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Comparison on phytochemical and physicochemical parameters of *Garcinia cambogia* (Gaertn.) Desr. and *Garcinia zeylanica* Linn fruit rinds

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Abstract

Background and Objectives: The fruits of *Garcinia cambogia* and *Garcinia zeylanica* (Family: Clusiaceae), look more like a small yellowish, greenish, or sometimes reddish pumpkin with thin skin and deep vertical lobes. The colour can vary considerably. The dried rinds are used in traditional recipes for cooking in many Southeast Asian countries. Present study was brought up as a physicochemical and phytochemical comparison of fruit rinds of *G. cambogia* and *G. zeylanica*.

Materials and Methods: Evaluation of physicochemical parameters (in terms of total ash, acid insoluble ash, water soluble ash, pH and specific gravity) and phytochemical [by screening of secondary metabolites and development of Thin Layer Chromatography (TLC)] analysis were carried out for both fruit rinds.

Results: Total ash, water soluble ash and acid insoluble ash contents were higher in *G. cambogia* than that of *G. zeylanica*. The values for pH and specific gravity of *G. cambogia* water extract were almost same to that of *G. zeylanica* water extract. Phenols, flavonoids, alkaloids, saponins, steroids and terpenoids were present in higher amounts in both *G. cambogia* and *G. zeylanica* water extracts. There were slight differences in R_f values of *G. cambogia* (254 nm: 0.07, 0.19, 0.30, 0.48, 0.54, 0.60, 0.73, 0.79, 0.94 and 366 nm: 0.06, 0.19, 0.23, 0.57, 0.66) and *G. zeylanica* (254 nm: 0.04, 0.11, 0.14, 0.32, 0.42, 0.47, 0.67 and 366 nm: 0.04, 0.08, 0.12, 0.15) TLC fingerprint profiles.

Conclusion: There were similarities and as well as differences in between *G. cambogia* and *G. zeylanica* in terms of phytochemical and physicochemical parameters.

Keywords: *Garcinia cambogia*, *Garcinia zeylanica*, phytochemical and physicochemical properties

Introduction

Garcinia cambogia (Gaertn.) Desr. and *Garcinia zeylanica* Linn. belong to the plant family Clusiaceae (Guttiferae). *G. cambogia* is known as Goraka, Kana-goraka in Sinhala; Korakkaipuli, Korukkai in Tamil or Madurammala^[1] and as well as Amlavetasa^[2] in Sanskrit. *G. cambogia* is a moderate-sized or large tree with a round head and rather drooping dark brown branches with rough bark. It has a large fruit which is more or less globular 6—7.5 cm long, 7—13 very deep vertical grooves forming as many blunt orange or yellow lobes, while the pericarp is very thick and fleshy; seeds as many as lobes. Flowering and fruiting is strictly seasonal (during February and March). It is distributed in the Western side of the Indian Peninsula and it is common in Sri Lanka in the moist low-country up to 1500 feet altitude^[1]. *G. zeylanica* is endemic to Sri Lanka^[3] and listed as globally endangered^[4]. It has brilliant yellow latex and it is characterized by its blood red live bark. The seedlings act as a major constituent of the undergrowth of the lowland wet zone forests in Sri Lanka^[5]. The principal acid of *G. cambogia* has been found to be (2)-hydroxycitric acid (HCA; 1,2-dihydroxypropane-1,2,3-tricarboxylic acid)^[6] and it is found in fruit and rind of *G. cambogia*^[7, 8]. *G. cambogia* contains 16–18% of HCA and both citric and malic acids in minor quantities^[6]. Dried rinds of *G. cambogia* are astringent and antiseptic, and useful in decoction for washing ulcers and as a gargle in weak and spongy gums. Internally, it acts as a stomachic and is used in anorexia and chronic dyspepsia. The sun-dried smoked rinds are frequently used as flavor condiments^[1]. In Ayurveda system of medicine, medicinal plants are grouped under different categories due to their therapeutic properties. *G. cambogia* is one of the ingredients which prescribe to increase digestive power, wellbeing in heart cure asthma, wounds, fractures and diabetes mellitus^[2]. However, many therapeutic properties and scientific investigations are documented for *G. cambogia* but not for *G. zeylanica*, which is an endemic plant in Sri Lanka. Therefore, an attempt was taken in the present study to compare the physico-chemical and phytochemical properties in between *G. cambogia* and *G. zeylanica* fruit rinds.

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Materials and Methods

Collecting plant materials

Fruits of *G. cambogia* and *G. zeylanica* (Fig. 1) were collected from home gardens in Colombo and Gampaha districts in Sri Lanka during the time period of August-October 2017. Vertical lobes were separated and the seeds were detached. Dried rinds of *G. cambogia* and *G. zeylanica* were dried in an oven at 50 – 55 °C for 48 h, cut into small pieces and stored at 4 °C in a refrigerator until used.

Preparation of hot water extract

Dried rinds of *G. cambogia* (~ 50 g) and *G. zeylanica* (~ 50 g) were added separately to two round bottoms containing 100 ml of distilled water and refluxed for 4 h, filtered and filtrate was concentrated under vacuum.

Evaluation of physicochemical parameters

Physicochemical parameters such as total ash, water soluble ash and acid insoluble ash contents were evaluated for dried rinds and specific gravity (at 25±2 °C) and pH (at 25±2 °C) values were evaluated for water extracts of *G. cambogia* and *G. zeylanica* [9].

Total ash

Approximately, 4 g of fruit rinds (which were cut into tiny pieces) were placed in previously weighed tarred crucibles. The samples were weighed accurately. The material was incinerated by gradually increasing the heat, not exceeding 550 °C until free from carbon using a furnace (Nabertherm L5/C6H), cooled in a desiccator, weighed and percentage ash was calculated by taking in account the difference of empty weight of crucible and that of crucible with total ash.

Acid insoluble ash

The total ash was boiled for 5 minutes with 25 ml of 7% dilute hydrochloric acid and filtered through ash-less filter paper. The insoluble matter remained in the ash-less filter paper as the residue. The ash-less filter papers were ignited for 15 minutes at a temperature not exceeding 550 °C in the furnace and the percentage of the acid-insoluble ash was calculated.

Water soluble ash

The total ash was boiled for 5 minutes with 25 ml of water and filtered through ash-less filter paper. The water insoluble matter was collected on an ash-less filter paper and washed with hot water. The filter paper containing the water insoluble matter was transferred to the original crucible, dried on a hot plate and ignited to constant weight. The weight of this residue was subtracted from the weight of total ash and the content of water soluble ash calculated.

Specific gravity and pH

Both specific gravity and pH of the extracts were determined using a specific gravity bottle and a pH meter (at 25±2 °C) respectively.

Phytochemical screening

The phytochemicals including phenols, flavonoids, alkaloids, saponins, steroids and terpenoids were tested [10] with slight modifications.

Test for phenolic compounds

(a) Ferric chloride (1 ml) was added to the extract (3 ml) in a test tube and mixed well. Appearance of a blue/green colour

indicates the presence of phenolic compounds.

(b) Lead acetate (0.5 ml) was added to the extract (2 ml) in a test tube and mixed well. Yellow precipitate indicates the presence of flavonols and flavones.

Test for Flavonoids

A volume of 1 ml of extract was added to 3 ml of dilute ammonia solution, followed by the addition of concentrated H₂SO₄. Appearance of yellow colour indicates the presence of flavonoids.

Test for Alkaloids

Picric acid (0.5 ml) was added to the extract (3 ml) in a test tube and mixed well. Yellow crystalline precipitate indicates the presence of alkaloids.

Test for Tannins

Vanillin in Ethyl alcohol (0.5 ml) and concentrated HCl (0.5 ml) were added to the extract (3 ml) in a test tube and mixed well. Red colour indicates the presence of tannins.

Test for Saponins

Distilled water (5.0 ml) was mixed with the extract (10 ml) in a test tube and mixed vigorously. Appearance of stable foam shows the presence of saponins.

Test for Steroids

A volume of 2 ml of H₂SO₄ was added to 2 ml of acetic anhydride and 1 ml of extract. A colour change from violet to blue/green indicates the presence of steroids.

Test for Terpenoids

A volume of 2 ml of extract was mixed with 1 ml of chloroform. A volume of 2 ml of concentrated H₂SO₄ was added along the sided of the test tube to form a layer. A reddish brown colour indicates the presence of terpenoids.

Thin layer chromatography (TLC) fingerprint development

Sample preparation: Dried rinds of *G. cambogia* (~ 50 g) and *G. zioeylanica* (~ 50 g) were added separately to two round bottoms containing 100 ml of methano and refluxed for 4 h, filtered and filtrate was concentrated under vacuum. The residue (1 g from each) was dissolved in 5 ml methanol and spotted on TLC plate. Methanol: dichloromethane: cyclohexane in a ratio of 0.3:4.7:1 v/v/v was used as the solvent system.

Results and Discussion

Physicochemical parameters which were determined as total ash, water soluble ash, acid insoluble ash, specific gravity and pH are listed in Table 1. The values for total ash, water soluble and acid insoluble ash were calculated on dry weight basis. The total ash content defines the total amount of material remaining after ignition [11]. The total ash usually comprises carbonates, phosphates, silicates, and silica, which include both physiological ash and non-physiological ash. Physiological ash refers to mineral components of the plant. The external substances which are adhered to the plant by contacting with the soil and sand are called non-physiological ash. Acid insoluble ash specifies impurities with silica, for example, earth and sand. Water soluble ash is the fraction of the total ash content, which is soluble in water. It's an indicator for water soluble salts contain in the plant. In a previous study, total ash, water soluble ash and acid insoluble

ash in *G. cambogia* were determined as 6.82, 0.42 and 0.88 respectively [12]. In the present study, values for the above physicochemical parameters of *G. cambogia* grown in Sri Lanka were diverse from above values. This may be due to differences such as in different geographical areas where the plants had grown, climate changes in those areas and their maturity levels. However, no reported data were found regarding physicochemical properties of *G. zeylanica*, for the comparison. Specific gravity and pH values were almost same in both species. Phytochemical screening showed positive results for phenols, flavonoids, alkaloids, saponins, steroids and terpenoids. The results are tabulated in Table 2. TLC fingerprint profiles were observed using UV spectrum under 254 nm and 366 nm wave lengths. There were nine spots bearing R_f values of 0.07, 0.19, 0.30, 0.48, 0.54, 0.60, 0.73, 0.79, 0.94 at 254 nm and five spots bearing R_f values of 0.06, 0.19, 0.23, 0.57, 0.66 at 366 nm for TLC fingerprint profile of *G. cambogia*. In contrast, there were seven and four spots bearing R_f values of 0.04, 0.11, 0.14, 0.32, 0.42, 0.47, 0.67 and 0.04, 0.08, 0.12, 0.15 at 254 nm and 366 nm respectively for TLC fingerprint profile of *G. zeylanica*. TLC is one of the simple and cheap techniques which can be used to identify or compare the chemical profiles of plants. Similar studies have been conducted to many plants such as *Rubia cordifolia* [13], *Mallotus philipinensis* [14] and *Phyllanthus niruru* [15]. In conclusion, there were similarities as well as differences in fruit rinds of both *G. cambogia* and *G. zeylanica* in terms of physico-chemical and phytochemical parameters.

(a) *Garcinia zeylanica* fruit(b) *Garcinia cambogia* fruit**Fig 1:** Fruits of (a) *Garcinia zeylanica* Linn and (b) *Garcinia cambogia* (Gaertn.) Desr**Table 1:** Physicochemical parameters of *Garcinia cambogia* and *Garcinia zeylanica* fruit rinds

Physicochemical parameters	<i>Garcinia cambogia</i>	<i>Garcinia zeylanica</i>
Total ash (% w/w)	7.3 ± 0.3	2.4 ± 0.1
Water soluble ash (% w/w)	4.8 ± 0.1	1.5 ± 0.0
Acid insoluble ash (% w/w)	0.6 ± 0.2	0.3 ± 0.1
pH (at 25±2 °C)	1.7 ± 0.1	1.7 ± 0.1
Specific gravity (at 25±2 °C)	1.1 ± 0.0	1.1 ± 0.0

Values (n=6) were expressed as MEAN ± SEM

Table 2: Phytochemical classes of *Garcinia cambogia* and *Garcinia zeylanica* fruit rinds

Phytochemical class	<i>Garcinia cambogia</i>	<i>Garcinia zeylanica</i>
Phenolics	+++	+++
Flavonoids	+++	+++
Alkaloids	+++	+++
Saponins	+++	+++
Steroids	+++	+++
Terpenoids	+++	+++

+: present ++: high amount +++: very high amount

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