

Physicochemical Properties of *Plukenetia volubilis* L. (Sachainchi) Seed and Fatty Acid Composition of Seed Oil

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Abstract

Plukenetia volubilis L. is one of medicinal plants. It is commonly known as sachainchi, sacha peanut or indica peanut. The sachainchi seed is touted by many as one of the world's healthiest super foods. In this research, the seeds of sachainchi were collected for chemical analysis such as phytochemical constituents, nutritional composition, elemental contents of seed sample and fatty acid composition of seed oil. The phytochemical detection gave rise to positive tests for alkaloids, flavonoids, glycosides, phenolic compounds, polyphenols, reducing sugars, saponins, steroids, tannins and terpenes respectively. In the determination of nutritional composition of the seed sample, the oil content was found to be the highest value (43.5-43.8 %). The protein content was found to be (24.8 – 25.1 %). The mineral contents of seed sample were analyzed by EDXRF (Energy Dispersive X-Ray Fluorescence) spectroscopy. In this analysis, potassium was found to be the highest amount. The fatty acid composition of seed oil was determined by GC-MS (Gas Chromatography-Mass Spectrometry) method. It can be observed that sachainchi seed oil contains palmitic acid, linoleic acid (omega-6) and linolenic acid (omega-3), respectively. Among them, linolenic acid (omega-3) was found to be the highest amount.

Keywords: sachainchi, phytochemical, nutritional, mineral, fatty acid

Introduction

Herbal medicine, also called phytomedicine refers to the uses of any plant's seeds, berries, roots, leaves, bark or flowers for medicinal properties. The medicinal effects of plants are due to metabolites especially secondary compounds by plant species. Plants contain primary metabolites such as proteins, carbohydrates, fats and secondary metabolites such as alkaloids, flavonoids, saponins, steroids, terpenes and tannins, etc. Plants cells produce a large amount of secondary products. Secondary metabolites carry out a number of protective functions in human body (Asolkar, 1992).

Plukenetia volubilis L. is one of the medicinal plants and commonly known as sachainchi, sacha peanut or inca peanut. It belongs to the family of Euphorbiaceae. It is native to the tropical southern America, Colombia, Ecuador, Peru and northeastern Brazil. It grows better in acidic soils and alluvial flats near rivers. The seeds of sachainchi are of the great interest because of their high oil content (35-60 %), which contains the high levels of linolenic (omega 3) and linoleic acid (omega 6) and consequently has a great potential for applications in the food and pharmaceutical industries. Other fatty acid such as oleic, palmitic and stearic acids are also present in minor proportions (Fanali, 2011).

These seeds are also rich in protein, alpha tocopherol (vitamin E), carotenoids (vitamin A), and fiber. Sachainchi is much more than just a pleasant snack food. This superfood is easily digested and unlikely to cause allergies or irritation (Maurer, 2012).

Therefore, in this research work, the phytochemical constituents, nutritional value, elemental composition of sachainchi seed and fatty acid composition of seed oil were analyzed.

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Botanical Description

Scientific name : *Plukenetia volubilis* L.

Family : Euphorbiaceae

English name : Sachainchi

Myanmar name : KyaelPè

Part used : Seeds



Figure 1: Sachainchi seeds



Figure 2: Sachainchi plant

Health Benefits of Sachainchi Seed

The seeds decrease LDL (Low Density Lipoprotein) and increase HDL (High Density Lipoprotein) cholesterol. The omega 3 also reduces inflammation in the brain, which can cause mood shifts, headaches and more. Vitamin E, vitamin A contained in sachainchi can improve vision and maintain eye health.

Since sachainchi seed oil contains the high amount of Omega 3 and Omega 6, this seed oil is super natural and it is good for brain and health of children, adult and old people (Maurer, 2012).

Aim and Objectives

Aim

The main aim of this research is to investigate the physicochemical properties of sachainchi seeds and fatty acid composition of seed oil.

Objectives

- To collect the seeds of sachainchi from Myitkyina Township, Kachin State.
- To carry out the phytochemical screening of the seed of sachainchi.
- To determine the nutritional composition such as moisture, ash, oil, nitrogen, protein, fiber and soluble carbohydrate of the sachainchi seed.
- To analyze the elemental composition of the seed of sachainchi by EDXRF spectroscopy.
- To determine the fatty acid composition of sachainchi seed oil by GC-MS (Gas Chromatography-Mass Spectrometry) method.

Materials and Methods

Sample collection and preparation

The seeds of sachainchi were collected from Myitkyina Township, Kachin State, Myanmar. After sample collection, the seeds were ground by electric grinder into finely powder. The powder sample were used in the experiments and stored in the air tight container before using.

Phytochemical screening

The various solvents extracts of seed sample were prepared to analyze the presence of certain phytochemicals. Analysis was done for alkaloids, flavonoids, glycosides, phenolic compounds, polyphenols reducing sugars, saponins, steroids, tannin and terpene.

Determination of nutritional composition of seed sample

The study of nutritional composition of seed sample such as moisture, ash, oil, crude fiber, nitrogen and protein, and soluble carbohydrate was performed.

Table (1) Determination of nutritional composition of seed sample

No.	Nutritional Content	Methods / Instruments
1.	Moisture	Oven drying method
2.	Ash	Muffle furnace
3.	Oil	Soxhlet Apparatus
4.	Crude fiber	Muffle furnace
5.	Nitrogen and protein	Micro Kjeldahl's method
6.	Soluble carbohydrate	UV-visible spectroscopy

Analysis on elemental composition of seed sample

The elemental composition of seed sample was analyzed by Energy Dispersive X-Ray Fluorescence (EDXRF) spectrophotometer .

Determination of fatty acid composition of sachainchi seed oil

Fatty acid composition of sachainchi seed oil was analyzed by GC-MS spectrophotometer.

Results and Discussion**Phytochemical constituents of seed sample**

Preliminary phytochemical analysis on seed sample was performed in order to know different types of organic compounds present in seed sample. Analysis of the extracts of seed sample revealed the presence of phytochemicals such as alkaloids, flavonoids, glycosides, phenolic compounds, polyphenols, reducing sugars, saponins, steroids, tannin and terpene, respectively. These phytochemicals are known to exhibit medicinal as well as physiological activities. Therefore, sachainchi seed, contains valuable phytochemical constituents for human's health.

Table (2) Results of phytochemical constituents of seed sample

No.	Constituents	Extract	Reagents used	Observation	Result
1.	Alkaloids	1% HCl	Dragendroff's reagent	Orange ppt.	+
2.	Flavonoids	ethanol	Conc: HCl, Mg	Pink color	+
3.	Glycosides	Water	10 % lead acetate	White ppt.	+
4.	Phenolic compounds	Water	10 % FeCl ₃	Purplish color	+
5.	Polyphenols	ethanol	1 % FeCl ₃ + 1 % K ₃ [Fe(CN) ₆]	Green blue color	+
6.	Reducing sugars	Water	Benedict's solution	Orange red ppt.	+
7.	Saponin	Water	-	Froth	+
8.	Steroids	ethanol	CHCl ₃ , acetic anhydride, Conc H ₂ SO ₄	Green color	+
9.	Tannin	ethanol	10 % FeCl ₃ , dil H ₂ SO ₄	Yellowish brown ppt.	+
10.	Terpene	pet-ether	CHCl ₃ , acetic anhydride, Conc H ₂ SO ₄	Pink color	+

(+) = Presence , (-) = Absence

Nutritional composition of seed sample

The determination of nutritional composition of dried seed powder was carried out to know the nutritional values of seed sample. From the experimental data, it can be observed that the seed sample contains the valuable nutritional composition which has benefits to humans. Among them, the oil content was found to be the highest value (43.5-43.8 %). The protein content was found to be (24.8 – 25.1 %) in the seed sample. The results are shown in Table (3).

Table (3) Results of nutritional composition of seed sample

No.	Nutritional Composition	Content (%)
1.	Moisture	3.5-3.6
2.	Ash	4.0-4.1
3.	Oil	43.5-43.8
4.	Fiber	8.6-8.7
5.	Nitrogen	3.97-4.02
6.	Protein	24.8-25.1
7.	Soluble carbohydrate	14.3-14.4

Elemental composition of seed sample by EDXRF spectroscopy

The seed sample contains minerals. It displays many beneficial properties. Minerals are important for our body to stay healthy. The elemental composition in seed sample was examined by EDXRF spectroscopy. The results are shown in Table (4).

Table (4) Results of elemental composition of seed sample

No.	Elements	Symbols	Results (mass%)
1.	Potassium	K	7.750
2.	Phosphorus	P	5.803
3.	Calcium	Ca	2.372
4.	Sulfur	S	1.371
5.	Aluminum	Al	1.020
6.	Chlorine	Cl	0.288
7.	Zinc	Zn	0.059
8.	Iron	Fe	0.058
9.	Titanium	Ti	0.047
10.	Cerium	Ce	0.035

According to experimental results, the sachainchi seed contains significant amount of dietary essential minerals such as potassium, phosphorus and calcium and etc. Among them, potassium was the most abundant mineral in seed sample. Therefore, sachainchi seed sample could be used in the human diet for supply these elements.

Determination of the fatty acid composition of sachainchieedoil by Gas Chromatography-Mass Spectrometry (GC-MS)

The GC-MS study was performed to determine the fatty acid methyl ester composition of the sachainchi seed oil. The gas chromatogram of the sample seed oil was shown in Figure 3

and the identified compounds were tabulated in Table (5). The GC-MS chromatogram showed the presence of three major compounds. They were palmitic acid, linoleic acid and linolenic acid. In this seed oil, the prominent unsaturated fatty acids are linoleic acid (omega 6 fatty acid) and linolenic acid (omega 3 fatty acid). These compounds are very important for the prevention of coronary heart disease and hypertension.

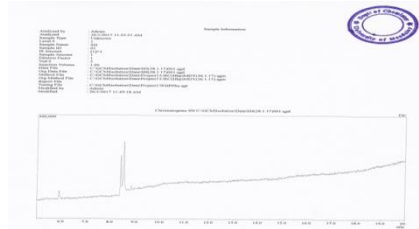


Figure 3: GC-MS Chromatogram

Table (5) Identified Compounds in Sachainchi Seed Oil by GC-MS

No.	Retention time(min)	Compounds	Structure
1.	5.915	Palmitic acid methyl ester Formula- $C_{17}H_{34}O_2$ MW – 270	
2.	8.430	Linoleic acid methyl ester Formula- $C_{19}H_{34}O_2$ MW – 294	
3.	8.545	Linolenic acid methyl ester Formula- $C_{19}H_{32}O_2$ MW – 292	

Conclusion

In this research, sachainchi seeds were collected for chemical analysis from Myitkyina Township, Kachin State. Physicochemical properties of seed sample were investigated. The phytochemical analysis indicated that sachainchi seeds contain the valuable phytochemical constituents which have health benefits to humans. From the experimental results of nutritional composition, it can be observed that sachainchi seeds were rich in oil (43.5 % - 43.8 %) and protein (24.8 % - 25.1 %).

The experimental results of elemental composition indicated that sachainchi seeds contain the significant amount of dietary essential minerals. Thus, it can be suggested that sachainchi seeds could be used in the human diet for supply these elements. Among them, potassium was the most abundant mineral found in seed sample. Fatty acid composition of sachainchi seed oil was analyzed by GC-MS. It can be observed that sachainchi seed oil contains palmitic acid, linoleic acid (omega-6) and linolenic acid (omega-3), respectively. According to intensities of peaks in GC-MS chromatogram, linolenic acid (omega-3) was found to be the highest amount. This indicated that sachainchi seed is one of the best plant-based sources of omega fatty acids and a vegetarian friendly substitute to fish oil. The highest amount in omega-3 and omega-6 in the oil helps to balance the nervous system and lowers the risk of cardiovascular disease.

Therefore, it can be concluded that sachainchi seeds are rich in protein, unsaturated fatty acid (omega-3 and omega-6), fiber and minerals for nutrition and health of human.

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