

**CZECH UNIVERSITY OF LIFE SCIENCES
PRAGUE**

Faculty of AgriSciences

**Department of Crop Sciences and Agroforestry in Tropics
and Subtropics**



Czech University of Life Sciences Prague

**Faculty of Tropical
AgriSciences**

Bachelor Thesis

**Piper lolot C.DC. and Piper sarmentosum Roxb.:two
different species or botanical synonyms? A review**

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BACHELOR THESIS ASSIGNMENT

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Thesis title

Piper lolot C.DC. and Piper sarmentosum Roxb.: two different species or botanical synonyms? A review

Objectives of thesis

Piper lolot was identified as very valuable species due to its economic importance, strong cultural connections and for different purposes of use. The results of the previous studies show the leaves of P. lolot, known in Vietnamese as La lot, are used both as medicine and seasoning in Vietnam. Nevertheless, in various literature sources we can find really unclear identification of La lot leading to free use of names P. lolot and P. sarmentosum without appropriate explanation of taxonomic or nomenclature consequences. It seems that some of the collected specimens were incorrectly identified due to failed recognition of the distinctive habit of the species. The thesis aims to provide the comprehensive review of the agricultural, ethnobotanical and taxonomic literature to consolidate the data on species and related taxonomy and nomenclature.

Methodology

The revision of taxonomic classification and nomenclature of the species will be performed through comprehensive literature survey completed by survey of specimens provided by digitalized herbaria collections. Also, the agricultural and ethnobotanical literature will be reviewed to summarize the data on species use and domestication.

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Kuebel KR, Tucker AO. 1988. Vietnamese culinary herbs in the United States. *Economic Botany*, 42(3): 413-419.

Nguyen MLT. 2003. Comparison of food plant knowledge between urban Vietnamese living in Vietnam and in Hawaii. *Economic Botany*, 57(4): 372-480.

Jaramillo MA, Callejas R. 2004. A reappraisal of *Trianaeopiper* Trelease: convergence of dwarf habit in some *Piper* species of the Chocó. *Taxon*, 53 (2): 269-278.

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Certification

I, Anna Krkonošková, declare that this thesis, submitted in partial fulfilment of the requirements for the bachelor degree, at the Faculty of Tropical AgriSciences of the Czech University of Life Sciences Prague, is wholly my own work unless otherwise referenced or acknowledged.

In Prague

Anna Krkonošková

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Abstract

Piper lolot was identified as very valuable species due to its economic importance, strong cultural connections and for different purposes of use. The results of the previous studies show the leaves of *P. lolot*, known in Vietnamese as *La lot*, are used both as medicine and seasoning in Vietnam. Nevertheless, in various literature sources we can find really unclear identification of *La lot* leading to free use of names *P. lolot* and *P. sarmentosum* without appropriate explanation of taxonomic or nomenclature consequences. It seems that some of the collected specimens were incorrectly identified due to failed recognition of the distinctive habit of the species.

Key words: *Piper lolot*, *Piper sarmentosum*, botanical description, geographical distribution, taxonomic classification, nomenclature, domestication status

Abstrakt

Piper lolot byl označen jako velmi cenný druh vzhledem ke své ekonomické důležitosti, silných kulturních vazbách a pro různé účely použití. Výsledky předchozích studií ukazují listy *P. lolot*, známý ve Vietnamštině jako La lot, používané jako lék a koření ve Vietnamu. Nicméně v různých literárních pramenech můžeme najít opravdu nejasné identifikace La Lot vedoucí k volnému použití jména *P. lolot* a *P. sarmentosum*. bez odpovídajících taxonomických či názvoslovných konsekvencí. Zdá se, že některé z vybraných vzorků byly nesprávně identifikovány kvůli neúspěšnému rozpoznání rozlišovacích zvyků druhu.

Klíčová slova: *Piper lolot*, *Piper sarmentosum*, botanický popis, zeměpisné rozšíření, taxonomická klasifikace, nomenklatura, domestikační status

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List of abbreviations

NCBI – The National Centre for Biotechnology Information

uBio – Universal Biological Index and Organizer

IPNI – The International Plant Name Index

HUH – The Harvard University Herbaria

IAPT – The International Association For Plant Taxonomy

MOB – Missouri Botanical Garden

FOC – Flora of China

HMNH – Harvard Museum Natural History

DIM Ho Chi Minh – Department of Internal Medicine Ho Chi Minh

1 Introduction

The origin of the plant family *Piperaceae*, and their occurrence is located mainly in the areas of the tropics and subtropics. Many of their representatives can be found in Asian countries. Here are the plants of the genus *Piper* widely used by local residents. Especially as a spice for flavoring food. Or form the very basis of some traditional Asian dishes. They are indispensable in ethnopharmaceutical medicine. The *Piper* is a popular cultural plant and have a rich ethnobotanical history. Ever since ancient times, plants of the genus *Piper* belongs to the important business items. Worldwide demand for new sources of income continues to grow. We are constantly looking for new alternatives that will supply the market. Also, modern medicine is still dependent on knowledge of plants. That are used to regularly in traditional folk medicine. Plants of the genus *Piper* opens up new possibilities.

The genus *Piper* (*Piperaceae*) includes many species that are difficult to identify regularly. Due to the high variability in their vegetative parts that are different. Hardly identifiable are small flowers and small fruits. This is the reason that leads to a large number of errors in the description and characterization of many unnecessary taxa (Tebbs 1989). Traditional collection methods have been very helpful for accurate description of the types of plants. Thus, we opened a clear path to understanding the biological diversity of plants. Unfortunately, these methods are inadequate today. Biological diversity is declining steadily over time, so we have to quickly discover and document. The fundamental problem is that many new species waiting several years to correct taxonomic classification and collecting expeditions are carried out irregularly (Webb et al. 2010). A great opportunity is the use of morphological characters found in the genus *Piper*. The evolutionary history of this group is more understandable when put together correctly phylogenetic relationships within this genus and combines the study of morphological characters with molecular research. Classification of the family and its departments within sequence molecular data provides many features for improved classification of the genus and its segregates (Jaramillo et al. 2004).

I created two hypotheses based on the claim that *Piper lolot* C. DC. and *Piper sarmentosum* Roxb. There are two different types or the same botanical synonym.

The thesis is conceived to bring a comprehensive overview related to the issue. This was based on information obtained from reliable sources. A literary review.

2 The Aims of thesis

The aim of this work is to correctly identify whether *Piper lolot* C. DC. and *Piper sarmentosum* Roxb., are two different species or botanical synonyms. The revision of taxonomic classification and nomenclature of the species will be performed through comprehensive literature survey completed by survey of specimens provided by digitalized herbaria collections. Also, the agricultural and ethnobotanical literature will be reviewed to summarize the data on species use and domestication. Thesis should answer two hypotheses, if *Piper lolot* C. DC. and *Piper sarmentosum* Roxb are two different species or *Piper lolot* C. DC. And *Piper sarmentosum* Roxb. are botanical synonyms.

3 Study background

3.1 A brief history of the species

The fossils from the order *Piperales* are rare; only remains of the genus *Piper* are known from the Paleocen Alaska. In the last tertiary was family *Piperaceae* expanded almost cosmopolitan (South America, China, Japan, Europe) (Novák et al. 1972).

3.1.1 The first occurrence of the spices and their use

Simpson (1995) said, that we have records of the use of onion and garlic more than 4,500 years ago but we don't know when people started to use herbs and species as flavoring agents. Before than the people started using refrigeration for saving their foodstuff, they used herbs and species for cover up the flavors of decaying food. Another use: they were making meals more interesting on taste. Main importance in common life, were using of species for religious ceremonies, producing fragrant smoke during ritualized cremation of the dead and embalming. Many centuries ago, Phoenicians gained in the Tyre nomad's aromas and species. The Nomads coming from Mesopotamia, where the trade with India and far-East was increasing. Thanks to Phoenicians was pepper delivered into the area of Mediterranean sea (Cattabiani et al. 2006).

The developments of events influenced the old centres of civilizations. That generated the good conditions for the basics knowledge of plants and their recording. And of course, the first systematic of plants. The Medicine used as a addition for the treating of injuries and diseases the recordings of plants (Morton 1981). In 4th century, Alexander the Great, through his conquest of new territories, opening the way to India. This action gave the impulse for the exchange between the West and the East (Cattabiani et al. 2006). Like the main center of trade with the spice in the Mediterranean was based Alexandria (Cairo). Thus Greeks expanded their spice trade paths. At the time when lived Hippocrates (approx. 400 B.C.) and Theophrastus (approx. 300 B.C) species and herbs were detailed described

botanically and were usually used in medicine, also for other purposes (Simpson et al. 1995).

3.1.2 **The first naming of the *Piper***

Likewise Cattabiani et al. (2006) mention that pepper was regarded as a solar plant and king of species. Theophrastos (in the 4th BC) alluded him under the name peper, from Sanskrit pippali, which the Romans translated as piper. The Greek name for the black pepper, *Peperi* gave basis for the name of the genus *Piper*, which is probably derived from it. Also Rosengarten (1973) says that the European names for black pepper was mostly derived from the Sanskrit root *Pippali*, which is the name for a long pepper (*Piper longum*) (Ravindran et al. 2000). In this time it was the most expensive and most popular spice, that best describes the folk saying "dear as a pepper" (Cattabiani et al. 2006).

Linnaeus tried to describe all known species of plants. He gave them the binomial names, that characterize scientific nomenclature. His work culminated in the year 1753, when he published his book *Species Plantarum*. Sir Hans Sloane was the London physician and made large collections of plants. After his dead were collections offered to the nation for £20,00. But this sum couldn't match the real value of these collections. Linnaeus had seen Sloane and his collections. After that he used informations from Sloane's book: *A Voyage to the islands Madeira...Jamaica* (1707 - 1725). This book was major work, because contained source for many tropical plants (for example: cocoa, sugar cane). This plants Linnaeus described in *Species Plantarum* (Jarvis 2007) Equally Yuncker (1958) and Ravindran (2000) which mentions that Linnaeus like first from botanists, in his piece of work *Species Plantarum* recognized 17 species in the Pipe family. And he included in the same genus *Piper* all of these species.

3.1.3 **The first classification systems and the inclusion of the family *Piperaceae***

Consistent naming of plants and animals became more difficult in the 18th century as the known world expanded through exploration (Jarvis 2007). Then in 1794 (40 years later) was introduced a second genus in the family, which was named *Peperomia* by Ruiz and Pavon (Yuncker 1958, Ravindran et al. 2000).

In the middle of 19th century began to appear the first classification systems. These systems were designed for family *Piperaceae* and were founded almost simultaneously (Jaramillo et al. 2004). In 1815 it was first registered the name *Piperaceae* family. L. C. Rich wrote him in the work of Humboldt, and Bonpland Kunth's *Nova Genera et Species Plantarum*. Over time Sprengel, Kunth, Miquel and others described a number of additional genera which were mostly isolated from the genus *Piper* (Yuncker 1958, Ravindran et al. 2000). F.A.W. Miquel wrote the first monographic study. His classic work (from 1843) called „ *Systema Piperacearum* “. It contains all known species in the family, occurring in his time. The family *Piperaceae* Miquel divided into two tribes: *Piperae* and *Peperomeae* (Ravindran et al. 2000). The knowledge of the *Piperaceae* created Miquel focused Casimir de Candolle, who has made changes in this arrangement. He concentrated most of the early generations in a large genus *Piper*, but some Miquel's groups remained at the same section or subgenus (Jaramillo et al. 2008).

De Candolle in 1869 in his work *Prodromus* recognized more than 1000 species and those subdivided into two genera *Piper* and *Peperomia*. *Prodromus* includes an extensive monograph of the whole family *Piperaceae* (Ravindran et al. 2000).

According to Jaramillo et al. (2004) which says, that: „ The actual classification of piper was formed throughout the 20th century, very chaotic. She was heavily influenced by and dependent on three important developments:

- (1) Treatments became fragmentary.
- (2) New genera were segregated from *Piper* on the basis of gross morphology.
- (3) A large number of new species were described without clear subgeneric affinities “.

De Candolle died in 1918. This moment ends his lifelong work on the systematic *Piperaceae*. His last work of 1923 „ *Piperacearum Clavis Analytica* “ containing the key to the family *Piperaceae*, is published posthumously. More than 3000 varieties of species are recognized in this key (Ravindran et al. 2000).

William Trelease was another monograph of the family *Piperaceae*, and left the infrageneric classification, followed by De Candolle. A broad and unstructured

piper with several small segregates was identified and described by Trelease, some have been described by Miquel. Yuncker was a follower of Trelease and continued his generic concepts. These generic concepts have become the starting point and were largely accepted in the rest of the 1900s (Jaramillo et al. 2008). Trelease, De Candolle and Miquel - After more than a century, took over responsibility for shaping the system of the family *Piperaceae* (Ravindran et al 2000). Last thirty years, for the genus *Piper* has made great efforts in terms of its development, in order to achieve its comprehensive infrageneric classification (Jaramillo et al. 2004).

3.2 Geographical Distribution

American Tropics in the genus *Piper* have a much richer variety than the Tropics of Asia and in the proportion of about 700 versus 300 species. On the islands of the South Pacific is generally found only 40 species. Africa has at least two species native only (Dyer et al. 2004).

The subconscious and research of eastern North American - eastern Asian plant separations are detected from the period of Linnaeus to the inception of the twentieth century (Boufford et al. 1983). The Asian floristic treatments are based on de Candolle's classification since of the 1990's (Jaramillo et al. 2008).

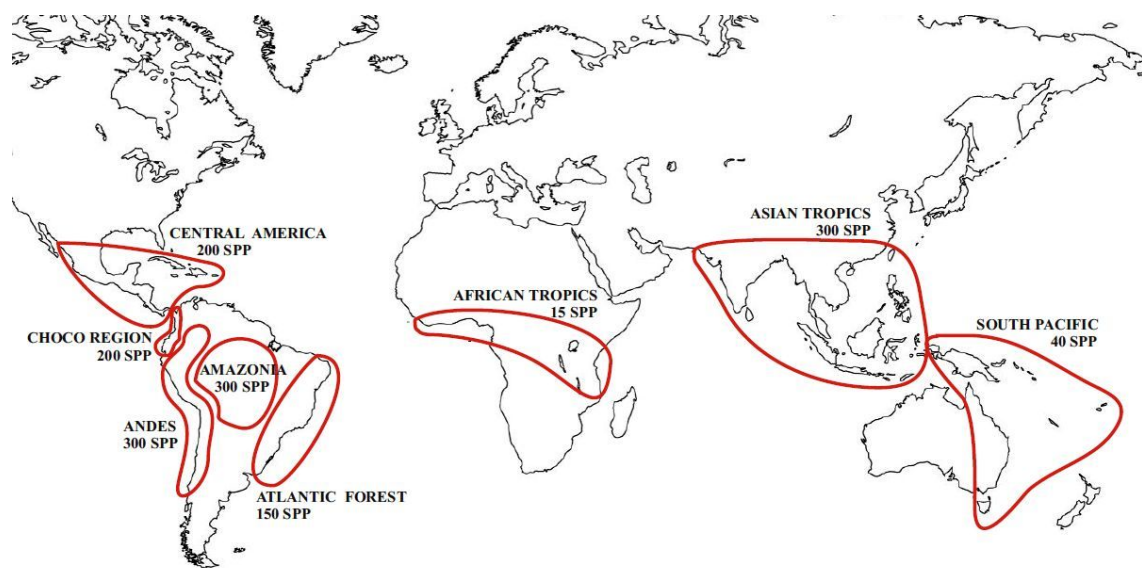


Figure 1: Geographic distribution of the genus *Piper* (Jaramillo et al. 2001).

Scientific research on plants takes more than two centuries. We have not discovered all plants. The time that we have documentation of plant diversity is constantly decreasing. This is a response to rapidly changing land use in Southeast Asia that causes instability in diversity. In addition, we have insufficient knowledge about the distribution of known taxa of this biogeographically complex area (Webb et al. 2010).

3.2.1 The current situation of the *Pipers* distribution

The problem is the lack of Southeast Asian biodiversity knowledge, which contributes to rapid loss of biodiversity. Most taxonomic groups are missing in the definition of the orientation of individual species. Awareness of their distribution is very low as well as the possibility of their best use (Webb et al. 2010). Needful outputs of the family *Piperaceae*, although a few, are favourably assessed by a wide percentage of people on the world (Heywood 1993). Southeast Asia places great emphasis to the sphere of agriculture. An important condition is its relative benefit to savings in the catchment area, which achieves to the higher value, than in the other countries of the world. Furthermore, development in the subregion was dependent on growth in agriculture, which is the most important factor for the immediate changes. Much of this positive move is transferred into new investments in the agricultural research (Raitzer et al. 2010).

3.3 Characteristics of the family *Piperaceae*

The family *Piperaceae* with others 4 families is positioned in the order Piperales and they are appearing in the Neotropics areas. This order is a part of Magnoliids and is also considered as the one of the most species-rich and heterogenous clades (Guimarães 2010). APG III (2009) said, that families in the order *Piperales* identified by Bercht & J. Presl in the year 1820 are *Aristolochiaceae*, identified by Juss in 1789, *Hydnoraceae* identified by C. Agardh in 1821, *Lactoridaceae* identified by Engl in 1888, as well *Saururaceae* identified by F.Voigt in 1811. And also belong here *Piperaceae* identified by Giseke in 1792. It is one of the largest group which are the part of flowering plants (Yuncker 1958). Specialization of this family of 'deviated from the original ancestors, especially

in morphological characters; anatomically approaching families of *Himantandraceae*, *Aristolochiaceae* and monocotyledonous plants (Novák et al. 1972). This family Piperaceae includes these 13 plant genera: *Artanthe*, *Lindenipiper*, *Macropiper*, *Manekia*, *Ottonia*, *Peperomia*, *Piper*, *Piperanthera*, *Pothomorphe*, *Sarcorhachis*, *Trianaeopiper*, *Verhuellia*, *Zippelia* (The Plant List 2010). The family *Piperaceae* is taken like one of the larger families but isn't the biggest. According to estimate, includes 2000 or more species (Yuncker 1958).

3.3.1 Species names belongig to the family *Piperaceae*

According to The Plan List (2010), noting the status of total 6,993 species names belonging to the Piperaceae family. Here are statistically evaluated:

Table 1: Species names of the family *Piperaceae* (The Plant List, 2010).

Status	Total no.	Total %
Accepted names	1,191	27,70 %
Synonym	2,309	33,30 %
Unplaced names	6	0,10 %
Unassessed names	2,699	38,90 %

According to The Plant List (2010), noting the status of total 7,631 names (including infraspecific names) belonging to the family *Piperaceae*. Here are statistically evaluated:

Table 2: All names of the family Piperaceae (The Plant List, 2010).

Status	Total no.	Total %
Accepted names	1,993	26,10 %
Synonym	2,91	38,10 %
Unplaced names	7	0,10 %
Unassessed names	2,721	35,70 %

3.3.2 Botanical description of the family *Piperaceae*

Growth forms of the Piperaceae are herbs, shrubs, climbers (Yongqian et al. 1999) and vines (Simpson, 2006) small trees, at times epiphytic (Judd, 2002). The **leaves** are simple, alternate, opposite. Base is sometimes asymmetric, veined pinnately or palmately (Yongquian et al. 1999). A typical **inflorescence** is a spadix (Simpson, 2006). The **flowers** are small (Yongquian et al. 1999) bisexual or unisexual, plants are divided into monoecious or dioecious (Judd, 2002). **Floral formula** describes the internal of the flower, **P** 0 **A** 3+3 [1-10] **G** 1 or (3, 4), superior (Simpson, 2006). The **fruit** is a drupe or nutlet (Yongquian et al. 1999). It is extremely specialized branch as demonstrated not only morphological characters, but also biochemical characters (Novák et al 1972). The plants are characterized by having in a parenchyma spherical and aromatic (etheric) oil cells. As the vasculature but with an outer cambium (Simson, 2006). The *Piperaceae* have different alkaloid (piperine, is distinguished for the whole family), various glycosides, sesquiterpenes, and other substances (Novák et al. 1972).

3.3.3 Botanical description of the genus *Piper*

Plants of *Piper* are climbers, herbs, small trees (Yongqian et al. 1999). Predominantly shrubs or subshrubs. They are living in the shades and moist places. They grow for one or a few years (Burger, 1972). *Piper* are two extremes in stem: stem and stem lianescent bush. Vines are rare in America. Burger in the year 1972, quoting 7 - 8 of 150 kinds Central America, they are much more common in Asia. Ridley in the year 1924, citing sixty *Piper* 75 lianas to Malaysia. Certain morphological features and the growth rate is directly related to the stem, and it is noted that the bushes are easier to study than certain lianescentes that have branches in the tree crown. Third type of stem, much rarer, was discovered by *P. lolot* C. CD. who is a naturalized species in the Botanical Gardens in Singapore and grow in greenhouses at the University of Orsay issue creeping stems, from place to place, erect stems completely comparable with the individual shrub species (Blanc & Andraos, 1983). **Stem** is sympodially branched and with terminal multifloral spikes. **Leaves** are alternate and provided with stipules. **Flowers** are bisexual, unisexual or poligamous grow in the gully curved bracts or goblet. **Perianth** is lacking, species

with the most comprehensive floral formula have 2 trifoliate circles of stamens; usually , however stamens less, inner circle is suppressed, in some species even one stamen in the outer circle atrophies, so there are only two stamens in the flower (for example the black pepper). **Pistil** interconnects most of the three, rarely two or four, rarely five carpels. **Stigmas** are sessile. **Ovary** is upper. **Fruit** is berry. **Seeds** have perisperm, in outside is hard, green-grey, inside farinaceous, off-white and endosperm; *Pipers* have starch granules composed of 4000 grains. In the leaves, wood and fruits are abundant secretory reservoir, containing pungent aromatic oils, for some is significant alkaloid piperine (Black pepper 5-9%, in the Long pepper 4-6%) (Novák et al. 1972). The leaves, stems and roots of the *Piper lolot* contain essential oils and alkaloids (alkaloid). Essential oils have 35 components, of which 25 components were found yet. The main component is the β -caryophyllen. The roots contain essential oils, the main ingredient is bornyl-acetate (DIM Ho Chi Minh 2010).

3.4 **Piper lolot C.DC.**

According to NCBI Taxonomy, the uBio (2013) states, that taxonomy of *Piper lolot*. Is the following.

Superkingdom: Eukaryota

Subkingdom: Viridiplantae

Streptophyta

Streptophytina

Embryophyta

Tracheophyta

Euphyllophyta

Superdivision: Magnoliophyta

Class: Magnoliids

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: Piper lolot

According to IPNI (2005) which states, that the name *Piper lolot* C. DC. was first introduced in one official source, *Annuaire du Conservatoire & du Jardin Botaniques de Genève* in the year 1896. Thus Anne Casimir Pyramus de Candolle (HUH, 2011), said in latin language, that *Piper lolot* is species nova (Candolle, 1897) This means New species (Hendrych et al. 2002). Candolle (1897) also introduced botanical description of *Piper lolot*, where he said, that **flowers** are unisexual or rarely on the basis are aments bisexual or the rare species are partly unisexual and partly bisexual. The flowers are sessile **Aments** grows against leaves. **Leaves** are petiolate, broadly ovate, on the basis symmetrically cordate, and on the apex are acuminate. On the obverse glabrous, the veins on the reverse are very finely pubescent, with 7-9 veins, midrib above the base. **Petiole** is very finely pubescent, on the basis is leaf sheath, bract is round, middle half-sessile. **Inflorescence** is short corrugated, **ovary** inferior, oval, ciliate on the top of blunt pointed. Tonkin, near Quang Yei (Balansa in H. 539 N. Mus. Par.) Perennial, called by Annam inhabitants *lolot*. Young **twigs** very slightly pubescent to glabrous, on the cross-sectional is collenchyma at libriformal bundles isolated, nearly circular, strongly ribbed on the twigs, bundles in the marrow are nearly row. The **blade**, when it is dry, is thinly membranous, greenish, slightly translucent dotted, approximately 13 cm long and 8,5 cm wide. **Petiole** is approximately 2,5 cm long. Ament, on the young sample, is about 12 mm long. **Stigmas** are 3 and short.

Another source from *Adansoniana*, where Blanc & Andraos (1983) mentioned *Piper lolot* in conjunction with woody plant. They said that, under this name will be grouped all types of shrubs standing upright and at different stages of development does not require the presence support. Height of the plants ranges from a few inches to the types of undergrowth about ten meters high for some types of pioneer tree species or forest species. This growth mode was achieved in only one type of Vietnamese, *S. Lolot*, naturalized in the botanical garden in Singapore. This species, which is used as a seasoning, it appears very close to the Malay species, *P. sarmentosum* C. DC because after our observations herbarium specimens stored in MNHN.

3.5 **Piper sarmentosum Roxb.**

According to NCBI Taxonomy, the uBio (2013) states, that taxonomy of *Piper sarmentosum*. Is the following.

Superkingdom: Eukaryota

Subkingdom: Viridiplantae

Streptophyta

Streptophytina

Embryophyta

Tracheophyta

Euphyllophyta

Superdivision: Magnoliophyta

Class: Magnoliids

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: *Piper sarmentosum*

According to IPNI (2005) which states, that the name *Piper sarmentosum* Roxb. was first introduced in two official sources. The first one source is called Asiatick Researches: Or, Transactions of the Society Instituted in Bengal, for Enquiring Into the History and Antiquities, the Arts, Sciences, and Literature, of Asia. Written by Asiatick Society. There is also mentioned *Piper sarmentosum* like replaced synonym *Piper latifolium* Hunt. Another one source is called Flora Indica; or, Description of Indian Plants written by William Roxburgh. Gilbert (1999) said, that William Hunter in the year 1807 used name “*Piper latifolium*“. So it mention the earliest literary sources for this taxon. It was only provisional name for a sterile plant. In an ongoing correspondence with Roxburgh, it was found that it is the same as the species in cultivation in Calcutta. And provisionally named as Roxburgh. (Fig.: 2). In Asiatic Research (1806) is written, that Hunter said: „In the enumeration which I published in the ninth volume of *Asiatic Researches* of the species of peper, indigenous or cultivated in *Prince Of Wales’s Islands*, one

called by the *Malays*, *Gádu*, *Caudo* or *Gadukh*, was mentioned, (p. 392.) Of this kind, the specimens which I had then seen being destitute of fructification, I was enabled by report only to refer it to this genus, and had no adequate means of ascertaining the specific character. To supply this defect, I obtained, by the assistance of friend on the island, some live plants of this species, and committed them to the care of DR. Roxburgh, who found them, when they blossomed, to be a species which had been introduced into the botanical garden some years before, and to which he has given the name *Piper Sarmentosum*. To this kindness I am obliged for the following specific character and description. W. M. Hunter. “

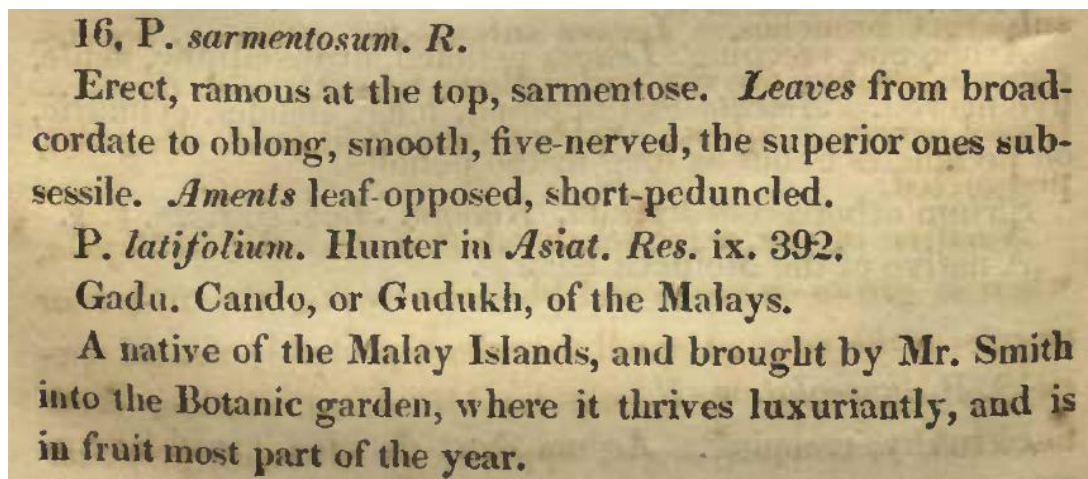


Figure 2: Description of *Piper sarmentosum* Roxb. and *Piper latifolium* Hunter in *Flora Indica* (Roxburgh 1820).

Roxburgh therefore provide the name and description, which first published the Hunter in addition to volume 11 in an “*Asiatick Researches*“. However, it was largely ignored. The name is often regarded as validated in the year 1820 in Roxburgh's *Flora Indica* (Gilbert et al.1999).

Table 3: Botanical description of *Piper sarmentosum* Roxb (According to Roxborough 1820).

Features	Botanical description of the <i>Piper sarmentosum</i> Roxb.
Stems	Erect, from six to eighteen inches high, ramous at top jointed and smooth, sarmentose
Sarmentose Shoots	Greath length, issuing in abundance from the top of the root, and the lower part of the stem, by which the plant is quickly propagated to any extent
Leaves	Alternate, five nerved the lower ones petioled, broad, re-entering, cordate; the upper ones (superior) sub-sessile, obliquely oblong; all are smooth on both sides, and shining on the upper one.
Aments	Solitary, opposite to the leaves, short – peduncled, oblong, small, rarely longer than a quarter of an inch long
Germes	Oval, one - celled
Ovulum	One attached by the base to the bottom of the cell
Fruit	Compound, cylindric, about size of an infant’s fingerm when ripe softish, and of a dark green or livid colour
Berries	Numerous, most of the gems prove abortive, one – celled
Seed	Solitary, oval, attached to the bottom of the cell
Integuments	Single, thin, light brown
Perisperm	Conform to the seed, friable
Embryo	Shape of small broad inverted cone lodget in the apex of perisperm
Radicle	Superior

3.6 Holotype, Lectotype, Synonyms

Gilbert et al. 1999 said, that „*Piper sarmentosum* Roxborough, in Hunter, *Asiat. Res.* 11: 565. 1810. *Chavica sarmentosa* (Roxborough) Miquel, *Syst. piperac.* 1: 242. 1843. TYPE: "cultivated in Calcutta," Roxborough tab. 1267 (lectotype, here designated, K) “.Lectotype denote species whose sample was later chosen

by researchers. It is designed as if it were a holotype. This sample is selected from a number of samples that are available at the original publishing author of a scientific name. And then if the holotype is destroyed, lost or no holotype was designated (NYBG, 2003). An adequate lectotype of this species, was created on the base of illustration, for Roxbourgh. Because, hasn't been found any other Roxbourgh's herbarium materials (Gilbert et al. 1999).

Holotype represents the name of species or infraspecific taxon is the only one specimen or illustration which is marked by the author as the nomenclatural type. As long as is the holotype preserved, determined application of the name. (IAPT 2012). Gilbert et al. 1999 said, that „*Piper lolot* C. DC., *Annuaire Conserv. Jard. Bot. Genève* 2: 272. 1898. Syn. nov. Type: Vietnam. Tonkin, Environs de Quang-yen. Sep. 1885, *Balansa* 539 (holotype, P) “

Gilbert appointed *Piper lolot* C. DC. as a synonym under *Piper sarmentosum* Roxb (Raman, 2012). (Tab.: 4). Synonyms are names of the same rank, which names the same syntaxon or syntaxon that are considered relevant to the same syntaxon, regardless of their status. Syntaxonomical or heterotypical synonyms are based on different nomenclatural types, but are considered to be relevant to the same syntaxon. When you change the definition of the syntaxon it can become nonsynonymous names. Names are pseudonyms when they are used by later authors with the same original author citation, but erroneously (Hendrych et al. 2002).

Table 4: Synonyms of the *Piper sarmentosum* Roxb (According to Raman et al. 2012, Gilbert et al. 1999).

<i>Chavica hainana</i> C. DC.	<i>Piper gym- nostachyum</i> C. DC.
<i>Chavica sarmentosa</i> (Roxb.) Miq.	<i>Piper lolot</i> C. DC.
<i>Piper albispicum</i> C. DC.	<i>Piper pierreii</i> C. DC.
<i>Piper brevicaule</i> C. DC.	<i>Piper saigonense</i> C. DC.

Synonyms plants are nothing new under the sun. Already in ancient Egyptian recipes, were plants featured under the „alegorical“ names. Mainly because the priests concealed before uninitiated persons, composition of their medicines and make them rarer and mysterious. The high-sounding synonyms, but usually very simple herbs. In finding the thesaurus from about 200BC. as we find „Babastid’s heart“ and „blood of Hephaesta“ meant Artemisia (southern wormwood); „genitals (penis) Ibsie“ and „hairy ape“ meant Anethum (dill); „heart of vulture“ Absinthum (common wormwood), and many others (Rystonová, 2007).

3.7 Ethnobotany

In the year of 1985 in North America, John Harshberger like first used the word ethnobotany. From this moment, are ethnobotanical studies considered as a separate field (Schultes & von Reis 1999). Martin (1995) saying that the prefix Ethno- means, how to easy express an idea ‘that’s the way other people look at the world’. Ethnobotany has been defined as the discipline concerned with the interactions between people and plants (Jones, 1941, cited in Hamilton et al. 2003). Ethnobotany is one of an interdisciplinary field, because utilizes methods from broad range of science traditions, mainly antropology and botany (Bridges et al. 2006, Albuquerque et al. 2009). Schultes & von Reis (1999) they said, that the continuous growth of this discipline continued in distribution of new terms. They described different and specialized subdivisions of this filed: ethnobiology, socioethnobotany, ethnopharmacology, ethnoecology, ethnomycology, paleoethnobotany, ethnomedicine and many others. Ethnobotany is a research field of science. He is broadly used for the documentation of indigenous knowledge. Especially on the use of plants. It provides an overview of useful plants. Area of interest are predominantly Asian countries and their local flora (Pei, 2001). Quantitative and qualitative ethnobotanical data are collected on the basis of different approaches and finally analyzed (Höft *et al.* 1999). To analyze and organize research data, it is recommended in all study use at least basic computer competence. (Bridges et al. 2006, Albuquerque et al. 2009) Ethnobotanical approaches by Höft (1999) depends on the nature of research and the overall study. The aim is to objectively assess the

reliability of conclusions based on the data. To explain these variants of ethnobotanical data are applied multivariate statistical methods:

- Significance of plant species and vegetation types to different social, ethnic and gender groups.
- Knowledge about plants and their utilization by different ethnic, social and gender groups.
- Priority indication of the different plant species.
- Woody plant species and their size class distribution.
- What is the quantitative impact of human use on regeneration patterns and plant growth.
- What is the quantitative impact of environmental factors on plant characteristics.
- What is the quantitative impact of horticultural and agricultural techniques on plants
- What are the quantitative pharmacological and morphological characteristics of plants.

Quantitative ethnobotany pointed out how you can relieve comparative study on indigenous knowledge. Especially the use of plants by different sociocultural groups. It offers a stable basis for assessing quantitative impacts of human activities on plants and ecosystems. (Slikkerveer, 2005).

Knowledge and language of indigenous people

Ethnobotany covers many aspects of being a part of how people naming and classifying plants. Which values are placed on them. Also their use and management. It permeates across the social and natural sciences (Hamilton et al. 2003). Indigenous knowledge are transmitted and maintained through oral tradition. These systematic information are unwritten and they are remains in different social structures. It refers

to the system of knowledge of indigenous people and minority cultures. Local or indigenous people of that area, created on the base of their perception, traditional knowledge related to biodiversity. Specifically, regarding to folk names of plants and animals. They are the roots of traditional biodiversity knowledge. (Berlin, 1992). We should present all the information about the community first in her language and descriptive terminology. Language of science is the external culture. It should not be in this case in the first place. We need to capture how these people see themselves. What is their vision of the world. We shouldn't people hide behind legal terms, such as intellectual property rights (McClatchey, 2005). (Table 5).

Table 5: Common names of *Piper sarmentosum* and *Piper lolot* in some Asian languages (Anna Krkonošková, 2013).

Language	<i>Piper sarmentosum</i>	<i>Piper lolot</i>	References
Cambodian	<i>Chaplu</i>	<i>Chaplu</i>	Yamamoto & Matsumoto (2011)
Khmer		<i>Chi plou</i>	uBio (2013)
Chinese	<i>Jia ju</i>		FOC (2013)
Malay	<i>Kaduk, Daun Sirih</i>		Kathun et al. 2011
Thai	<i>Phak i loet</i> <i>Cha phlu</i>		Wiat (2006)
Vietnamese		<i>Lot Lot</i> <i>Lolot</i> <i>Cây lá lô</i>	UMP Ho Chi Minh (2010) Candolle (1897) uBio (2013)

Traditional uses of medicinal plants

The plants constantly play an irreplaceable role in human welfare. And always will be. Thanks to the plants, people get food, medicines, fuel, building materials and labor for the construction and the manufacture of crafts and many others. Their genetic and chemical components are constantly explored for human benefit. (Hamilton et al. 2003). Traditional Healers use medicinal herbs, Which are the main source of medicines. Also, traditional midwives, mothers in households plants harvested from the wild gardens. While maintaining the commonly used plants is

constantly high demand for medicinal plants in home gardens. The WHO Said That 80% of the world population, especially those in tropical regions are dependent on plant products. It is their main form of medication (Shingu, 2005). Unfortunately, in the last three decades of the last century, speed up work on a catalog of existing knowledge of plants. They compete with the rapidly disappearing natural resources. Specifically, with Tropical Forests (Ramirez, 2007).

Medicinal uses of *Piper lolot* C.DC.

In southeastern Asia is *Piper lolot* usually used for medicinal purposes (Perry 1980; Kuebel, 1988). Vietnam currently belong to countries that have the highest agrobiodiversity in the world (Shmith et al. 2008). Traditional medical systems in Vietnam, their historical roots date back to the period before more than 2000 years ago. Candolle (1897) mentioned area of Tonkin, near Quang Yei (Balansa in H. 539 N. Mus. Par.) and where *Piper lolot* was traditionally used by Annam inhabitants. In 1945, there was an establishment of independence. It has brought new ideas for the use of traditional medicine (Hoang et al. 2008). Until today different ethnic society in Vietnam using medicinal plants. In particular for the treatment of certain diseases. This is due to their easy availability (Banskota et al. 2003). The *Piper lolot* is still popular for his pharmacological effect. The leaves of *P. lolot* are a drug. They are used as a mask on the skin, or a decoction for oral treatment of bone pain, arthritis, rheumatism, with sweating hands and feet, with nausea, vomiting, flatulence, bloating, abdominal pain, diarrhea. Use 5 to 10 grams of dried leaves, or 15-30 fresh leaves. Doses of 2-3x a day. It is necessary to comply with the regular in take of fluids while. A decoction of the leaves is good for soaking the feet sweating. The limbs are cooled by immersion (DIM Ho Chi Minh 2010). Nevertheless, there are cases where some knowledge of traditional healing methods and medicinal plants are still a mystery. The main reason is the reluctance of people to share with each other on this knowledge, and thus the value of traditional knowledge is rapidly disappearing into oblivion. Holders of traditional knowledge are poor people in remote areas and results between research institutes are not clear (Handa et al. 2006). Local people mainly use herbal medicinal plants that grow in their range in places such as: forest edges, forest floor, in fields, villages and along roads (Hoang et al. 2008). As well *P. lolot* is widely planted in the wilderness places,

turned to the north. The plants are cutting into the slices 20-25 cm long and they are planted in moist soil and cool under the trees (DIM Ho Chi Minh 2010). There are no restrictions on the trade in medicinal plant products. Many of them are not registered due to lack of proper government policies (Handa et al. 2006). Major role in the recovery and revaluation of indigenous knowledge can play ethnobotanical research (Hoang et al. 2008).

Medicinal uses of *Piper sarmentosum* Roxb.

Piper sarmentosum Roxb., plants are located in countries with tropical forests, namely: Southern China, Cambodia, Philippines, India (NE India and Andaman Islands), Laos, Indonesia, Malaysia and Vietnam (Mathew et al. 2004, Raman 2012). Roxburgh (1820) in *Flora Indica* said, that *Piper sarmentosum* is a native of Malay islands. James Edward Smith was a botanist, founder and president of the Linnaean Society of London (Botanicus, 2013). These Mr. Smith brought sarmentosum to the Botanic garden in Calcutta. Here grew luxuriantly and had fruits for the greater part of the year (Roxburgh, 1820). In Malaysia is *P. sarmentosum* regarded as a traditional medicinal plant. The main therapeutic effects of this plant is proven with regular use. Treat acne, gum disease, reduce white discharge menstrual cycle in women (Kathun et al. 2011). *P. sarmentosum* Roxb (Tawan et al. 2002) from Malaysia has a local name *Kaduk* and *Daun Sirih* (Kathun et al. 2011). Decoctions and ointments are made from the leaves. These products are used in the treatment of pain in the bones. Headache in children is reduced by using tiles. Tiles are put on the forehead (Thawan et al. 2002). In all regions of Thailand are plants of the genus *Piper* processed by the local Thai people as food. Most popular ethno economic species are *P. nigrum* and *P. sarmentosum*. Nationally are mainly used for cooking. They contain flavoring substances. They grow on the plantations and home gardens. Fresh leaves are eaten as a vegetable (Chaveerach et al., 2006). The local name for *P. sarmentosum* is *Phak i loet*, Thai name is *Cha phlu* (Wiar, 2006). Culture, vegetation, religion, topography, species diversity, the ceremonies are important issues. The way local people use plants of the genus *Piper* is determined by these issues. This situation occurs commonly in every area of Thailand (Chaveerach et al., 2006). Thai traditional doctors prepared to treat cancer Benjakul. This statement

showed Itharat et al. in 1998, when examining the wisdom of indigenous Thais. In patients with cancer is used as an adaptogen drugs. The main component of these Thai medicinal plants: *Piper longum* Linn., *Piper sarmentosum* Roxb., *Piper interruptum* Opiz., *Plumbago indica* Linn., *Zingiber officinale* Roscoe A. (Itharat et al. 2007). Extracts of *Piper sarmentosum*, *Andrographis paniculata* and *Tinospora crispa* are effective against malaria (Jantan 2004).

Uses of *Piper lolot* C.DC. and *Piper sarmentosum* Roxb for the production of rice wines and liqueres

According to Yamamoto & Matsumoto (2011) who say that, in Cambodia, there are sweet ingedience and herbs and spices used to make starters They are therefore widely sought. A lot of people put new straters on straw or rice husks. These techniques are widely distributed. They can be based initially in one place. And then actively disseminated to distant areas of Southeast Asia. In Cambodia, we can see two different production processes. The first method is based on the “rice wine culture”. It is characteristic that does not use rice liquor and old starters. On the contrary, uses leaves and branches covering the starter. But not used for drying starter. The second process is based on the “rice liquor culture”. It is characterized by the use of rice liquor, blown over the starters. Furthermore, old starters, they are scattered over new starters and/or mixed with rice powder. And the addition of sugar without using plant plant materials . Culture of rice wine is an older process in Cambodia and the new technique of rice liquor culture has penetrated into regions later.

Plants and Other Materials Used for Fermentation Starters:

Local name: *chaplu*

Scientific name: *Piper lolot* or *Piper sarmentosum*

Plants part: root

4 Literature sources and methods

This thesis is written in the form of literary review. Information was collected from scientific databases (Web of Knowledge , Google Scholar, Scopus and Science Direct et al.). The main source for this work is an online database of scientific journals (Ethnobotany journal, Journal of Plant Scieces). In addition, digital collections from herbaria like MBG and digital libraries, such as Botanicus, Biodeiversity Heritage Library. Names of plants and synonyms, their inclusion in the classification system was verified using uBio, IPNI, The Plant List et al. Literature sources were also drawn from a number of specialized books, dealing with the issue of plant systematic, ethnobotany, nomenclature, and others were obtained from libraries. Some sources have authors written in various foreign languages. Therefore, had to be translated into the English language.

Plant systematics is science of diversity, it means discovery, description and interpretation of its. It includes also the synthesis of information on diversity based on the form of predictive classification systems. In practice the systematics respond to classification and identification of plants (Judd et al. 2002).

Classifications mean placing plants in a logically organized scheme of relationships. The classification system is hierarchical. Greater inclusive group such as the green plant kingdom, are superior to smaller progresively nested groups as well as families inclusive of genera and species (Judd et al 2002).

Identification is the process when we try to determine whether the unknown plant belongs to a known group of plants. Methods for plant identification are written description and image comparision.. (Judd et al. 2002).

Image Comparision is method when unknown plant can be visually identified. By comparing photographs or illustrations of known taxa from books and webpages, which provides a suitable sources. Because, photographs and illustrations are often

available only for a small subset of possible taxa. Also, it may be difficult to find the right photo or illustration. It requires to explore all options. The main measure is that two or more taxa may appear in their mutual comparison very equally. The photographs and illustrations may not be correctly displayed. Especially important differences in the morphological characteristics of plants. Each visual image should include a technical description of the plant (Simpson, 2006).

Another method for correct identification is to compare the properties of an unknown plant with a written description of the possible known taxon. This way we can determine with certainty whether the range of properties of unknown plants are identical with properties that are defined in the description of known plants (Simpson 2006).

5 Results and discussion

Anatomy of *Piper sarmentosum* Roxb. is constantly neglected. Even in spite of the prevailing confusion with other morphologically similar species (Raman et al. 2012). (Tab. 6).

Table 6: Comparative morphology of *Piper sarmentosum* Roxb. and *Piper lolot* C. DC. (According to FOC 2013 and UMP Ho Chi Minh 2010).

	Feature	<i>Piper sarmentosum</i> Roxb.	<i>Piper lolot</i> C. DC.
Habit	a. Growth form	Herb	Herb, shrub
	b. Size	< 10 m	High standing, 30 – 40 cm
	c. Position of the stem	Mostly creeping along ground	Ground-terrestrial
	d. Venation	-	Longitudinal
	e. Surface of the stem	-	Many grooves longitudinally
	f. Reproduction system	Dioecious	-
	g. Colour	-	Dark green
	h. Epidermis	Most parts very finely powdery pubescent at least when young	With smooth and short hair
	i. Fertile stems	± erect	-
	j. Flowering	April – November	April
Fruit	k. Type	Drupe	-
	l. Shape	Subglobose, 4 - angled	-
	m. Length	2.5 – 3 mm	-
	n. Position	Partly connate to rachis	-

Leaf blade	o. Size	7-14 × 6-13 cm	Abundant leaves, 10-12 × 18-12 cm
	p. Shape	Toward base of stem ovate to suborbicular, those toward apex of stem smaller, ovate or ovate-lanceolate. Base cordate to rounded, sometimes cuneate on apical branches, ± symmetric, apex acute.	Assymetrical, ovate to cordate, wide with a sharp edge.
	q. Upper surface, epidermis, colour	Glabrous, ± membranous, finely glandular	Glossy, sparsely dotted, dark green
	r. Lower surface, epidermis, colour	Finely powdery pubescent along veins, ± membranous, finely glandular	Light green coloured, gently and briefly fuzzy
Veins	s. Position of the veins	Reaching leaf apex	Curved towards the tip of a leaf
	t. Number of veins	7	-
	u. Upper	Pair arising 1-2 cm above base Glaucous when dry	-
	v. Lower	Very prominent	-
	w. Reticulate venation	Conspicuous	-
Petiole	x. Length	2-5 cm	2-5.cm
	y. Epidermis	Very finely powdery pubescent	-
	z. Shape	-	Cylindrical
	aa. Position	-	Protruding on the concave side of the leaf, expanded by the stem

Based on the available information, I created a comparative morphological Table. 5. Thus I compare *Piper lolot* C. DC. and *Piper sarmentosum* Roxb. For a description of *Piper sarmentosum* I used the informations which are available on the online database FOC (2013). Also Tropicos. org. (2013) provides this feature, but more detailed. These botanical online database publishing MBO. In Tropicos. org. (2013) is mentioned William Roxburgh like author of this species. The name is often regarded as validated in the year 1820 in Roxburgh's *Flora Indica* (Gilbert et al.1999). The *P. sarmentosum* was again described in FOC in the year 1999, by Yongqian (Tab.: 6). Gilbert appointed *Piper lolot* C. DC. as a synonym under *Piper sarmentosum* Roxb. (Raman, 2012). (Tab.: 4) This information is generally accepted without a correct determination of both species in the taxonomic and nomenclatural patterns. Raman (2012) said, taht number of publications and online databases (www. plantnames.unimelb. Edu.au, www.ars-grin.gov; www.wikipedia.org, etc.), treat these two species as clearly one. According to IPNI (2005) *Piper lolot* C. DC. was first introduced in one official source, Annuaire du Conservatoire & du Jardin Botaniques de Genève in the year 1896. This source Candolle originally written in Latin. Here he mentions a tribe Annam residents of Tonkin. It is today's Vietnam Hanoi area. There is still the species *P. lolot* native plant, widely used by local residents as well as before the 2000 years of this culture. It is true that the identification of *P. lolot* was about seventy years later than, Roxbourg did it at *P. sarmentosum*. Roxburgh (1820) in *Flora Indica* said, that *Piper sarmentosum* is a native of Malay islands. Historical data and background information on species identification play their essential role in this case. Language knowledge about plants and their uses are created for several centuries. The basis of Annam language is Malay. It is possible that this plant was originally domesticated and transported at the same time as the arrival of the Malay in this area. But I found only one reliable ethnobotanical source where Yamamoto & Matsumoto (2011) refers *P. lolot* and *P. sarmentosum* as distinct one species, but without clear morphological description. In Cambodia, these plants are called by local people in one common name *Chaplu*. (Tab.: 4). In Thailand is common name for *P. sarmentosum* *Cha phlu* (Wiar, 2006) and in ethnical group of Khmer is *P. lolot* known as *Chi plou* (uBio, 2013) . No other specifying information than the similarity in the names of plants, weren't seen in

addition to their use in the preparation of traditional Asian dishes and especially in traditional folk medicine. *P. sarmentosum*. Treat acne, gum disease, reduce white discharge menstrual cycle in women (Kathun et al. 2011). Thai traditional doctors prepared to treat cancer Benjakul (Itharat et al. 1997). The leaves of *P. lolot* are used as a mask on the skin, or a decoction for oral treatment of bone pain, arthritis, rheumatism, with sweating hands and feet, with nausea, vomiting, flatulence, bloating, abdominal pain, diarrhea (DIM Ho Chi Minh 2010). Necessary information about the use of *P. lolot* and botanical description, I translated from a source written in Vietnamese. It is the only one detailed source that I found. (Tab.: 6). Samples were collected and described at Department of Internal Medicine, University of Medicine and Pharmacy Ho Chi Minh City, in the May, 2010. We mustn't forget the french article from the authors Blanc & Andraos from the year 1983, published in *Adansoniana*. Here's the *P. lolot* mentioned in connection with his growth habit, but also, there is first hypothesis. This species, which is used as a seasoning, it appears very close to the Malay species, *P. sarmentosum* (Blanc & Andraos, 1983).

Many online databases from herbaria provides pressed and dried plants of *P. lolot*, but necessary morphological description is not available. Tropicos. org. (2013) also summarizes information about *P. lolot*, there is mentioned collectors Mary Merello & Heidi H. Schmidt. They determined *P. lolot* in the City of Los Angeles in the China town, Ai Hoa Supermarket in the 1999. Their description is based on these ethnobotanical informations. Leaf glossy green above, lighter beneath, *La Lot*. Unfortunately this description states that since Candolle almost nothing has changed. According to Gilbert (1999) which, said that „It seems that C. De Candolle failed to recognize the extremely distinct habit and based his descriptions on minor variations in leaf size and shape, due largely to variation between the lower leaves and the upper most leaves associated with the inflorescences, and also variation in size and color of the inflorescence with age".

6 Conclusion

Based on all available information and found that relate directly or indirectly to the subject. I can say that this topic cover the work would have to become lifelong mission. Most literary sources dealing with the plant *P. lolot* is located in one the Asian languages. A major problem is still the language barrier. I found *P. lolot* in most scinetific articles as a synonym of *P. Sarmentosum*. In this work, I was not focused on comparing the description of *P. sarmentosum* by Roxborough and *P. lolot* by Candolle. Since their description is not sufficient for a correct judgment. For any from these two hypoteses, that *Piper lolot* C. DC. and *Piper sarmentosum* Roxb. There are two different types or the same botanical synonym. Similarly, the information that I compared in Tab.: 6 wasn't sufficient for proper botanical identification. Because the inflorescence wasn't in the same character. The second method based on the comparsion of these two herbaria dried form of the habit, wasn't made in this search. The solution would be if a, person, ethnobotanist has done a research on a comparison of the two designated plants *P. sarmentosum* and *P. lolot*. This determination should be made by the original inhabitants of the area such as Vietnam, which is exactly the kind *P. lolot* original. Identification should be conducted under the same conditions and should be compared using the same methods. It is important to focus on the correct identification of the inflorescence and then the other defining features. What is the for determination of these two species and all plants in the genus of *Piper* species main determinative factor.

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Table 1: Summary of the taxonomic history of Piper (Jaramillo et al. 2008).

Knuth 1839	Miquel 1843-44, 1845	C. de Candolle 1869	C. de Candolle 1923	Trelease 1928-50	Trelease and Yuncker 1950; Yuncker 1972- 73	Callejas 1986	Tobbs 1993 a,b
<i>Piper</i>	<u>Muldera</u> <u>Piper</u> <u>Cubeba</u> <u>Chavica</u> <u>Peltandron</u> <u>Euchavica</u> <u>Sphaerostachyon</u>	<u>Schizonephos</u> <u>Eupiper</u> <u>Apopiper</u>	<u>Muldera</u> <u>Eupiper</u>	<i>Piper</i>	<i>Piper</i>	<u>Muldera</u> <u>Piper</u> <u>Cubeba</u> <u>Chavica</u> <u>Peltandron</u>	<i>Piper</i>
<i>Enckea</i>	<u>Macropiper</u> <u>Coccobryon</u> <i>Enckea</i> <i>Callianira</i>	<u>Coccobryon</u> <u>Enckea</u>	<u>Macropiper</u> <u>Coccobryon</u> <u>Enckea</u>	<u>Macropiper</u> <i>Anderssoniopiper</i> <i>Discipiper</i> , <i>Lindeniopiper</i> <i>Arctotonia</i> <i>Pleiostachyopiper</i>	<u>Macropiper</u> <u>Coccobryon</u> <i>Arctotonia</i>	<u>Enckea</u> <u>Arctotonia</u>	
<i>Schilleria</i> <i>Otonia</i>	<u>Sphaerostachys</u> <i>Otonia</i>		<u>Otonia</u>	<i>Otonia</i>	<i>Otonia</i>	<i>Schilleria</i> <u>Otonia</u>	<u>Otonia</u>
<i>Heckeria</i>	<u>Pothomorphe</u> <i>Peltobryon</i>	<u>Pothomorphe</u>	<u>Heckeria</u>	<i>Pothomorphe</i> <i>Trianaeopiper</i>	<i>Pothomorphe</i> <i>Trianaeopiper</i>	<u>P.politii-complex</u> <u>P.marginatum-</u> <u>complex</u> <u>Peltobryon</u> <u>P.nudifolium-</u> <u>complex</u> <u>Trianaeopiper</u>	<u>Lepianthes</u>
<i>Steffensia</i>	<u>Artanthe</u> <u>Isophyllon</u> <u>Churumayu</u> <u>Radula</u> <u>Leiophyllon</u> <u>Otonioides</u> <u>Nhandi</u> <u>Saliunca</u> <u>Hymenophyllon</u> <i>Nematanthera</i> <i>Rhyncholepsis</i> <u>Macrostachys</u> <u>Hemipodion</u> <i>Zippelia</i>	<u>Steffensia</u> <u>Nematanthera</u> <u>Carpunya</u>	<u>Steffensia</u> <u>Nematanthera</u> <u>Carpunya</u>	<i>Sarcorhachis</i> (= <i>Manekia</i>)	<i>Sarcorhachis</i>	<u>Steffensia</u> <u>Isophyllon</u> <u>Churumayu</u> <u>Radula</u> <u>Nematanthera</u> <u>Macrostachys</u> <u>Hemipodion</u> <u>Sarcorhachis</u> <u>Zippelia</u>	<u>Churumayu</u> <u>Radula</u>

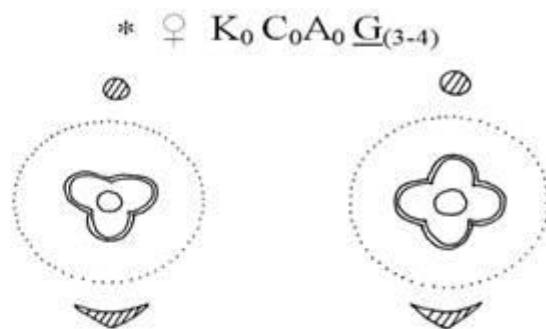


Fig.: 1. Floral formula of *P. lolot* (DIM Ho Chi Minh 2010).



Fig.: 2. Growth habit of *P. lolot* (DIM Ho Chi Minh 2010).

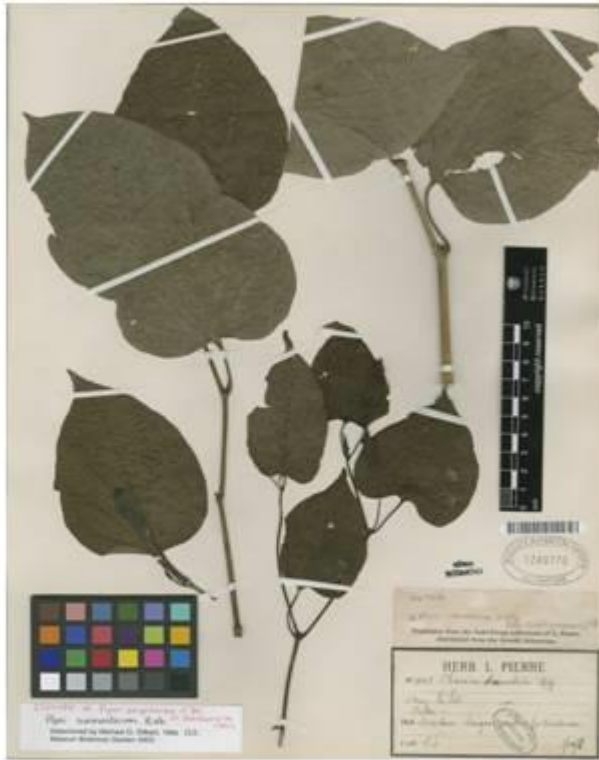


Fig: 3 *P. Sarmentosum* (Tropicos. Org, 2013).



Figure 131. 1-6. *Piper hagenii* Lintner, n. sp. in fl. —1. Male flowering branch. —2. Leaf from lower portion of plant. —3. Male inflorescence portion. —4. Inflorescence. —5. Detail from male flower showing stam and ovary. —6. Detail from male flower showing ovary and stamen. —7-10. *P. sarmentosum* Roxburgh, W.B. in fr. —7. Male flowering branchlet. —8. Male inflorescence. —9. Female inflorescence. —10. Detail from female flower. (POC 119, FRPS 20(1): 84, pl. 18, 1982. —R.F.S. Hoang (drawing))

Fig: 4 The drawing of *P. sarmentosum* (Tropicos.org, 2013).



Fig: 5 *P. sarmentosum* (NYBG, 2003).



Fig: 6 Copies of illustration *P. sarmentosum* by Roxburg. Published in *Flora Indica* (Kew, 2013).