 | 8.00373 | 88 | 0.00000000000455399 | 42 | 48 | 10.574 | 2.521 | 17.5932 | 0.000000 |
| Ru | 0.012 | 0.008 | 3.36048 | 88 | 0.00115233452994463 | 42 | 48 | 0.005 | 0.005 | 1.1516 | 0.637078 |
| Ba | 38.922 | 7.531 | 8.20472 | 88 | 0.00000000000176791 | 42 | 48 | 25.958 | 5.114 | 25.7682 | 0.000000 |
| La | 0.257 | 0.074 | 6.20149 | 88 | 0.00000001770267650 | 42 | 48 | 0.188 | 0.076 | 6.1141 | 0.000000 |
| Nb | 0.006 | 0.004 | 4.52737 | 88 | 0.00001863982556006 | 42 | 48 | 0.003 | 0.002 | 1.6364 | 0.103486 |
| Rb | 550.207 | 350.361 | 5.35990 | 88 | 0.00000066165270863 | 42 | 48 | 191.943 | 161.761 | 1.4080 | 0.256677 |

**Table 24: Results from Student T-test between tea with flavour or no flavour. Discussed in chapter 5.**

| | Mean (no-flav) | Mean (flav) | t-value | df | p | Valid N (no-flav) | Valid N (flav) | Std.Dev. (no-flav) | Std.Dev. (flav) | F-ratio (Variances) | p (Variances) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Y | 0.268 | 0.444 | -2.89131 | 88 | 0.00483219178784 | 59 | 31 | 0.24 | 0.33 | 1.8977 | 0.036673 |
| Cd | 0.031 | 0.050 | -1.65508 | 88 | 0.10147041094051 | 59 | 31 | 0.06 | 0.04 | 2.4509 | 0.009121 |
| Sn | 0.014 | 0.061 | -1.52316 | 88 | 0.13130323392160 | 59 | 31 | 0.02 | 0.24 | 216.5173 | 0.000000 |
| Cs | 4.000 | 6.242 | -1.60500 | 88 | 0.11207731884422 | 59 | 31 | 6.31 | 6.28 | 1.0088 | 1.000000 |
| Ce | 0.166 | 0.282 | -2.15646 | 88 | 0.03377549143909 | 59 | 31 | 0.22 | 0.28 | 1.5722 | 0.139691 |
| Pr | 0.030 | 0.048 | -2.40802 | 88 | 0.01812639458869 | 59 | 31 | 0.03 | 0.04 | 2.1231 | 0.014029 |
| Nd | 0.122 | 0.201 | -2.59701 | 88 | 0.01102111995370 | 59 | 31 | 0.12 | 0.17 | 2.0213 | 0.021689 |
| Sm | 0.028 | 0.049 | -3.07966 | 88 | 0.00276469440805 | 59 | 31 | 0.03 | 0.04 | 2.3623 | 0.005010 |
| Tb | 0.006 | 0.010 | -3.15918 | 88 | 0.00216889802020 | 59 | 31 | 0.01 | 0.01 | 1.9053 | 0.035507 |
| Dy | 0.037 | 0.064 | -3.18124 | 88 | 0.00202618468806 | 59 | 31 | 0.03 | 0.05 | 2.0611 | 0.018300 |
| Ho | 0.009 | 0.014 | -3.01623 | 88 | 0.00334539812772 | 59 | 31 | 0.01 | 0.01 | 2.0252 | 0.021336 |
| Er | 0.027 | 0.047 | -3.09618 | 88 | 0.00262964191640 | 59 | 31 | 0.02 | 0.03 | 1.9801 | 0.025863 |
| Tm | 0.005 | 0.008 | -2.73087 | 88 | 0.00763074984533 | 59 | 31 | 0.00 | 0.01 | 2.0145 | 0.022330 |
| Yb | 0.030 | 0.053 | -3.22257 | 88 | 0.00178216808211 | 59 | 31 | 0.03 | 0.04 | 2.0006 | 0.023694 |
| Lu | 0.005 | 0.008 | -2.72006 | 88 | 0.00786421427790 | 59 | 31 | 0.00 | 0.01 | 1.9574 | 0.028474 |
| Hf | 0.001 | 0.001 | 0.37413 | 88 | 0.70920676040434 | 59 | 31 | 0.00 | 0.00 | 1.4514 | 0.269044 |
| Tl | 0.319 | 0.461 | -2.11333 | 88 | 0.03740369851308 | 59 | 31 | 0.28 | 0.34 | 1.4241 | 0.247237 |
| Pb | 0.517 | 0.603 | -0.61284 | 88 | 0.54156038687818 | 59 | 31 | 0.65 | 0.60 | 1.1648 | 0.660732 |
| Th | 0.006 | 0.012 | -2.51882 | 88 | 0.01358218898187 | 59 | 31 | 0.01 | 0.02 | 3.4727 | 0.000048 |
| U | 0.010 | 0.020 | -2.89580 | 88 | 0.00476967093955 | 59 | 31 | 0.01 | 0.02 | 2.0466 | 0.019469 |
| Li | 0.528 | 0.983 | -3.25729 | 88 | 0.00159866430257 | 59 | 31 | 0.54 | 0.78 | 2.0979 | 0.015631 |
| B | 42.644 | 61.631 | -2.82466 | 88 | 0.00585464962450 | 59 | 31 | 30.47 | 29.98 | 1.0331 | 0.946042 |
| Na | 1325.688 | 3352.111 | -2.30306 | 88 | 0.02363321596455 | 59 | 31 | 3179.06 | 5158.68 | 2.6332 | 0.001566 |
| Mg | 5915.030 | 7337.489 | -1.83478 | 88 | 0.06991645727642 | 59 | 31 | 3644.60 | 3185.74 | 1.3088 | 0.426935 |
| Al | 2916.557 | 4318.135 | -2.53252 | 88 | 0.01309795075764 | 59 | 31 | 2615.33 | 2243.75 | 1.3586 | 0.364280 |
| Si | 189.944 | 329.151 | -3.19993 | 88 | 0.00191218036806 | 59 | 31 | 174.32 | 232.53 | 1.7794 | 0.060204 |
| P | 10858.378 | 11299.226 | -0.44115 | 88 | 0.66018576234628 | 59 | 31 | 4816.39 | 3831.63 | 1.5801 | 0.174721 |
| S | 9008.589 | 12351.762 | -2.80191 | 88 | 0.00624666864521 | 59 | 31 | 4598.33 | 6632.34 | 2.0803 | 0.016852 |
| K | 131891.605 | 149199.973 | -1.48986 | 88 | 0.13983743931071 | 59 | 31 | 55549.68 | 45604.12 | 1.4837 | 0.241645 |
| Ca | 1123.236 | 2680.103 | -4.18378 | 88 | 0.00006765994118 | 59 | 31 | 999.20 | 2514.84 | 6.3346 | 0.000000 |
| Ti | 0.204 | 0.291 | -2.86431 | 88 | 0.00522486102716 | 59 | 31 | 0.08 | 0.21 | 6.0269 | 0.000000 |
| V | 0.061 | 0.099 | -2.92573 | 88 | 0.00437118696495 | 59 | 31 | 0.05 | 0.08 | 2.6355 | 0.001550 |
| Cr | 1.407 | 1.723 | -0.82966 | 88 | 0.40897731748092 | 59 | 31 | 1.81 | 1.53 | 1.3881 | 0.331144 |

| | Mean (no-flav) | Mean (flav) | t-value | df | p | Valid N (no-flav) | Valid N (flav) | Std.Dev. (no-flav) | Std.Dev. (flav) | F-ratio (Variances) | p (Variances) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mn | 1547.946 | 2395.886 | -2.94597 | 88 | 0.00411928457953 | 59 | 31 | 1117.40 | 1588.93 | 2.0220 | 0.021624 |
| Fe | 14.260 | 27.557 | -3.60387 | 88 | 0.00051887522720 | 59 | 31 | 13.60 | 21.30 | 2.4515 | 0.003413 |
| Co | 0.844 | 1.409 | -3.36909 | 88 | 0.00112097379111 | 59 | 31 | 0.66 | 0.92 | 1.9528 | 0.029043 |
| Ni | 25.882 | 39.302 | -2.97358 | 88 | 0.00379733004509 | 59 | 31 | 17.59 | 24.83 | 1.9933 | 0.024447 |
| Cu | 40.239 | 53.769 | -2.04293 | 88 | 0.04405116284544 | 59 | 31 | 27.71 | 33.62 | 1.4721 | 0.206186 |
| Zn | 89.996 | 99.912 | -0.90617 | 88 | 0.36731971827927 | 59 | 31 | 46.70 | 54.06 | 1.3398 | 0.336540 |
| Sr | 6.881 | 15.347 | -4.28453 | 88 | 0.00004663766404 | 59 | 31 | 6.96 | 11.79 | 2.8654 | 0.000584 |
| Ru | 0.008 | 0.012 | -3.11098 | 88 | 0.00251384099336 | 59 | 31 | 0.01 | 0.01 | 1.0050 | 1.000000 |
| Ba | 16.887 | 32.254 | -3.02585 | 88 | 0.00325057581390 | 59 | 31 | 20.25 | 27.29 | 1.8153 | 0.051834 |
| La | 0.133 | 0.211 | -2.16822 | 88 | 0.03284087359917 | 59 | 31 | 0.13 | 0.21 | 2.3733 | 0.004778 |
| Nb | 0.004 | 0.005 | -2.32319 | 88 | 0.02247512100597 | 59 | 31 | 0.00 | 0.00 | 1.1007 | 0.737447 |
| Rb | 432.700 | 464.412 | -0.70537 | 88 | 0.48244191274224 | 59 | 31 | 188.34 | 227.84 | 1.4634 | 0.213103 |