PHYNUTRIENT ANALYSES OF PANAWIL (*LEPTOSALENA HAENKEI,* C. PRESL)

J.N. Paing and L.P. Pladio

Biology and Chemistry Department
Benguet State University

ABSTRACT

Panawil (*Leptosolena haenkei C.* Presl) belongs to the family Zingiberaceae which is endemic to Northern Luzon, Philippines. It thrives in cluster in a very specific area of Benguet and Mountain Province. The phytonutrient analyses revealed that the indigenous vegetable panawil is a rich source of phytochemicals (terpenoids, tannins, flavonoids, total phenolics, and antioxidants); minerals (phosphorus, potassium, iron, and zinc); and vitamins A (β-carotene) and C (ascorbic acid). Phytonutrient analyses of the plant samples collected from different parts of Benguet and Mountain Province reveal that there is no significant difference, except that there is a high significant difference in vitamin C of panawil from both Benguet and Mountain Province.

Keywords: phytochemicals, endemic, Benguet, and Mountain Province.

INTRODUCTION

Globalization have changed the lifestyle of people, amplified work speed, longer work schedules, and physical pressures. People also have adapted to a different eating habit where busy people are contented with eating 'easy-to-cook foods like instant and tasty meals but lesser quantity and quality of nutrients. In 2007, LEISA noted that with the continued urbanization, globalization and changing lifestyles, people are more exposed to "fast foods" like processed, treated, or stored foodstuffs of low nutritional value.

Indigenous vegetables (IVs) are plant species, variety or a crop genuinely native to a region where it evolved or became naturalized over a period of time (AVRDC (1990).

Traditional vegetables have high contents of proteins, calcium, phosphorus, iron, potassium, zinc, iodine, manganese, magnesium and other mineral elements that are essential components for human health benefits (Rubahaiyo, 2006). In addition, Swai (2006) reported that traditional vegetables are nutritionally higher and are excellent sources of Vitamins A and C, folic acid, proteins, and minerals compared to other exotic vegetables. Plants with nutritional values and bioactive components are now processed and marketed as nutraceuticals. Cotton (1996) reported that many plant species are being exploited because of various biological activities exhibited by the secondary chemicals or phytochemicals they contain.

The abundance of food supplements prepared from herbs claiming to be rich in phytonutrients being sold in the market is an indication of the acceptance of these products for health reasons.

One plant that is indigenous to the Cordillera is an herb locally known as 'panawil' growing in Benguet and Mountain Province. Co (2002) identified 'panawil' as *Leptosolena haenkei* C. Presl belonging to the Family Zingiberaceae. The flowers 'panawil' are locally utilized as vegetable. Based on observation, this wild plant occupies a narrow distribution range and thrives on hilly and steep terrain. The flowers are gathered for consumption before it fully blooms. Local folks acknowledge the flower to have a sweet smelling taste, delicious when combined with fish and meat dishes. Fruits are gathered for consumption and may also serve as food for wild animals.

According to AVRDC (1990), it is necessary to identify plant species that do not contain toxic components and are rich sources of dietary nutrients and with great potential value for future utilization. The

viable importance of 'panawil' as a source of nutrients is enough reason to protect and conserve the plant. Conversely, the ecological importance, medicinal, and food value of 'panawi'l was based on the assumptions that 'panawil' grow in Benguet and Mountain Province is a rich source of phytonutrients; and that the phytonutrient contents of panawil may vary where it grown.

The study covers the three municipalities of Benguet such as Bakun, Itogon, and Bokod and the three municipalities in Mountain Province which includes Sagada, Bontoc, and Tadian.

Objectives of the Study

The researcher based the study on the following premises, that:

1. 'Panawil' plants are relatively growing both in Benguet and Mountain Province.

2. The indigenous vegetable 'panawil' growing in Benguet and Mountain Province are rich sources of phytonutrients

3. The phytonutrient contents of 'panawil' may vary when grown in Benguet or in Mountain Province.

MATERIALS AND

METHODS The Plant Sample

Enough samples of 'panawil' plants were collected in Benguet and Mountain Province.

Three municipalities per province were selected for the sampling site. Leaf samples collected for analysis included those from the shoot to the first three sheaths (pseudostem) below the shoot. The leaf samples were sorted, washed, and air-dried at the BSU-STVRDC Centralized Laboratory prior to analyses.

'Panawil' plant sample was brought to the University of the Philippines Diliman, Quezon City for the botanical identification. The leaf part of the 'panawil' plant was used for the phytonutrient analyses. This study was conducted from October 2007 to January 2008 at Benguet State University.

Phytonutrient Analyses

Plant sample preparation. About 100 grams of air-dried leaves of 'panawil' were cut and homogenized using a blender. Enough volume of ethyl alcohol was added to submerge the plant sample for 48 hours, after which was filtered using a Buchner funnel. The filtrate collected was concentrated using a rotary evaporator with the water bath maintained at 40 ^{o}C. The residue left represents the 'panawil' crude ethanol extracts used for the phytochemical analysis.

Phytochemical screening. The standard protocol ofGuevara(2005)wasusedinthephytochemicalanalysis in the determination of the secondary metabolites in the 'panawil' extract. The phytochemicals found in 'panawil' was determined based on the intensity of colors in the test tubes. The scale which corresponds to the intensity of the colors and precipitates obtained from the tests uses Table 1 to get semi-quantitative values. The presence of phytochemicals was confirmed using the Thin-Layer Chromatography (TLC) technique.

Table 1. Scale used to determine semi-quantitative level

INTENSITY OF COLOR/ PRECIPITATE OF REACTION	QUALITATIVE DESCRIPTION	SEMI-QUANTITATIVE LEVEL
+++	Intense	3
++	Moderate	2
+	Light	1

Mineral and vitamin analyses. About 1 kg of air-dried 'panawil' leaves was analyzed for mineral and vitamin content. The analytical method, Ashing-acid Digestion / Atomic absorption spectrophotometry, was used for the analysis of the plant minerals; potassium, phosphorus, iron, and zinc, while HPLC was used for determining the β-Carotene, ascorbic acid, total phenolic contents and antioxidant activities of the plant samples.

RESULTS AND DISCUSSION

The Plant Sample

Botanical description. *Leptosolena haenkei*, C. Presl., locally known as 'panawil' in Benguet and Mountain Province (Figure. 1) was first identified by K.B. Presl. in 1827 which was based on specimens collected at twin peaks, Tuba, Benguet. However, Ridley (1906) described the species as as *Leptosalena insignis* Ridl.

According to Larsen *et al.* (1998) as cited in Funakoshi et al. (2005) the genus *Leptosalena* came from the Greek word '*Lepto-solen*' which means 'slender pipe'. *Leptosalena C.* Presl (Zingiberaceae) which is endemic to Northern Luzon, Philippines. It comprises the species which is *L. haenkei* C. Presl. wherein *Leptosalena* is outstanding and distinct in the Zingiberaceae Family because of its large flowers with extremely long and slender corolla tube extended from the calyx for more than half its length.

Figure 1. The 'panawil' Plant

Phytochemical contents. Phytochemical analysis done on the crude ethanol extracts of the air-dried 'panawil' leaves using test tube. Reactions showed that terpenoids, flavonoids and tannins are present (Table 2). Thin-layer chromatography was performed on the crude ethanol extract to confirm the presence of the phytochemicals determined in the pre-test (Table 3). Results confirmed that flavonoids, tannins, and terpenoids are thus present in 'panawil'. Other analyses revealed the presence of total phenolics and antioxidants in the sample.

Table 2. Phytochemical screening of the crude ethanol extracts from 'panawil'

TESTS	COMPOUNDS
Salkowski	Terpenoids*
Ferric chloride, Gelatine	Tannins*
Bathe-Smith & Metcalf, Wilstatter	Flavonoids*
Mayer's, Draggendorff 's, Wagner's	Alkaloids
Keller-Kiliani, Kedde, Liebermann-Burchard	Steroids
Borntrager's	Anthraquinones
Guignard	Cyanogenic glycoside

Table 3. Confirmatory test using thin-layer chromatography

COMPOUND TESTED	PRAY REAGENT	OBSERVABLE POSITIVE RESULT
Flavonoids, Steroids	Antimony () Chloride	Intense yellow to orange visible zones appear on spraying for glycosidic flavonoids.
Phenols, Tannins, Flavonoids	Potassium Ferricyanide-ferric chloride	Blue spots
Higher alcohols, Phenols,Steroids, Essential oils	Vanillin-sulfuric Acid	Triterpenes and sterols appear as blue-violet spots. Essential oils-zones with wide range of colors
Alkaloids	Dragendorff's reagent	Brown-orange visible spots immediately on spraying
Coumarins, Phenols, Anthrones, Anthraquinones,	Methanolic potassium hydroxide (Borntrager's reagent)	Anthraquinones-orange color Anthones-yellow Coumarins-blue

According to Chou (1989) the bitter taste and toxins of many food sources are due to the presence of phytochemicals like alkaloids, tannins, flavonoids, cyanogenic glycosides and triterpenes. These phytochemicals are considered non-nutrient compounds that impart bitter taste in plants (Cataldo *et al*., 2003) as cited in Bolayo (2006). According to Guevara (2005), secondary metabolites are present in small quantity in plants and have no known function. They are metabolic products that are not involved in plant growth or reproduction.

Polyphenols are the most abundant group of plant phenolic compounds known to provide much of the flavor, color, and taste to fruits, vegetables, and seeds. It includes the flavonoids, tannins, and terpenoids.

Phenolic compounds are associated with plant pigments some of which are associated with the defense of plants against a range of attacks from browsing animals (Crozier, 1986). Flavonoids are polyphenolic compounds that are ubiquitous in nature and are categorized according to chemical structure into flavonols, flavones, flavanones, isoflavones, anthocyanidins, aurones, cathechins, and chalcones.

The flavonoids have been reported to have anti-viral, anti-allergic, antiplatelet, anti-inflammatory, antitumor, and antioxidant activites (Buhler, *et al.*, 2000). Tannins are plant polyphenolics that possess the property of precipitating proteins from aqueous media, which can be classified into hydrolysable tannins and the condensed or proanthocyanidins (Guevara, 2005).

The concentrations of the flavonoids, tannins, and terpenoids were determined semi-quantitatively in panawil. Figure 2 shows that these phytochemicals are generally higher in samples taken from Mountain Province. The result validates the assumption that phytochemicals in 'panawil' may vary when grown in different habitats or distribution, for example, in Benguet and Mountain Province.

Antioxidants in 'panawil' as shown in Figure 2 is higher than the total phenolic contents. This was observed both in Benguet and Mountain Province. This is probably because antioxidants include the vitamin c and carotenoid contents of the plant, although total phenolics also generally include the flavonoids, tannins, and carotenoids (β-Carotene) in 'panawil'. Antioxidants are compounds that protect cells from the damaging effects of free radicals. Furthermore, the presence of antioxidants, phenolics, terpenoids, tannins, and flavonoids suggest that the plant be a good source of medicinal constituents beneficial to man.

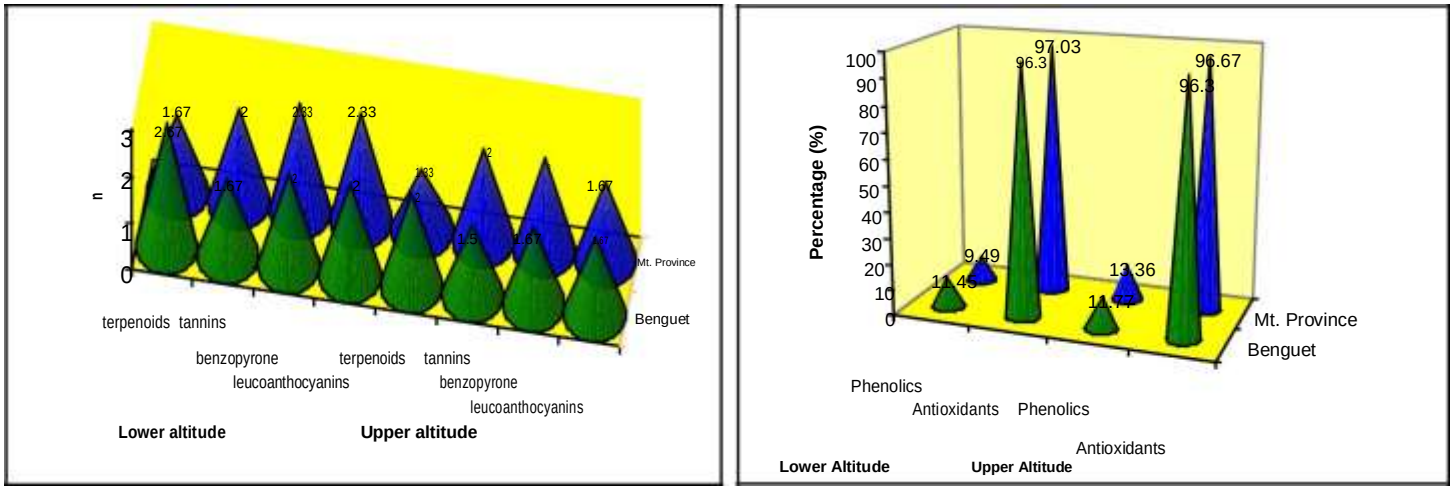

Figure 2. Phytochemical contents of panawil in Benguet and Mountain Province

Phytochemical contents of 'panawil' may vary when grown in Benguet or Mountain Province. The mean values of the phytochemical contents were compared between the plant samples collected from Benguet and Mountain Province. Results of the t-test showed that only the mean difference of the antioxidant contents of 'panawil' indicates a significant difference.

This means that the ability to scavenge hydroxyl radicals is higher in 'panawil' plants gathered from Mountain Province than those from Benguet. This can also be related to the higher content of antioxidants in 'panawil'. Supportively, the study of Santiago (2005) revealed that the antioxidant capacity varies considerably from one kind of vegetable to another. Garcia *et al.,* (2005) added that strongly colored fruits and vegetables are known to contain high phytochemicals and antioxidant properties.

Mineral Contents

Minerals are assumed to be present in 'panawil'. Results of the analysis revealed the presence of the following minerals: phosphorus, potassium, iron, and zinc.

Figure 3 shows that the highest among the minerals determined in panawil is potassium. This was observed both samples from Benguet and Mountain Province. Iron and zinc content are very minimal compared to potassium.

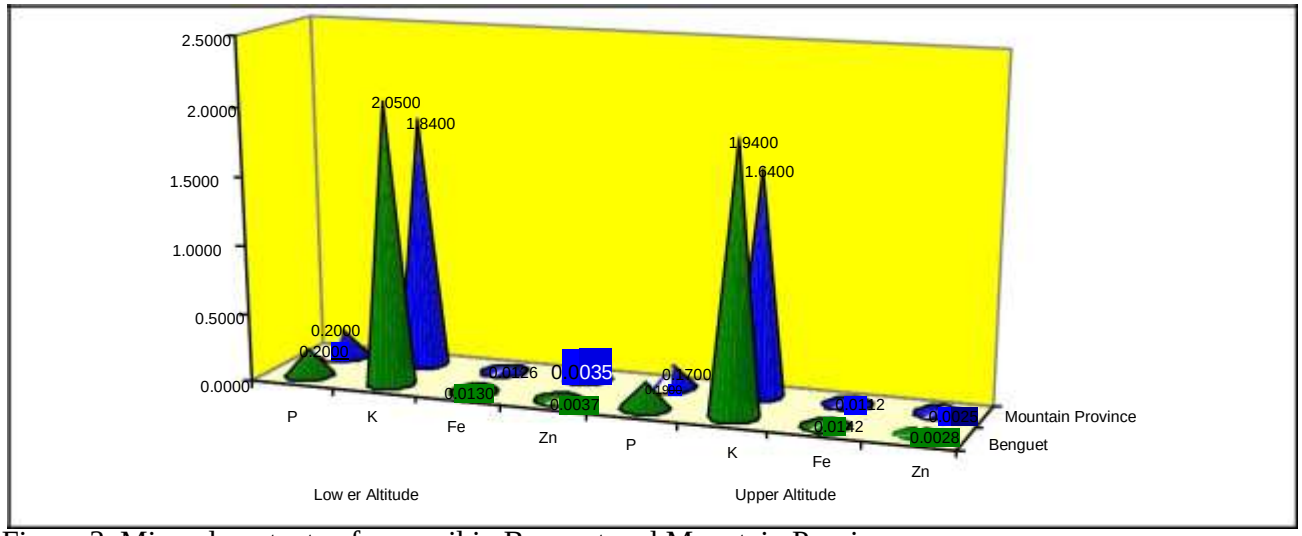

Figure 3. Mineral contents of panawil in Benguet and Mountain Province

Plant derived minerals contribute to what the body needs. Potassium helps regulate and stabilize blood pressure levels which may help in the prevention of strokes. Parker (2003) stated that iron is required for a number of vital functions, including growth, reproduction, healing and immune function. He further mentioned that minerals in the elemental form when ingested are extremely toxic and fatal. But plant derived minerals are 100% absorbable and is beneficial to health. Comparing the Recommended Dietary Intake (RDI) for minerals and vitamins which the body needs to the mineral contents of 'panawil', the amount which 'panawil' can supply far exceeds what is required.

In terms of the mineral contents of 'panawil' plants collected from Benguet and Mountain Province were compared and results of the t-test showed that the mean differences are not significant. This implies that the amount of minerals which can be derived from 'panawil' is the same whether grown in Benguet or Mountain Province.

James (1995) as cited by Bolayo (2006) reported that differences in composition may occur as a result of loss of some volatile inorganic constituents during the analysis. He further classified the minerals with values greater than 100 ppm or 0.01% as major and trace elements if the values are lesser than 100 ppm or 0.01%.

Vitamin Contents

Results of the vitamin analysis showed that β-Carotene and ascorbic acid are present in the indigenous vegetable 'panawil'. Vitamin A was determined as β-carotene, the precursor of vitamin A. On the other hand, vitamin C was determined as ascorbic acid. These vitamins are considered dietary antioxidants hence they probably contribute to the antioxidant activity of 'panawil'. Comparatively, 'panawil' from Benguet and Mountain Province contains high vitamin A, while vitamin C in Mountain Province is lower than in Benguet (Figure 4).

With the above mentioned results, 'panawil' as a food source can contribute to the vitamin requirement of the body. Vitamin A plays an important role in vision, essential for the integrity of epithelial tissues, bone development, reproduction and healthy skin (Bolayo, 2006). According to Kohlmeir (2003), vitamin C is important for gum, arteries and other soft tissues, brain function and act as antioxidants defense against free radicals.

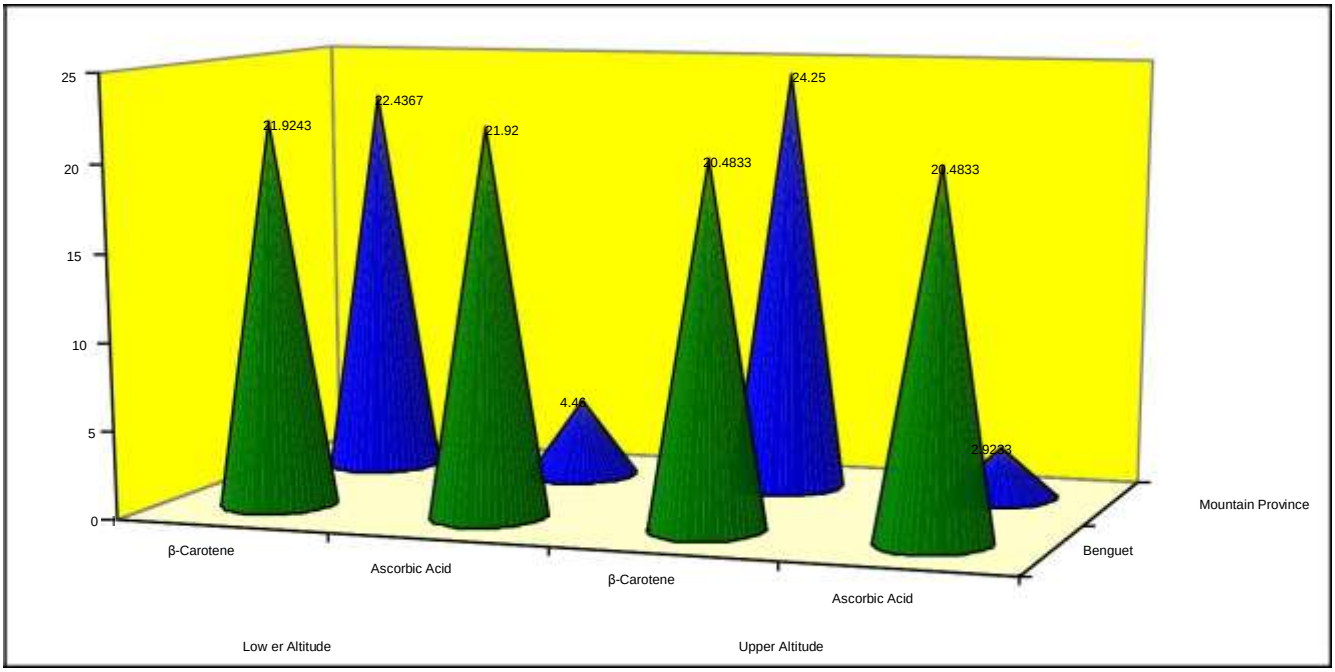

Figure 4. Vitamin contents of panawil in Benguet and Mountain Province

The comparison using the t-test between the mean values of the vitamin contents of panawil samples collected from Benguet and Mountain Province revealed that the mean values of β-carotene have no significant difference. On the other hand, there is a highly significant difference between the means of vitamin C (ascorbic acid) content of 'panawil' both in Benguet and Mountain Province.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

In the study, phytochemical and chemical analyses revealed the presence of the following phytonutrients in the indigenous vegetable 'panawil': phytochemicals (terpenoids, tannins, flavonoids, total phenolics, and antioxidants), minerals (phosphorus, potassium, iron, and zinc), and vitamins A (β-carotene) and C (ascorbic acid). Furthermore, the phytonutrients present in 'panawil' collected from in Benguet and Mountain Province have no significant differencehavinf comparable results, except that the vitamin C (ascorbic acid) content of panawil in Benguet is higher than in Mountain Province.

Conclusion and Recommendation

Based on the results, the following conclusions were drawn. The indigenous vegetable 'panawil' is a rich source of phytonutrients: phytochemicals such terpenoids, tannins, flavonoids, total phenolics, and antioxidants; minerals like potassium, phosphorus, iron and zinc; and vitamins such as vitamins A (β-carotene) and C (ascorbic acid). 'Panawil' being a rich source of phytonutrient is recommended for vegetable consumption; the presence of other phytochemicals that have medicinal value makes it also a candidate as medicinal plants. Given a thorough study on the bioactive components, the plant can be tapped as a potential source of herbal drugs.

ACKNOWLEDGEMENTS

We are greatly indebted to the Philippine Inter-Universitaire Co-Operation Programme through the Semi-Temperate Vegetable Research and Development Center (PIUCP-STVRDC) which provided the financial support. My profound gratitude to VLIR-PIUC promoter and coordinators Dr. Dirk de Waele, Dr. Darlyn D. Tagarino, Dr. Sonwright B. Maddul and Dr. Luciana M. Villanueva.

LITERATURE CITED

BOLAYO, Y. D. 2006. Phytonutrient Analysis of the Shoots of Passion (*Passiflora edulis,*Sims). Masters Thesis. Benguet State University, La Trinidad, Benguet.

BUHLER, D.R. and C. MIRANDA. 2000. Antioxidant Activities of Flavonoids. The Linus Pauling Institute. Retrieved on April 12, 2008 from http://lpi.oregonstate.edu/f-w00/flavonoids

CHOU, C.H. 1989. The Role of Allelopathy in Phytochemical Ecology. Phytochemical Ecology: Allelochemicals, Myotoxins and Insect Pheromones and Allomones. Institute of Botany, Academia Sinica Monograph Series No. 9, Taipei.

CO, L. 2002. Phylogeny of *Leptosolena haenkei* in the Family Zingiberaceae. Acta Phytotax. Geobotany.

CROZIER, A.M. and H. ASHIHARA. 2006. Plant Secondary Metabolites : Occurrence Structure and Role in the Human Diet. New York: John Willey and Sons, Inc.

GARCIA, V.V., T.O. MAGPANTAY, and L.D. ESCOBIN. 2005. Antioxidants Potential of Selected Philippine Vegetables and Fruits. Institute of Food Sciences, College of Agriculture, University of the Philippines, Los Baños, Laguna.

GUEVARA, Q.B. 2005. A Guidebook to Plant Analysis: Phytochemical and Biological. University of Santo Tomas Publishing House, UST, España, Manila.

KOHLMEIER, M. 2003. Nutrient Metabolism. London: Academic Press.

LOW EXTERNAL I NPUT A N D SUSTAINABLE AGRICULTURE (LEISA). 2007. Healthier Farmers, Better Products. Vol.23. No.3. Amersfoort, the Netherlands.

LIRIO, G.L, L.O. AYYOKAD and J. N. PAING. 2006. Indigenous Semi-Temperate Vegetables of Cordillera. Benguet State University, La Trinidad: Unique Printing Press, Baguio City.

MALASPINA, A. 1996. Functional Food s: Overview and Introduction, Nutrition Review Manual.

PARKER, R. 2003. Introduction to Food Science Delmar Thompson Learning, Inc. Australia

RUBAHAIYO, E.B. 2006. Conservation and Use of Traditional Vegetables in Uganda. Paper for Conference in Africa on Indigenous Vegetables. Proceedings of the IPGRI International Workshop on Genetic Resources of Traditional Vegetables in Africa: Conservation and Use 29-31 August 1995, ICRAF-HQ, Nairobi, Kenya. Retrieved on July 17, 2006 from http://www.ipgri.cgiar.org/ publications/HTMLPublications/500/begin. htm#Contents

SANTIAGO, P.M. 2005. Flavonol and Flavonol Contents of Selected Fruits. Masters Thesis. University of the Philippines Los Baños, Laguna.

SWAI, R.A. 2006. Conservation and Use of Genetic Resources of Traditional Vegetables in Tanzania. Proceedings of the IPGRI International Workshop on Genetic Resources of Traditional Vegetables in Africa: Conservation and Use 29-31 August 1995, ICRAF-HQ, Nairobi, Kenya. Retrieved on July 17, 2006 from http://www.ipgricgiar.org/ publications HTMLPublications/500/begin. htm#Contents