

Ethnobotanical Survey and Nutritional Composition of *Ficus pseudopalma* Blanco (Moraceae)

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F*icus pseudopalma* is an endemic medicinal plant with great ethnobotanical applications. Aside from being an ornamental plant, it is also being consumed as food and medicine. However, there are no data yet on its nutritional composition that supports its nutritional significance and utilization in the healthcare industry. For that reason, this study was conducted to provide essential information regarding the plant's health benefits, as well as to evaluate its current traditional use. A local survey was conducted in Baao, Camarines Sur, Bicol, Philippines that involved 51 respondents who are residents of the place and who are familiar with the plant. Powdered leaves of *F. pseudopalma* were subjected to chemical analysis in the Food and Nutrition Research Institute-Department of Science and Technology. The results of the survey showed that leaf decoction was most popularly used as medication for the treatment of high blood pressure, urinary problems, diabetes, high cholesterol and other medical conditions. High values of dietary fiber (46.3%) and total carbohydrates (51.0%), and minimal mineral content were recorded from the powdered leaves of *F. pseudopalma*. These data strongly suggest that the powdered dried leaf may be used as an indigenous ingredient in various healthy high-fiber-enriched, nutritious recipes and menus, and/or dietary functional foods and energy drinks.

INTRODUCTION

The emergence of new dietary fiber sources from various indigenous plant foods is on the rise and has significantly contributed to innovative food science and technology; indigenous plants as sources of dietary fiber is a new industry that has largely been untapped. The food industry declares "high fiber" as one of the most leading functional trends in the United States as a consequence of which the demand for functional high dietary fiber intake has continuously increased. The American Dietetic Association encourages the public to consume adequate amounts of dietary fiber from a variety of plant sources (Slavin 2008).

Among the endemic plants of the Philippines, *Ficus pseudopalma* Blanco (Moraceae) is one of the medicinal plants used as traditional remedy for diseases such as diabetes, hypertension and kidney stones (Stuart 2011). In addition, the plant is used as an ornamental decoration because of its palm-like appearance, and can easily be grown and cultivated in the backyard. The plant comes from the family of *Moraceae* and is locally known as "niog-niogan", "lubi-lubi", "mili-bili", palm-leaf Fig, Philippine Fig and *Draceana* fig *Ficus*.

The chemical constituents of the plant include several bioactive compounds such as: squalene, polyphenol, α -amyirin acetate, β -amyirin acetate, β -amyirin fatty acid ester, lupeol fatty acid es-

KEYWORDS

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ter, lupenone, ursenone and oleonone (Ragasa et al. 2009). Some of these compounds have been found to possess antioxidant, anticancer and antimicrobial activities (Sirisha et al. 2010), and cardioprotective, hepatoprotective and gastroprotective properties (Goto et al. 2010, Souza et al. 2011).

More recently, *F. pseudopalma* was reported to have antioxidant activity against several free radicals *in vitro* (Santiago and Valerio 2013, Bueno et al. 2013, Santiago and Mayor 2014). Antioxidants are used to stabilize reactive oxygen species (ROS) and reactive nitrogen species (RNS) levels in the body. The imbalance and deregulation of the oxidant defense mechanism of the body lead to oxidative stress that in turn induces several diseases such as cardiovascular disease, diabetes, cancer and chronic degenerative disorders. In relation to its antioxidant activity, cytotoxicity towards hepatocellular carcinoma (HepG2) and prostate cancer cells (PRST2) has been demonstrated by crude extracts of *F. pseudopalma* (Bueno et al. 2013, De Las Llagas et al. 2014).

Considering the potential health benefits that people could derive from *F. pseudopalma*, this study was performed with the aim of evaluating the current traditional uses of the plant where it is widely grown, its nutritional composition, and its possible use both in the food and in the healthcare industry.

MATERIALS AND METHODS

The Ethnobotanical Survey

Ficus pseudopalma is an endemic species of fig found in the Philippines. Aside from its use as an ornamental plant, the young shoots and leaves are cooked as vegetables, and a decoction of the leaves is used for the treatment of kidney stones and diabetes (Stuart 2011). To date, little is known about the plant, especially about its traditional use to remedy various other ailments in places where it is widely cultivated.

Respondents and Location

The respondents of the study were selected from Barangays San Juan and San Vicente in the municipality of Baao, Camarines Sur in Bicol. These two Barangays were chosen due to their rural setting and low altitude, where the plant grows in thickets (Stuart 2011). The geographical location of the areas of study is shown in Figure 1. Faith healers from the selected areas were also interviewed to find out if the plant is used in their practice of traditional medicine.

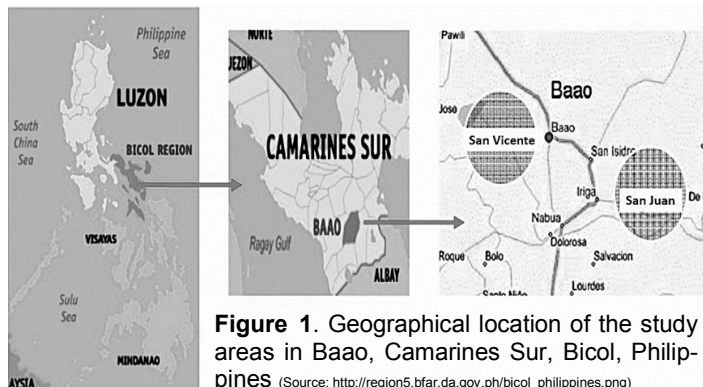


Figure 1. Geographical location of the study areas in Baao, Camarines Sur, Bicol, Philippines (Source: http://region5.bfar.da.gov.ph/bicol_philippines.png)

The Questionnaire

A questionnaire was devised for the survey using Tagalog since Baaoneños, like most Bicolanos, are fluent in Tagalog aside from Bicol, the native dialect. The questions were modified and loosely based on the questionnaire used by Poblete (1999). The first part of the questionnaire consists of personal data such as name, age, gender, civil status and occupation of the respondent, while the second part encompasses the knowledge of the respondent on the ethnobotanical and/or ethnopharmacological significance of *F. pseudopalma*.

Data Gathering Process

Baao is a 3rd class municipality in the 4th district, composed of 30 barangays and a total population of 54,971 in 2010 according to the National Statistical Coordination Board. A permit to conduct the ethnobotanic survey was sought from each respective barangay captain of the selected barangays before the actual study. Informed consent was also sought from the respondents of the study. While the ordinary respondents were selected randomly, faith healers were identified and located with the help of the locals; no appointments were made prior to the visit. The research was conducted using both formal and non-formal interviews through a semi-structured questionnaire and open-ended conversations. The interviews and discussions were also carried out using both Tagalog and Bicol dialects. Questionnaires were given to those who can read and write; those who cannot read and old people were assisted in answering the questionnaire.

Copies of the questionnaire, the consent form and the letter requesting permission from the barangay captains are available from the authors, or from Philippine Science Letters (editors@philsciletters.org).

Statistical Treatment of the Data

The collected data were tabulated and analyzed using descriptive statistics. Fidelity Level (FL) was used to estimate the agreement among the locals about a reported use for the most cited diseases. FL was computed according to the formula:

$$FL = (N_p/N) \times 100$$

Where:

N_p = number of locals that claim a use of the plant to treat a particular disease

N = number of locals that claim the use of the plant to treat any given disease

Plant Collection and Preparation

The *Ficus pseudopalma* leaves that were collected from Baao were authenticated by the Botany Division of the National Museum of the Philippines. The leaves were cleaned and air-dried inside the laboratory for one week. The dried leaves were then cut into morsels and ground into powder using a Wiley Mill.

Chemical Analysis

The powdered leaves of *F. pseudopalma* were sent to the Food Analytical Services Laboratory of the Department of Sci-

ence and Technology-Food and Nutrition Research Institute (DOST-FNRI), Philippines for analysis and to determine its nutritional value. Conventional gravimetric methods were employed to estimate the total ash and moisture content of the powdered leaves, while acid hydrolysis and enzymatic degradation (certified by the Association of Official Analytical Chemists) were done to assess the total fat and dietary fiber contents, respectively. The Kjeldahl method of protein determination was used to check the crude protein content of the powdered leaves. Atomic absorption spectroscopy was performed to estimate the mineral content, in particular for sodium, potassium, calcium and zinc.

RESULTS AND DISCUSSION

Ethnobotanic Survey

For the study, 51 locals from two barangays were surveyed regarding the different uses of the plant. The mean age of the respondents was 58 years, mostly between 41 to 70 years old (74%). The majority of the respondents were female (80%), married (82%) and worked mainly as housewives (31%), herbalist/healers (19%) and teachers (16%), while some worked as store owners (12%), government employees (8%), farmers (4%), or in unspecified jobs (10%). The distribution of the respondents according to age, gender, civil status and occupation is found in Figure 2. All of the respondents were familiar with the plant and its vernacular (Bicol) name, *Lubi-lubi*, as well as its subdialect (Rinkonada) name, *Mili-Bili*. According to the survey, the plant is mainly used for nutritional purposes where its young shoots and leaves are cooked in a variety of ways (Table 1). The degree of agreement of the locals (based on FL) on how *Lubi-lubi* is prepared as food is also shown in Table 1.

Table 1. The variety of ways in which *Ficus pseudopalma* is cooked as food based on the ethnobotanic survey; (n=51).

Manner of Preparation	Fidelity Level
Cooked with coconut milk (" <i>Ginagataan</i> ")	64.7%
Cooked on top of steaming rice then garnished with calamansi juice (" <i>Ini-Ensalada</i> ")	35.3%
Cooked as side dish (" <i>Bini-berdura</i> ")	33.3%
Cooked with egg (" <i>Tinortorta</i> ")	9.8%

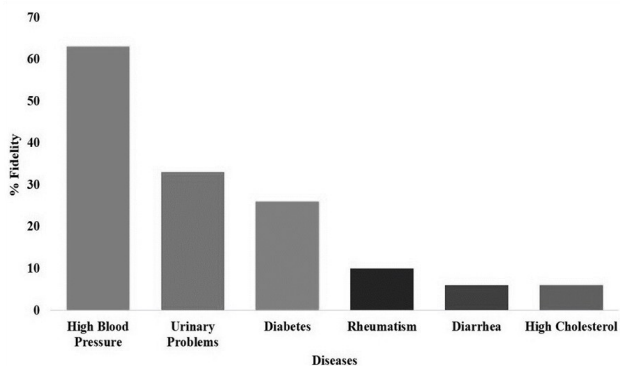


Figure 3. Ethnobotanical uses of *F. pseudopalma*; n=51 participants. The survey was conducted in selected barangays from the municipality of Baao, in the province of Camarines Sur, Philippines.

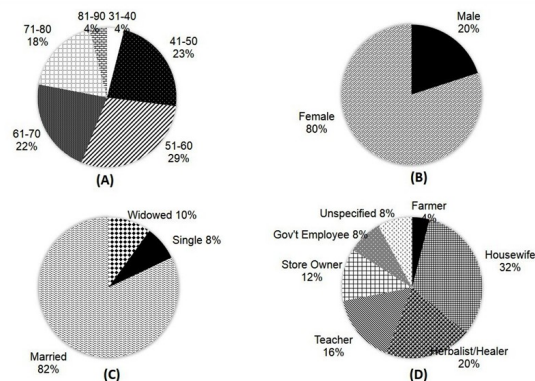


Figure 2. Demographic profile of respondents (n = 51) in the ethnobotanic survey: (A) Age Distribution, (B) Gender Distribution, (C) Civil Status, (D) Occupation.

The plant is also used for its medicinal properties as presented in Figure 3. Based on FL, the locals use the plant for the treatment of different diseases that include high blood pressure (63%), urinary problems (33%), diabetes (26%), rheumatism (10%), diarrhea (6%) and high cholesterol (6%).

Nutritional Value of *F. pseudopalma*

Based on the results obtained from the analysis done at DOST-FNRI, the powdered leaves of *F. pseudopalma* have a very high total carbohydrate (51g) and total dietary fiber (46.3g) content, and a low total fat content (3.6g) as shown in Figure 4.

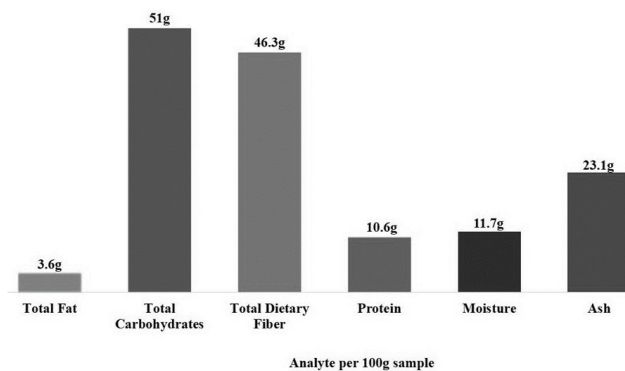


Figure 4. Major nutritional constituents of *F. pseudopalma*.

Trace minerals are also significant on the diet and are consumed based on the recommendation set by the Recommended Energy and Nutrient Intakes (RENI 2002). Our results show that calcium (3.721g) and potassium (1.137g) are the trace minerals present at the highest level in the powdered *F. pseudopalma* leaves (Figure 5).

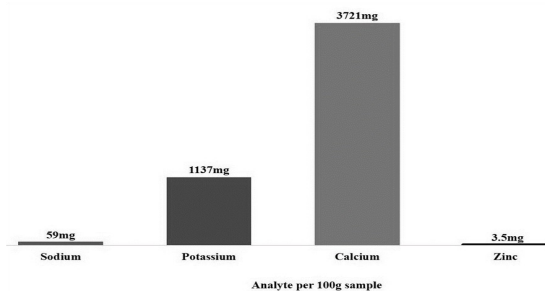


Figure 5. Mineral Content of *F. pseudopalma*.

In order to lessen the incidence of malnutrition in the country, development and production of a cheaper nutritious food will be of great help in sustaining the nutritional needs of children, especially those from low-income families. An endemic Philippine plant with great nutritional value and that can be easily cultivated, may help address the country's problems with malnutrition. Based on its identified chemical constituents (Ragasa et al. 2009), *F. pseudopalma* has been proposed to perform a number of biological functions in relation to the treatment of various diseases (Santiago and Valerio 2013, Bueno et al. 2013, Acosta et al. 2013, De Las Llagas et al. 2014). Thus, as a functional food ingredient, it is important to identify the nutritional composition of powdered *F. pseudopalma* leaves. Considering the health benefits that can be obtained from the use and consumption of *F. pseudopalma* by the respondents in this study, further analysis of the nutrient content of the plant was performed to have a better understanding of the plant's nutritional importance.

As presented in Figure 3, the plant is usually used in the treatment of hypertension. Hypertension is usually related to high cholesterol levels; the occurrence of this medical condition is associated with endothelial dysfunction and vascular structural changes (Virdis et al. 2011). In hypertensive patients, elevated levels of low-density lipoproteins (LDL) can impair the endothelium-dependent nitric oxide (NO•) production that can result in overproduction of NO• (Vita et al. 1990, Lassegue and Griendling 2004, Seiler et al. 1993). At high levels, NO• reacts with superoxide anions ($\bullet\text{O}_2^-$) and produce peroxynitrite (ONOO⁻) anions that are responsible for the damaging effect (Kim et al. 2001). In addition, the oxidation of LDL by prolonged exposure to ROS and RNS may also contribute to the damage to the endothelial cells of the arteries that may result in further inflammation (Naseem 2005). Furthermore, the consumption of food with high sodium but low potassium contributes also to the increase in blood pressure (Haas 2000). Thus, the ability of the plant to lessen the occurrence and effect of hypertension and hypercholesterolemia can be attributed to its ability to scavenge NO• radicals and inhibit lipid peroxidation (Santiago and Valerio 2013, Bueno et al. 2013, Santiago and Mayor 2014). And it is likely that the high-potassium and low-sodium content of powdered *F. pseudopalma* leaves (Figure 5) also contributes to its antihypertensive effect.

Aside from its ability to normalize blood pressure and lessen cholesterol levels, the plant is also used to treat kidney stones. One of the pathways involved in the formation of calcium oxalate stones is through the activation of the Renin-Angiotensin system, which leads to the formation of angiotensin II. This substance can lead to the further release of ROS. In a study by Acosta et al. (2013), the crude leaf extract of *F. pseudopalma* was shown to prevent and treat the ethylene glycol-induced urolithiasis in Sprague-Dawley rats, which was comparable to the activity of the standard lupeol. According to that study, a therapeutic dose of 1000 mg/kg crude dichloromethane extract of leaves of *F. pseudopalma* was able to significantly lower serum creatinine and urine oxalate levels. The extract was found to produce no toxicity at a 2000 mg/kg dose based on the Organization for Economic Cooperation and Development (OECD 425)

Main Test performed on Sprague-Dawley rats (Acosta et al. 2013, Santiago et al. 2013). Furthermore, the presence of electrolyte minerals such as potassium and sodium can assist in the regulation of the body fluid level so as to prevent the formation of more oxalate stones.

Diabetes is also one of the diseases common among Filipinos. Hyperglycemia is caused by an impaired insulin synthesis and secretion by pancreatic cells (Kaneto et al. 2010). Over production of ROS is also linked to the pathogenesis of diabetes, which contributes to the down regulation of insulin gene expression that can promote apoptosis (Harmon et al. 2011). Thus, the regulation of ROS levels is also of great importance in the treatment of diabetic patients.

Rheumatoid arthritis is a disease characterized by inflammation and destruction of joint cartilage and bone (Grant and El-Fakahany 2004), which can lead to joint immobilization and deformity. Studies have shown the relation of NO• to bone formation and remodeling, especially in the regulation of both osteoblasts and osteoclasts activities (Van't Hof and Ralston 2001). This may support the connection of NO• to the occurrence of rheumatoid arthritis, wherein patients diagnosed with this condition have higher levels of NO• (Onur et al. 2001). In connection with that, the ability of the *F. pseudopalma* leaf extract to inhibit NO• (Santiago and Valerio 2013, Bueno et al. 2013, Santiago and Mayor 2014) can be helpful in the prevention of both diabetes and rheumatoid arthritis.

In plants, carbohydrates are usually in the form of glycosides, which have important biological activities as vitamins and antibiotics, and as cardioprotective and anticancer agents (Kren and Martinkova 2001). Dietary fibers are also a form of carbohydrates that are important in the risk reduction of several diseases, including cardiovascular diseases, diabetes, obesity and certain gastrointestinal disorders (Anderson et al. 2009). Inadequate fiber consumption can lead to constipation, hemorrhoids and elevated levels of cholesterol and sugar in the blood. Though the residents do not usually use it as an anticancer agent, it is important to look into the plant's cytotoxicity towards cancer cells. Most of the components that were identified in *F. pseudopalma*, such as the triterpenes lupeol acetate, oleanone, ursenone and α -amyrin acetate (Ragasa et al. 2009), had been previously studied for their cytotoxic activity against a wide range of cancer cell lines. Furthermore, De Las Llagas et al. (2014) and Bueno et al. (2013) have shown the effectivity of the plant in killing PRST2 and HepG2, respectively.

Considering the nutritional and bioactive contents of *F. pseudopalma*, it can be said that the plant has great potential in promoting good health. Since the plant is easily grown and is widely distributed within thickets at low altitudes, *F. pseudopalma* can serve as a cheap and readily available source of functional food ingredients, used as a component in supplements, or developed into nutraceutical products. Thus, *F. pseudopalma* could be a better and cheaper substitute for high-fiber food products, whole grains, or fiber-enriched products since it is indigenous, local and inexpensive compared to expensive imported materials.

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CONFLICTS OF INTEREST

The authors declare no conflict of interests.

CONTRIBUTION OF INDIVIDUAL AUTHORS

LAS conceptualized the study and prepared the draft of the manuscript. **ABRM** compiled all data and helped in the preparation of the manuscript. **JBA** conducted the ethnobotanical survey.

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