



Effect of Brewing Time and Temperature on the release of Manganese and Oxalate from Lipton Tea and *Azadirachta Indica* (Neem), *Phyllanthus Amarus* and *Moringa Oleifera* blended Leaves

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ABSTRACT: This study evaluates the oxalate content and manganese released in three plant material (*Moringa oleifera* leaves, *Phyllanthus amarus* leaves, *Neem* leaves) used as tea and compared with the conventional Lipton tea. The manganese and oxalate test was determined by varying brewing temperature at 29°C, 50°C, 100°C for different times 2mins, 5mins, and 10mins in 200ml of water. From the experimental result, oxalate released in the tea samples brewed for 2mins, 5mins and 10mins in 200ml, was 0.15mg, 0.31mg, 0.44mg at 29°C, 0.20mg, 0.44mg, 0.88mg at 50°C, 0.56mg, 0.88mg, 1.22mg at 100°C for *Phyllanthus amarus*, 0.11mg, 0.33mg, 0.55mg at 29°C, 0.22mg, 0.44mg, 0.66mg, at 50°C, 0.33mg, 0.65mg, 0.88mg, at 100°C for *Moringa oleifera*, 0.16mg, 0.39mg, 0.68mg at 29°C, 0.39mg, 0.50mg, 0.73mg at 50°C, 0.46mg, 0.80mg, 1.12mg, at 100°C for *Azadirachta indica*, 0.20mg, 0.44mg, 0.60mg at 29°C, 0.33mg, 0.55mg, 0.80mg, at 50°C, 0.68mg, 0.88mg, 1.08mg at 100°C for Lipton respectively. Manganese in the tea samples brewed for 5mins and 10mins in 200ml, released 0.36mg, 0.48mg at 50°C, 0.98mg, 1.18mg at 100°C for *Phyllanthus amarus*, 0.26mg, 0.36mg at 50°C, 0.58mg, 0.66mg at 100°C for *Moringa oleifera*, 0.46mg, 0.56mg at 50°C, 0.72mg, 0.76mg at 100°C for *Azadirachta indica*, 3.0mg, 6.08mg at 50°C, 4.16mg, 8.56mg at 100°C Lipton. Oxalate release was highest in *Phyllanthus amarus* blended leaves sample brewed for 10mins at 100°C and lowest in *Moringa oleifera* blended leaves sample at brewing temperature and time of 29°C and 2mins respectively. While manganese release is highest in Lipton at a brewing temperature of 100°C for 10mins and lowest in *Moringa oleifera* leaves sample at a brewing temperature of 50°C for 5mins. The result shows that the rate of release of manganese and oxalate in brewed tea increase with increase in brewing temperature and time.
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Tea has natural antioxidant properties that may help reduce the risk of developing heart diseases. *Moringa oleifera* leaves, *Neem* leaves, and *Phyllanthus amarus* leaves has been found to be good antioxidants, antifungal, antiviral, and anti-inflammatory agents. In most countries they are taken as tea to treat diabetics, obesity, fever, pneumonia, ulcers, skin diseases, heart diseases, liver diseases and so many other diseases [www.selfgrowth.com, www.ehow.com, www.globalherbalsupplies.com]. *Moringa oleifera* has approximately 46 antioxidants and is one of the most powerful sources of natural anti-oxidants. Mothers who took *Moringa oleifera* tea were shown to produce more than twice the amount of breast milk than those who didn't consume *Moringa oleifera* tea [www.selfgrowth.com]. The herb *neem* is used to treat a wide range of ailments due to its extensive healing properties. There are 15 active substances in *neem* [www.ehow.com]. They are non-toxic to human and highly toxic to insects, making it an ideal insecticide. *Neem* leaves nourish and strengthen digestive disorders and are used to correct problems of the stomach and bowel. They are also effective in reducing nausea, indigestion, gastritis and so on [www.ehow.com]. *Phyllanthus amarus* leaves are taken to relieve fever and backaches stimulate the kidney, relieve the condition of hepatitis and also as a liver tonic [www.globalherbalsupplies.com].

Tea contains oxalate, overconsumption of which can cause kidney stones, as well as binding with free calcium in the body. Other minerals may be bound as well [www.associatedcontents.com]. The bioavailability of oxalate from tea is low, thus negative effect requires a large intake of tea. Oxalates are naturally-occurring substances found in plants,

animals, and in humans. In chemical terms, oxalates belong to a group of molecules called organic acids, and are routinely made by plants, animals, and humans. Our bodies always contain oxalates, and our cells routinely convert other substances into oxalates [Prakash et al, 1993]. Dietary oxalates are usually restricted to 50 milligrams per day under these circumstances. One cup of raw spinach in leaf form (not chopped) weighs about one ounce (28.35g), and contains about 200milligrams of oxalate, so 50 milligrams for the day would permit a person to consume only 1/4 cup of raw spinach (and no other oxalate sources could be eaten during the day) [Sienera R. 2006].

Tea is one of the richest sources of manganese in our diet. A cup of green tea contains about 0.41-1.58milligram of Manganese. Other sources of manganese include pineapple, beans, vegetables (spinach), nuts, and so on [Kelsay et al 1983]. Manganese is a mineral element known to be both nutritionally essential and also potentially toxic. The central nervous system is most critically affected by toxic levels of manganese, and it can cause permanent and unrecoverable disabilities. Early warning symptoms of manganese toxicity include headaches, weak muscles and insomnia. Manganese is used by the kidneys, liver, pancreas and endocrine systems. Doctors recommend that we get 5.0-11.0milligrams of manganese in our diets each day [www.ezinearticles.com].

Increased recommendation for the consumption of these medicinal plants due to their potential ability to treat or reduce the potency of diseases has triggered this research to help determine the best brewing

temperature and time, required to release just about enough oxalate or manganese required by the body, as well as indicates when in excess. The evaluations of oxalate and manganese release in brews from *moringa oleifera* tea, *neem* tea and *phyllanthus amarus* tea using Lipton tea as the conventional tea brewed at different temperature and time, shows the concentration of oxalate and manganese consumed daily.

MATERIALS AND METHODS

The leaves of *neem*, *moringa oleifera* and *phyllanthus amarus* were dried at room temperature for two weeks then blended, lipton tea was bought from a shop in Gwagwalada residential area of the FCT of Nigeria. Weight of the blended leaves used for analysis was equivalent to the mean weight of the content of one lipton bag (2.3g)

Determination of Manganese: One sachet of each tea sample was soaked in 200ml of distilled deionised water for each run at temperatures of 50°C and 100°C. For each determination, 25ml of the sample solution was drawn at every five and ten minute interval at a given temperature and placed in a 50ml flask and made up to mark with deionised water.

Determination of Oxalate: The method of Oke O.L (1969), was used with slight modification. In this research, 2.3g (equivalent weight of one Lipton tea bag) of the dry blended sample was wrapped in a tea bag, brewed at varying temperatures at 29°C, 50°C, 100°C, in 200ml water and at varying time 2mins, 5mins, and 10mins. 5ml of the brewed extract was made alkaline with 1ml of 2M NaOH solution, 1ml of 5% CaCl₂ solution, and 3 drops of phenolphthalein indicator. The mixture was left to stand for 3hrs after which it was centrifuged at 3000rpm for 15mins, the supernatants were discarded and the precipitates washed 3 times with hot water with thorough mixing and centrifuging each time. 2ml of 3M H₂SO₄ solution was added and dissolved by warming on a water bath at 80°C. The content of each tube was then titrated with freshly prepared 0.01M KMnO₄ solution. The titration was carried out at room temperature until a first colour change that last for 30 seconds was observed.

RESULTS AND DISCUSSION

The concentration of manganese released in brews of lipton tea, *Moringa oleifera*, *Phyllanthus amarus* and *Azadirachta indica* leaves sample for 5mins at brewing temperature of 50°C, was found to be sufficiently low for all tea samples, though Lipton tea released 3.66mg/200ml which was higher compared

with the release of the other brews with concentrations lower than 1mg/200ml, its lowest release concentration was in *Moringa oleifera* 0.26mg/ml. At 100°C brewing temperature and brewing time of 5mins, the concentration of oxalate released in the brew increased for all tea samples having the highest concentration in lipton tea 4.16mg/200ml and lowest concentration in *Moringa oleifera* 0.48mg/200ml. The same increase in the concentration of manganese released into the brew was observed when the brewing time was extended to 10mins, Lipton tea also had the highest concentration of 6.08mg/200ml and 8.56mg/200ml and *Moringa oleifera* having the lowest concentration 0.36mg/200ml and 0.66mg/200ml at brewing temperature of 50°C and 100°C respectively for both.

The four tea samples analyzed are within range of daily requirement of manganese by the body (2-5mg per day though the body can handle a bit more with out becoming toxic). In Lipton tea, manganese released was 8.56mg/200ml at 100°C for 10 mins, 6.08mg/200ml at 50°C for 10mins. Most time brews are prepared at 100°C (boiling point for water) and left for a period of 2-5mins though some individuals leave it for a longer time (10mins or more). The longer the Lipton tea was brewed, the higher the concentration of manganese analysed. Table 1. Shows the concentration of manganese released with respect to temperature and time.

Oxalate exists in plants in a crystalline form or as calcium oxalate or as a soluble anion. The release of oxalate was investigated by precipitating the oxalate then acidifying it before titrating with 0.01M KMnO₄ solution. The experiment was done in triplicates for each tea samples at different temperatures and time. Oxalate concentration increases as temperature and time increases. The highest release of oxalate was in *phyllanthus amarus* leaves sample releasing 1.22mg/200ml of oxalate at 100°C for 10mins, this concentration still is within range of daily consumption of oxalate. All tea samples along with the conventional Lipton tea released low concentration of oxalate at 29°C brewed at 2mins. Though the required amount of oxalate by the body is 50mg per day, from the results stated above, daily consumption of any of this tea sample would not pose any risk to the consumer. Table 2. Shows concentration of oxalate released in lipton tea, *Moringa oleifera*, *Phyllanthus amarus* and *Azadirachta indica* leaves samples at different brewing temperatures (29°C,50°C,100°C) and time(2mins,5mins,10mins).

Table 1. Manganese content in mg/200ml

Samples	Time (minutes)	Temperature (° C)	Temperature (° C)
		50	100
Lipton	5	3.66	4.16
Moringa Oleifera	5	0.26	0.58
Phyllanthus amarus	5	0.36	0.98
Azadirachta indica	5	0.46	0.72
Lipton	10	6.08	8.56
Moringa Oleifera	10	0.36	0.66
Phyllanthus amarus	10	0.48	1.18
Azadirachta indica	10	0.56	0.76

Table 2. Oxalate release in mg/200ml

Tea/Leaves sample	Time (minute)	Temperature (° C)	Temperature (° C)	Temperature (° C)
		29	50	100
Lipton	2	0.20	0.33	0.68
Lipton	5	0.44	0.55	0.88
Lipton	10	0.60	0.80	1.08
Moringa oleifera	2	0.11	0.22	0.33
Moringa oleifera	5	0.33	0.44	0.65
Moringa oleifera	10	0.55	0.66	0.88
Phyllanthus amarus	2	0.15	0.20	0.56
Phyllanthus amarus	5	0.31	0.44	0.88
Phyllanthus amarus	10	0.44	0.88	1.22
Azadirachta indica	2	0.16	0.39	0.46
Azadirachta indica	5	0.39	0.50	0.80
Azadirachta indica	10	0.68	0.73	1.12

Conclusion: This study has shown that prolong soaking of tea bags in boiled water before consumption tends to give brews with enhanced level of manganese and oxalate content, it is therefore necessary to avoid prolonged soaking of tea bags especially that of Lipton tea (manganese release was 8.56mg/200ml at 100°C for 10mins), which is higher than the daily body requirement for manganese as we also consume other type of meals that has manganese and oxalate in them which could have implication for manganese toxicity and kidney stone respectively. The concentration of calcium released at varying temperature and time should be further investigated, also the calcium interaction with the oxalate released should also be investigated.

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