Comparative Analysis on the Phytochemical, Proximate and Mineral Composition of the Seeds and Peels of Lime

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Abstract
Comparative Analysis on the Phytochemical, proximate and mineral composition of the seeds and peels of lime was carried out. The phytochemical, and proximate screenings were carried out using standard methods. The mineral analysis was carried out by using Atomic Absorption Spectrophotometer. The proximate analysis revealed that the seeds contain Moisture 8.20%, Ash 12.09%, Crude fat 8.50%, Crude Protein 1.93%, Crude fibre 20.71%, and Carbohydrate 48.58% while the peels contain Moisture 10.60%, Ash 15.27%, Crude fat 14.67%, Crude Protein 2.30%, Crude fibre 23.36% and Carbohydrate 33.80%. The phytochemical analysis revealed the presence of alkaloids, saponins, flavonoids, terpenoids, phenols, and volatile oils in both the seeds and peels of the lime. In addition, the seeds contain steroids, while the peels contain tannins, balsams and anthraquinone. The mineral analysis revealed that the seeds contain Ni (0.17 mg/100g), Pb (0.01 mg/100g), Mn (0.20 mg/100g), Zn (0.57 mg/100g), Cr (0.17 mg/100g), Mg (9.02 mg/100g), Ca (27.02 mg/100g), Cd (0.01 mg/100g), Fe (2.55 mg/100g) and Cu (4.81 mg/100g) while the peels contain Ni (0.15 mg/100g), Pb (0.21 mg/100g), Mn (0.21 mg/100g), Zn (0.23 mg/100g), Cr (0.13 mg/100g), Mg (7.61 mg/100g), Ca (100.22 mg/100g), Cd (0.01 mg/100g), Fe (1.67 mg/100g) and Cu (0.21 mg/100g). The lime seeds and peels can serve as potential sources of drugs and nutrition with the seeds having higher concentration of minerals.

Keywords: Steroids, Seeds, Peels, Nutrition, Drugs, Atomic Absorption Spectrophotometer.

Introduction
Lime belongs to the Rutaceae family. Limes are small round and seedy, and turn yellow under Mediterranean conditions. Tahiti limes are larger, green and shaped like lemon [1]. Lime tree is found in Brazil, U.S.A, Mexico, China, Indian, Nigeria, Spain, Italy, Egypt, Pakistan, Florida, California, Arizona, Texas, Argentina, Iran, and Turkey. The tree may reach 20-30 inches in height. In nature, stems are often armed with long thorns. Leaves are unifoliolate, relatively thick, and ovate with acute to obtuse tips, having entire or crenulate margins. Most cultivars are self pollinated [2]. Lime has a glossy skin that is deep green in colour, although limes turn more yellow as they ripen. They are at the height of their lively, tart flavor when they are green in colour [3]. Lime are available in the market places throughout the year. Limes are oval or round in shape having a diameter of one or two inches with green flesh and skin. They can either be sour or sweet depending on the variety; however, sweet limes are not readily available [4]. Sour limes contain citric acid giving them an acidic tart taste, while sweet limes lack citric acid and are sweeter in flavour[5]. Limes contain flavonoid compounds that have anti-oxidant and anti-cancer properties[2]. The flavonoids have been shown to stop cell division in many cancer cell lines, they are most interesting for their antibiotic effects. Limes are excellent sources of vitamin C which is vital for a strong immune system. The immune system's main goal is protection from illness, so a little extra vitamin C may be useful in conditions like colds and flu [3]. Lime contains a Limonoids which helps to fight cancer of the mouth, skin, Lungs, breast, stomach and colon[6]. Research is being carried out on the cholesterol lowering effects of lime. Lime also provides protection against inflammatory polyarthritis, a form of rheumatoid arthritis which involves two or more joints[7]. Lime peels have high oxalate content. Lime juice might help to prevent kidney stone formation through their high citrate content[8]. The present study has been designed to evaluate the phytochemicals, proximate and
mineral composition of the seeds and peels of Lime.

Materials and Methods
Collection of plant materials
Lime peels and seeds were removed from fresh fruits and dried for two weeks. The dried peels and seeds were ground separately with mortar and pestle and sieved with a mesh of 0.5mm diameter hole size. The powdered samples were stored in clean air-tight container at ambient temperature for three days.

Preparation of extract
The lime peels powder was extracted using Methanol. 200g of the powder was placed in a muslin cloth and inserted into the soxhlet extractor. Methanol was used as the extraction solvent for a period of eight hours. At the end of the extraction period the solvent was recovered by rotary evaporator and the extracts were collected. The same extraction procedure was repeated for the lime seeds powder and the extract was also collected.

Phytochemical Analysis
The phytochemical analyses were carried out using standard methods [9, 10].

Proximate Analysis
The proximate analyses were carried out in triplicate with the result being presented as mean values. The analyses were carried out by adopting standard methods [11].

Mineral Analysis
The powdered samples of the seeds and peels of lime were digested separately by weighing 2g of the powdered sample and treating it with 10ml of a mixture of nitric acid and perchloric acid (2:1v/v) until a clear solution was obtained. The digest was allowed to cool and then transferred into a 100ml volumetric flask and made up to mark with distilled water. Atomic Absorption Spectrophotometer was employed to determine the elements. Potassium and sodium were determined using flame photometer.

Standard Analysis
The results were expressed as the mean ± standard deviation.

Results and Discussion
Phytochemical Analyses
The results of the phytochemical analyses are given in Table1. This revealed the presence of alkaloids, saponins, flavonoids, terpenoids, phenols and volatile oils in both the seeds and peels of lime. It also revealed the presence of tannins, balsams and anthraquinones only in the peels of lime, but steroids was only present in the seeds of lime. The medicinal values and phytochemical activities of the seeds and peels of the lime are due to the presence of secondary metabolites they contain[9].Both the seeds and peels of lime can serve as anti-cancer agent due to the presence of saponins in them.

Table 1: Phytochemical analyses of the peels and seeds of Lime

| Phytochemicals          | Lime Seeds | Lime Peels |
|-------------------------|------------|------------|
| Alkaloids               | +          | +          |
| Saponins                | +          | +          |
| Flavonoids              | +          | +          |
| Terpenoids              | +          | +          |
| Tannins                 | -          | +          |
| Phenol                  | +          | +          |
| Glycosides              | -          | -          |
| Cardiac Glycosides      | -          | -          |
| Steroids                | +          | -          |
| Resins                  | -          | -          |
| Balsams                 | -          | +          |
| Volatile oils           | +          | +          |
| Phlobatannins           | -          | -          |
| Carbohydrate            | -          | -          |
| Anthraquinone           | -          | +          |
The quantitative determination of the secondary metabolites (Table 2) shows that the lime seeds contain more of Alkaloids and Saponins while the lime peels contain more of Flavonoids, Phenols and Tannins.

### Table 2: Quantitative determination of secondary metabolite in the seeds and peels of Lime

| Secondary Metabolites | Lime Seeds | Lime Peels |
|-----------------------|------------|------------|
| Alkaloids             | 7.20%      | 6.40%      |
| Saponins              | 10.40%     | 8.80%      |
| Flavonoids            | 10.00%     | 13.40%     |
| Phenols               | 5.40%      | 11.20%     |
| Tannins               | 2.20%      | 4.80%      |

**Proximate Analyses**

Results of the proximate analyses in Table 3. The result shows that the lime peels contain Carbohydrate (33.80%), Crude protein (2.30%), Crude fat (14.36%), Ash (15.27%), Moisture (10.60%), and Crude fibre (23.36%) while the seed contains Carbohydrate (48.58%), Crude protein (1.93%), Crude fat (8.50%), Ash (12.09%), Moisture (8.20%) and Crude fibre (20.71%). The carbohydrate content is more in the lime seeds than in the peels, and lower in Securinega virosa leaf (64.25%) [12]. The carbohydrate content indicates that both the seeds and peels can serve as sources of energy. Their low content of carbohydrate shows that lime is low in calorie. The ash content indicates that they contain mineral elements. The peels contain more ash content than seeds, which shows that the peels could be a better source of minerals. The low moisture content of the seeds compared to the peels shows that the seeds would hinder the growth of microorganisms and could help storage. The lime peels contain more crude fat than the seeds. This is also more than the crude fat of Securinegavirosa leaf (4.70%) and water spinach leaves (12.00%). This could serve as a source of energy. The crude protein (2.30%) and crude fibre (23.36%) of the lime peels are more than that of the lime seeds. Which is higher than the crude protein (1.98%) and crude fibre (8.80%) of Securinegavirosa [8]

### Table 3: Proximate Analysis of the peels and seeds of Lime

| Components | Values (%)(n=3) |
|------------|----------------|
| Seeds      | Peels          |
| Moisture   | 8.20           | 10.60         |
| Ash        | 12.09          | 15.27         |
| Crude fat  | 8.50           | 14.67         |
| Crude Protein | 1.93      | 2.30          |
| Crude fibre| 20.71          | 23.36         |
| Carbohydrate| 48.58         | 33.80         |

**Mineral Analysis**

The result of the mineral analysis is given in Table 4. This reveals that the lime peels contain 100.22mg/100g of calcium while the seeds contain 27.02mg/100g of calcium. The calcium content of the peels is more than that of the seeds. This is also greater than that of Securinegavirosa (2.90mg/100g). Calcium is very good for the maintenance of bones, teeth and muscles for growth. The lime seeds do not contain lead even though the peels contain littlequantity of lead 0.21mg/100g. This reveals that the lime is free of lead poison. Nickel, chromium, cadmium and manganese contents of the lime seeds and peels were very little which
indicates that lime is free of the adverse effect of the trace elements. Iron content of the lime seed is 2.55mg/100g which is more than that of the peels with 1.67mg/100g. This is also more than that of securinega virosa 2.02mg/100g. Iron is essential for haemoglobin formation and oxidation of protein, fat and carbohydrate [13]. Copper is a pro-oxidant and catalyze the oxidation of unsaturated fats and oils as well as ascorbic acid. The copper content of lime seeds is 4.81mg/100g which is higher than that of the lime peels with 0.21mg/100g. This is also higher than that of T.terrestris leaves with 1.28mg/100g. The magnesium content of the lime seeds is 9.02mg/100g which is higher than that of the peels with 7.61mg/100g. Magnesium is very important in combating blood circulatory diseases such as ischemic heart disease. The Zinc content of the lime seed is 0.57mg/100g which is also higher than that of the lime peels with 0.23mg/100g, however lower than the zinc content of securinega virosa leaves with 0.85mg/100g [8]. Zinc is useful in the synthesis and degradation of lipids, carbohydrates, proteins and nucleic acids.

| Mineral   | Seeds concentration (mg/100g) | Peels concentration (mg/100g) |
|-----------|-------------------------------|------------------------------|
| Calcium   | 27.02                         | 100.22                       |
| Lead      | 0.10                          | 0.21                         |
| Nickel    | 0.71                          | 0.15                         |
| Chromium  | 0.17                          | 0.21                         |
| Manganese | 0.20                          | 0.21                         |
| Iron      | 2.55                          | 1.67                         |
| Copper    | 4.81                          | 0.21                         |
| Magnesium | 9.02                          | 7.61                         |
| Zinc      | 0.57                          | 0.23                         |
| Cadmium   | 0.01                          | 0.01                         |

Conclusion
Lime peels and seeds can serve as potential sources of minerals and the presence of secondary metabolites in them could be responsible for their medicinal importance.

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