Ethnobotanical Study of Ritual Plants used by the Bai People of Shaxi, Southwest China

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February 2011

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Cover Picture:
Bai woman pouring incense powder onto an incense heap (Hess 2010).

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Abstract

The first part of this study documents local uses of ritual plants among the Bai people in the Shaxi Valley, in the biologically and culturally diverse Hengduan mountain region of Southwest China (Yunnan Province). In total, the uses, and use contexts of 24 ritual plant species from 16 botanical families were documented. The documented species are incense plants (17 spp.), special food plants (4 spp.), ghost plants (2 spp.), and others (1 sp.), and are used in various religious contexts. In Shaxi, ritual fumigations are conducted for the communication with spiritual entities, and in some cases also for personal well-being, and to strengthen self-awareness. Interview and observation data suggest that Cupressus funebris, Gaultheria fragrantissima, and Ligustrum sempervirens are the mainly used incense species, and that the smell of the smoke is the foremost quality for which incense species are selected.

In the second part, the dynamic headspace sorption method was successfully adopted for the first time to collect volatile organic compounds (VOCs) of incense smoke. The VOCs of eleven incense species from Shaxi were qualitatively and quantitatively analyzed using gas chromatography-mass spectrometry (GC-MS). In total, 38 VOCs were tentatively identified and comprised mainly monoterpenoid (10), sesquiterpenoid (7), benzenoid (6), and methoxy phenolic (6) compounds. In accordance to literature, the detected terpenoid, and benzenoid compounds represent good candidates for being at least partly responsible for the pleasant odours of the smokes. Besides, Diethyltoluamid, a potentially strong pharmacological agent, and insect repellant, was detected in smoke of four species. Multivariate analysis of their volatile profiles reveals that the species are well clustered intraspecifically and separated interspecifically. Gaultheria, Ligustrum, and Cupressus were the best separated species, and, at the same time, were frequently found in the incense mixtures for censer use. Local incense producers thus seem to prefer species for their mixtures which allow for a most divers olfactory bouquet when burnt.

The presented results of both parts of this study enable to portray the diversity of cultural and potential pharmacological aspects of ritual, especially incense plant uses in Shaxi.

Acknowledgements

This study would not have been possible without the help of a number of people. In particular, I am highly thankful to the following persons:

Dr. Caroline Weckerle for giving me the opportunity to conduct this research in Shaxi, and for all the valuable inputs, and discussions on my work.

The Inhabitants of Shaxi for their kind, and patient participation in the study, especially the Ouyang family for their openness and hospitality.

Chen Yulin for his amicable accompaniment, and assistance as interpretor in the field.

Prof. Dr. Florian Schiestl for enabling me to conduct the chemical analysis, and for the valuable inputs, and discussions on the work.

Dr. Ed Connor for sharing his technical expertise on the chemical analysis, and for his valuable inputs on the work.

Prof. Dr. Yang Yongping, Kunming Institute of Botany Chinese Academy of Sciences, for organizing the research permits for Shaxi.

Christina Maurer for English proofreading.

Lukas Meier for his support as graphics designer.

Klara Hess, and Astrid Ehlert for their lively photographies.

Matthias Geck for helping me with the identification of some of the plant specimens collected during the field research.

The study was financially supported by the Baumann Stiftung.

1. Introduction

Currently, humanity is facing a massive erosion of cultural and biological diversity (Kauai Declaration 2007, Cox 2000). With the ongoing loss of cultures, distinct philosophical and pragmatic approaches to the organization of life diminish, and opportunities to achieve sustainability in the future decline (Kauai Declaration 2007). Ethnobotany is recognized as a way to document, analyze, apply, and preserve traditional knowledge held by ethnic groups around the world (Cox 2000).

1.1 Ethnobotany

In its widest sense, ethnobotany is termed the „[...] science of people's interactions with plants." (Turner 1995:264) and is based on a transdisciplinary research approach that incorporates methodologies and concepts of disciplines like botany, cultural anthropology, ecology, medicine, and pharmacology. In more detail, it is also called

> „[...] the study of the interactions and relationships between plants and people over time and space. This includes the uses, knowledge, beliefs, management systems, classification systems, and language that both modern and traditional cultures have for plants and their associated terrestrial and aquatic ecosystems." (Kauai Declaration 2007:1).

Ethnobotany is used to document traditional knowledge,[1] which is considered critical for

> „[...] the preservation of the integrity of the cultures that possess it, and important for us all to understand, record, and, when appropriate and helpful, apply in other situations. The capacity to innovate and to share lessons learned is a quintessential human characteristic [...]" (Kauai Declaration 2007:2).

Ethnobotanical knowledge is also used in development planning and policy-making processes to devise solutions for resource management decisions, and vice versa to study the effects that policies have on resources and the communities relying on these resources (Alcorn 1995, Balick and Cox 1996:179-208, Varghese and Ticktin 2008). Finally, ethnobotany is considered useful to interpret and understand past interactions of humans and ecosystems in the palaeo and archaeobotanical record (Alcorn 1995).

1.1.1 Historical Aspects

In the 1890s, John Harshberger (1869-1929) first coined the term ethnobotany in his publication The Purposes of Ethnobotany, which is generally accepted as its origin as a scientific discipline (Balick and Cox 1997:3). According to Harshberger, ethnobotany can (1) help to classify tribes through variations in their plant uses, (2) indicate trade routes and historical distributions of plants

1 In the literature, ‚local', ‚indigenous', ‚traditional ecological knowledge' (TEK), etc. are used to describe different modes of knowledge in opposition to ‚scientific knowledge' (e.g. Berkes 2000). Despite the ambiguities inherent to such terms, the strict dichotomization has been relativized (Agrawal 1995). A discussion of this issue can be found in Büeler (2010).

used by humans, and (3) promote the discovery of new commercial products (Heinrich 2010:10). Harshberger‘s contribution was preceded by other researchers who studied plant uses by diverse ethnic groups around the world, like Carl von Linné (1707-1778) or Alexander von Humboldt (1796-1859; Heinrich 2010:9). Besides Linné‘s groundbreaking introduction of the modern binomial nomenclature, he also documented the everyday plant use by the Sami in Lapland in the 1730s, for which he is called a pioneer ethnobotanist (Balick and Cox 1997:28-29). Another prominent ethnobotanist was Richard Evans Schultes (1915-2001), who documented innumerable uses of economically valuable plants by ethnic groups across the Americas and contributed to the methodological development of participant observation (Balick and Cox 1997:21). Among his most remarkable achievements is the documentation of the rituals and the beliefs that contextualize the use of the sacred mushrooms of the Aztecs (Teonanacatl) around 1940 (ibid).

Early ethnobotanical studies were largely shaped by economic and imperialist motives (Alcorn 1995). While these early studies tended to analyze the studied knowledge system largely from etic perspectives, later research, from the 1950s onwards, turned out to be rather emic (Clément 1998). At that time, there were two more or less distinct categories of ethnobotanists – the economic botanists, searching for new plants of potential commercial value, and the ethnoscientists, studying how people perceive and manage their environments (Clément 1998, Martin 1995:224). Since the late 1960s, the research topics changed towards more developmental and conservational problems (ibid). The late 1980s and early 90s were characteristic for a growing awareness of „[...] an inextricable link between cultural and biological diversity [...]“. [2](Maffi 2005). The trend for a growing recognition of the interrelations between nature and humans led to the conceptualization of biocultural diversity, which was recently defined as the

> „[...] total of the world’s differences, no matter what their origin. It includes biological diversity at all its levels, from genes to populations to species to ecosystems; cultural diversity in all its manifestations (including linguistic diversity), ranging from individual ideas to entire cultures; and, importantly, the interactions among all of these.“ (Harmon and Loh 2005:1).

The growing awareness of the ‚linkage‘ of humans and nature also influenced the Convention on Biological Diversity, (CDB) [3] (Maffi 2005). The parties of the Convention are encouraged to

> „[...] respect, preserve, and maintain knowledge, innovations, and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity [...]“. (Article 8j, CBD 2010)

2 Excerpt from the declaration of Belém from 1988. For the declaration text, see http://www.ethnobiology.net/global_coalition/declaration.php

3 The aims of the convention are (1) biodiversity conservation, (2) sustainable use of biodiversity, and (3) fair and equitable sharing of the benefits arising from the use of biological resources; for details see http://www.cbd.int/ . The Bonn guidelines, published in 2002, are intended to assist the signing parties of the CBD in the process of obtaining access and benefit sharing (ABS).

Exemplary areas of biocultural diversity are: material culture, language, knowledge, and technology (e.g. resource-processing techniques), resource management (e.g. forestry), social relations (e.g. land use policies), sacred sites, and rituals (UNESCO 2007).

1.1.2 Ritual Plants

Ritual plants are plants that people make use of for rituals. Such plants can be used for ritual healing (e.g. Rodrigues and Carlini 2006), as hallucinogens (e.g. Frenopoulo 2005), as incense or decoration for the communication with spirits (e.g. Büeler 2010, Weckerle et al. 2006), or they can constitute sacred entities like trees (Dafni 2007).

Rituals can be defined as ‚*Rites de Passage*', a term introduced by the anthropologist Arnold van Gennep in his work *Les Rites de Passage* in 1909 (Encyclopædia Britannica, 2010). In short, such rites are

> „[...] rituals which transport a person from one condition or social status to another, such as the rites of birth, puberty, marriage, or death [...]" (Classen et al. 1994).

Another way of defining a ritual is that it (from lat. Ritual from ritus: established form, custom) consists of specific symbolic cultural actions which ensure and reinforce tradition and identity of a collective through continuous and repetitive memorization (Brockhaus Enzyklopädie 1992). Therefore, rituals enable to pass norms and values to future generations and belong to the processes that visualize the common origin which (besides other factors) constitutes culture. (ibid).

1.1.3 Incense in Rituals

Ritual and religious uses of plant-derived smokes [4] are documented of around 400 species for 570 uses and so constitute the second largest use category of plant-derived smokes, after medicinally used smokes (in Pennacchio 2010:3). Ritual smokes can be actively inhaled, or passively as ambient smoke.

The use of incense in rituals [5] is documented in many cultures (e.g. Bhattarai et al. 2006, Case et al. 2003, Weckerle et al. 2006). In the case of Judeo-Christian tradition, the smell of incense can evoke such strong associations that its perception is a signifier of religious activity (Kenna 2005). Multiple factors explain this association of the smell of incense with religious practice. First,

> „[...] smells are both part of what they convey (the smell of food comes from real food), but in addition, they also convey the idea of what they come from, the idea of eating, of a meal, of commensality [...]. It is precisely because smells are disembodied that they are good for expressing an ideal or absolute truth which hovers on the edge of actualization (the incense smoke drifting upwards hunts at the ideal order)." (Kenna 2005:65)

4 Smoke (an aerosol) is a mixture consisting of a solid and/or a liquid and a gaseous phase that is generated through burning or smoldering. The fundamental chemical mechanisms underlying smoke production are burning (an exogenous chemical reaction with oxygen) and pyrolysis (chemical breakdown of larger into smaller molecules by high temperatures). (Brockhaus Enzyklopädie 1992)

5 Latin: incendere, „to burn" (Oxford Latin Dictionary, 1968).

Second, smells can be used in rituals because of their ability to evoke intense emotions that are linked to strong memories [6](Classen et al. 1994:2, Kenna 2005).

Third, incense often smells religious, because

> „[...] smells (like sounds) do not have clear boundaries; we can smell something at a distance from the source of the smell itself (the smell of something cooking; the smell of the sea; the smell of a person on their discarded clothes or on bedlinen). Smells cross the boundaries of place and time.“ (Kenna 2005:64-65)

This boundary-crossing nature of smell

> „[...] is often made use of to help the participants in a rite of passage – for example, a funeral – to cross over from one stage to the next: they are symbolically wafted along with the olfactory flow.“ (Classen et al. 1994:123)

Finally, incense smoke has the integrative power to unify the participants of a ritual because of the all-enveloping aromatic atmosphere it creates (Classen et al. 1994:123). The smoke of incense is probably just as important for its association with religion as its smell, since it can help to visualize the invisible, like sunbeams or air movements.

1.2 Research Goals

The Shuhi and other ethnic groups in the Shuiluo valley in South-West China use ritual and incense plants for various religious purposes (Büeler 2010, Weckerle et al. 2006, 2005a, 2005b). The Shuhi select incense plants based on habitat as well as the type and the smell of the smoke (Weckerle et al. 2006).

In Shaxi, another remote valley in the Hengduan mountains, Ineichen (2007) indicated the existence of yet undocumented ritual and incense plant knowledge. This study thus aims at the documentation and comparative analysis of the contemporary ritual plant uses by the local population, including the related knowledge, practices, and beliefs. In detail, the present study seeks to document

- the locally used species, including their scientific as well as local names
- the ritual practices, including the preparation and the actual use of the plants
- the beliefs associated with the use and the meanings of and reasons for the use.

Since a large part of the used ritual plants consists of incense plants, additional aims are

- the characterization of the main volatile compounds present in the smoke of used incense plants
- the comparative analysis of the volatile compound patterns.

6 For the same effect, smells are used in aromatherapy (Hänsel and Sticher 2007:467-468) and so-called aroma-chology, the study of the relationships between psychology and odorant technology (Jellinek 1996).

1.3 The Study Area

Shaxi township (Jianchuan county, Dali prefecture) lies in the North-West of Yunnan province, roughly between the two cities Dali and Lijiang (Figure 1A). Shaxi encompasses an area of 288km^2 and consists of a high plateau at an altitude of about 2‘100 meters a.s.l. which is flanked by two mountain chains that delimit the valley in the west and east and reach heights of up to 3‘100 meters a.s.l. (Feiner et al. 2002, Ineichen 2007). Due to its geographic situation the township is also termed ‘Shaxi valley’, a remote valley located “[...] in the foothills of the Himalayas and locked into a dead-end situation [...]” (Feiner et al. 2005:196). The Hengduan mountain range, in which Shaxi is located, is known for its rich biological diversity and recognized as one of the 25 top global biodiversity hotspots by Conservation International, comprising 12,000 plant species, including 3,500 endemics (Myers et al 2000). The region is also noted for harboring a remarkable cultural diversity (Hsu 1998).

1.3.1 Recent Research

Shaxi has been in the focus of earlier studies: Ineichen (2007) documented local medicinal plant knowledge and the potential of medicinal plant cultivation as a means for sustainable development and poverty alleviation. Weckerle et al. (2009) investigated local medicinal plant knowledge and its relation to Chinese mainstream herbal medicine. Huber et al. (2010) focused on livelihood and conservation aspects of the Non-wood Forest Product (NWFP) collection, and Hess (2010) studied the integration of the ‚western‘ and Chinese medicinal systems in a small medical office.

1.3.2 Climate and Vegetation

The frost season in Shaxi starts in the middle of October and ends in the middle of April with an average temperature of 12.2 degrees Celsius. The annual precipitation is 740-790mm, with a rainy season from June to September (Morel and Forster 2002). Heihui river, ultimately a Mekong tributary, flows through the fertile valley bottom in a north to south direction and is mostly enclosed by farmland (i.e mainly rice paddies) and settlements. The adjacent mountains are largely vegetated with subtropical mixed pine (*Pinus yunnanensis*) and oak (*Quercus* spp.) forest (Figure 1B). This vegetation type is also referred to as subtropical conifer forest (SCF), a species association that displaces subtropical evergreen broad-leaved forest (SEBF) in heavily disturbed habitats (for more details see Ineichen 2007, Li and Walker 1986).

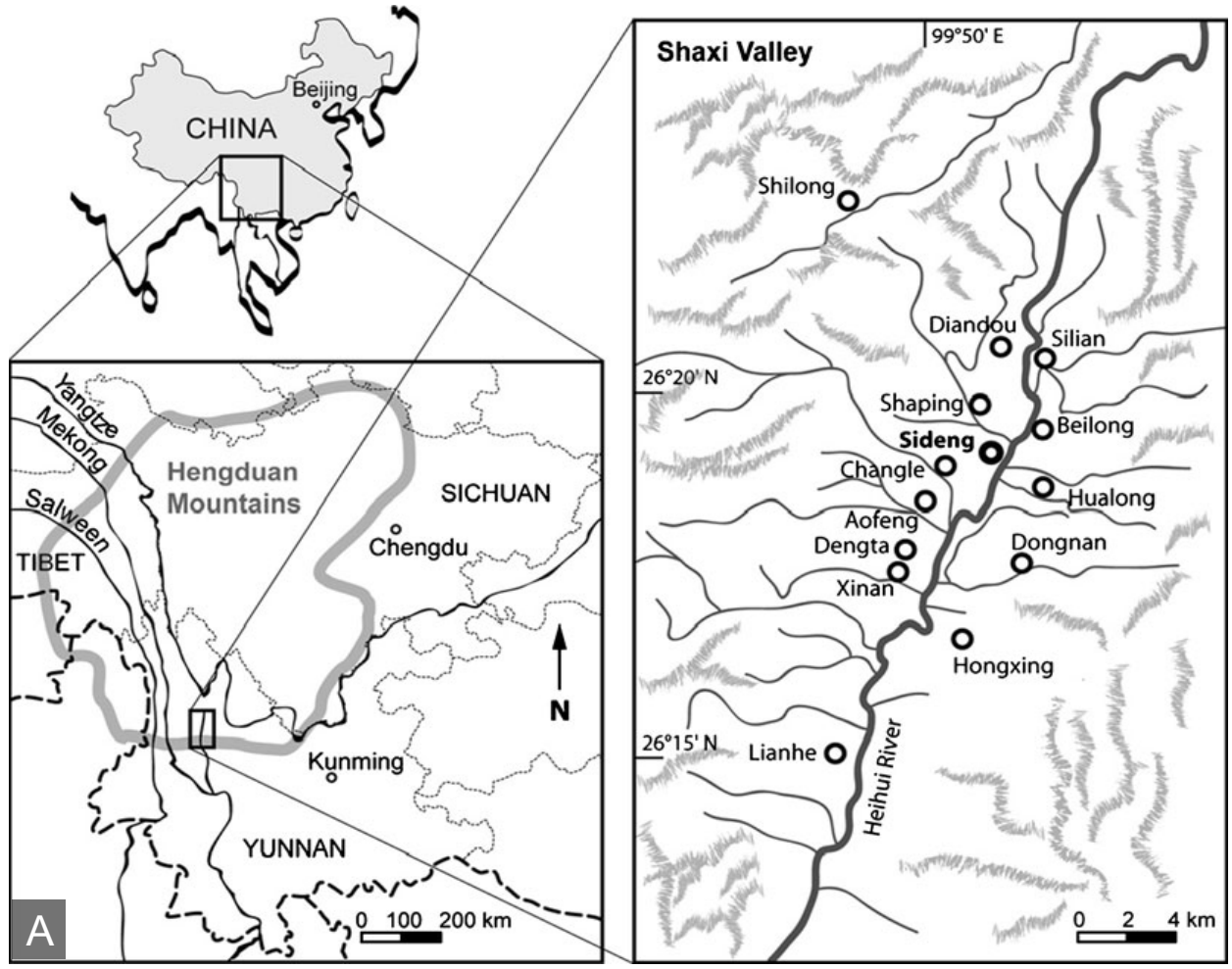


Figure 1

A Location of the study area in Southwest China and the village groups of Shaxi (from Huber et al. 2010).

B The Shaxi valley. Slopes harbor subtropical conifer forest, which is typical for anthropogenically heavily disturbed areas (Staub 2010).

1.3.3 Historical Aspects

The present-day civilization in the valley has been preceded by human inhabitance for a long time. First traces of rice cultivation are documented from ca. 1700 BC, and first signs of a civilization are documented from the late Shang Dynasty (1523 BC-1027 BC), which presumably arose from semi-nomadic communities (Katzen 2002 and references therein). The predecessors of the present day Bai and Yi inhabiting Shaxi are considered to have formed the basic population of the Nanzhao Kingdom from the 8th until the early 10th century AD. After the downfall of the Nanzhao Kingdom, the Bai established and retained a prevailing position within Yunnan (Backus 1981:46-52).

Shaxi, especially Sideng, acted as an important stopover along the Tea and Horse Caravan Trail, a trade route that connected Southwest China with Tibet and India (Yang 2004). The first traces of the trail date back to the period of the Tang dynasty (618-907 AD). Its most prosperous period was during the Ming Dynasty (1369-1644 AD), and it underwent further development during the Qing Dynasty (1644-1911 AD). The trail was mainly used for the trade of Chinese salt, sugar, and tea, in exchange with Tibetan (war-) horses. Besides the trade of goods, the trail also facilitated cultural exchange (Yang 2004). The intermixture of local and foreign cultural elements in Shaxi is reflected in reliefs in the Shizhong Temple grottoes in the Shibaoshan area and shows local traditional architecture together with foreign (e.g. Tibetan or Persian) cultural elements (Feiner et al. 2002). The history of the Tea and Horse Trail, and thus also Shaxi‘s role as flourishing regional trade center, ended with the political changes and the motorized transportation introduced in the 1950s (Feiner et al. 2002). The closure of the trail had a significant economical impact on Shaxi, which had been largely dependent on the trade route (Katzen 2002). At that time, many socio-economical spheres were subject to change. Sideng became the center of the new local government, new infrastructure (the first hospital and a new school) was created, and new industrial and agricultural practices were established (for a detailed historical description see Katzen 2002).

This political turmoil and Shaxi‘s elevated, rural, and interior geographical position are considered the main reasons why it has remained poor and underdeveloped since then. On the other side, and compared to other places, the lack of economical development is regarded as central for the survival of much of Shaxi‘s countryside and cultural heritage (Feiner et al. 2002).

In 2002, the World Monument Fonds (WMF) listed Sideng‘s old market area as one of the 100 most endangered heritage sites, since it “is the only surviving example of a way station on the Tea and Horse Caravan Trail, with an intact theater, guesthouse, temple complex, and gate” (WMF, 2006). Since then, the Shaxi Rehabilitation Project (SRP), a joint project of the Swiss Federal Institute

of Technology Zürich (ETH) and the People's Government of Jianchuan County, seeks to realize an integrated „preservation of the site and the improvement of the economic and ecological situation of the valley [...]" (Feiner et al. 2002:84). The still ongoing project aims at (1) the sustainable rehabilitation and development of the valley, (2) the preservation of historical assets of Sideng and the whole of Shaxi, especially (3) the restoration and re-integration of Sideng's old market place, and (4) the establishment of a model for sustainable rural development (Feiner et al. 2002). In the meantime, the project leadership has been transferred solely to the government of Jianchuan.

1.3.4 Economy

The average annual per-capita income in Shaxi was around 1,170 CNY in 2004, which corresponds to about 141 USD [7](Ineichen 2007, Huber et al. 2010). The main income sources for large parts of the population are agriculture, livestock, and the trade of mushrooms, of which the latter is especially important for the people living in the hills (Huber et al. 2010). Small parts of the population work in the construction, the industrial, the transportation, and the gastronomic sectors (Ineichen 2007).

Agriculture is dominated by the cultivation of rice and tobacco in the valley bottom and corn, beans, and potatoes in the surrounding hills. Besides these crops, barley, wheat, rapeseed, chili, and bugleweed are also grown, depending on the altitude and the exposition. (Huber et al. 2010)

1.3.5 Demography

In 2004, the commune of Shaxi comprised approximately 23'000 inhabitants, of which the majority or 85.1% belonged to the Bai, 11.2% were Han, 2.4% Yi, and 1.3% Lisu (Ineichen 2007). Population forecasts expect approximately 34,000 people to inhabit Shaxi by the end of 2020 (Feiner et al. 2002). While the Bai and Han usually inhabit the fertile valley bottom, members of the Yi and Lisu live in scattered settlements in the flanking western and eastern mountains (Huber et al 2010).

1.3.6 The Bai

As of 2000, the Bai population totaled 1.8 Million members, the majority of whom lived in China's southwestern provinces of Yunnan, Sichuan, and Guizhou (Schmitt 2007). In Yunnan, where one-third of the population accounts for ‚ethnic minorities', the Bai form the second largest group, after the Yi, roughly comprising 1.5 Million residents (CIBIK 2006; for more details on the term minority see Appendix). The official classification of the People's Republic of China puts the Bai language close to the Yi branch in the Tibeto-Burman language family (Ma 1998). However, among

7 In December 2004, 1 USD was equivalent to 8.2765 Chinese Yuan.

linguists, still no consensus has been reached on the relationship of Baic to other languages (for a detailed discussion see Schmitt 2007), since it contains elements similar to Tibeto-Burman, Chinese, and Tai or Mon-Khmer (Ramsey 1987:290).

2 Research Methodology

Fieldwork in Shaxi was conducted for a total of one and a half months in September 2009 and May and June in 2010. During this time, interviews and participant observation were carried out to document local ritual plant use and knowledge.

2.1 Interviews

Due to the quite exploratory research question, aiming at a yet unstudied domain of species, and because of the short duration of field work, a rather open sampling strategy was chosen. Informants were chosen using the complementary strategies of snowball, purposive, and convenience sampling, which are all described in detail in Russell (2006:186-194). In particular, snowball sampling was pursued after interviews, when informants were asked to suggest further knowledgeable informants. Contrary to the expectations, this did not work out well; few informants were willing to recommend other informants. Convenience sampling was therefore the main sampling strategy, and people who were met by chance were asked for an interview. For incense producers and temple custodians, purposive sampling was chosen, since these informant categories are crucial for a better understanding of ritual plant use and hard to sample by chance.

Informal conversation, unstructured, semi-structured, and structured interviews (described e.g. in Russell (2006)) were carried out in Chinese with the help of an interpreter, who was already familiar with the research area and fluent in English and Mandarin. The interviews were carried out with a total of 47 informants from Sideng (20), Changle (9), Shibaoshan (3), Silian (3), Diantou (2), Dongnan (2), Shaping (2), Aofeng (1), Bailongtan (1), Hongxin (1), Meiling (1), Xinan (1), and Zongdeng (1). The average age of all informants was over 55 years, 25 were female, and 22 were male. Of all informants, 44 belong to the ethnic group of the Bai, two informants were Han, and one was Yi (see detailed list in Appendix).

Figure 2 shows the distribution of ages between male and female informants. While female informants of all ages between 20 and 83 years (50.3±22.4 years) were interviewed, only four males below the age of 60 years acted as informants (overall age 24-86 years; 64.1±15.2 years). An additional problem was that it turned out to be hard to conduct interviews lasting longer than half an hour. This, together with the difficulty of finding enough informants, especially male ones, and the fact that snowball sampling only worked in a few cases, very likely reflects seasonal aspects of the local agriculture: Fieldwork took place right during the busy period of buckwheat harvest and

the planting of tobacco and rice saplings, and many informants refused to participate in scheduled interviews due to pending labor. As a consequence, fewer and shorter interviews than planned were carried out, which resulted in a lack of quantitative data.

Semi-structured interviews were conducted with an interview guide (see Appendix) covering questions on the topics of incense plant knowledge, uses, and associated beliefs. Structured interviews were carried out on ritual plants, using representative parts of mentioned species that were bagged in transparent plastic jackets. These were shown to the informants, who were asked to tell the plant‘s name, its uses, the used parts, and how these are used. Use reports (e.g. see Weckerle et al. 2009), itemizing each mentioned combination of species name, plant part used, use, and name of informant were compiled for the analysis of information about relevant plant species.

The help of the interpreter was crucial for data collection. He was already very familiar with the study area and had certain relations to locals, which facilitated the social entry into the study population. However, the fact that the interpreter was fluent in Mandarin and English, but not in the local dialect of the Bai, turned out to be a limitation. Although the ability to speak Mandarin is very common with the Bai (and the Yi), it turned out to be difficult to interview especially older informants properly.

A cultural domain can be thought of as a category of ‚objects‘ which are mentally organized and related according to certain criteria. Groupings, also called pile sorts, are applied as a research technique to study such domains in a deep and standardized way (e.g. Büeler 2010). During fieldwork, several groupings of the locally used ritual plants were attempted. For this, the informants were given previously documented plastic-jacketed plants and asked to freely organize these plants into piles. The groupings did not work out well, since the informants raised logical questions regarding the set task. The clarifying intervention of the interpreter helped them to understand the exercise, but influenced the results in a suggestive manner. Possibly, the groupings were carried out too early during field work, with too few items to organize, so that the task made no sense to the informants.

2.2 Participant Observation

Participant observation was undertaken to complement the gathered interview data. Generally, participant observation can be used for many reasons when conducting scientific research on cultural groups (see Russell 2006:354-356). In this study, it especially enabled the collection of visual data on ritual occasions, such as the Dragon Boat Festival, and allowed to gain a better, more intuitive

understanding of the local culture. It further helped to cross-check interview data, allowed the collection of data that can't be gathered otherwise, and helped to create a mutual atmosphere of trust with the locals. However, compared with the traditional duration of anthropological field research of one year or more (Russell 2006:349), the field research phase of this study is short, and thus the conducted participant observation was rather observational than participatory.

2.3 Plant Material Collection

The relevant species were vouchered, and plant material for smoke analysis was collected. The specimens were identified at the herbarium of the Kunming Institute of Botany (KUN), following the nomenclature of the Flora of China. One set of specimens was deposited at the herbarium of Kunming Institute of Botany (KUN), another one was sent to the herbarium of the Institute of Systematic Botany of the University of Zurich (Z) for deposition.

2.4 Recording of Local Plant Names

The names of the local species were partly recorded on tape and can be provided upon request. The recordings were performed with the help of three Bai persons of different ages and both sexes.

2.5 Policy

Research was conducted according to the Convention on Biological Diversity (CBD), including the Bonn guidelines on Access and Benefit Sharing (ABS). The research and plant export permissions were organized by the Kunming Institute of Botany. Field research took place in agreement with the responsible local authorities of Sideng and Kunming and in prior informed consent with all informants. Regarding the sharing of benefits that arise through this study, the local deposition and exposition of a set of labeled specimens is planned. This will be realized in association with an ongoing medicinal plant garden project in Shaxi.

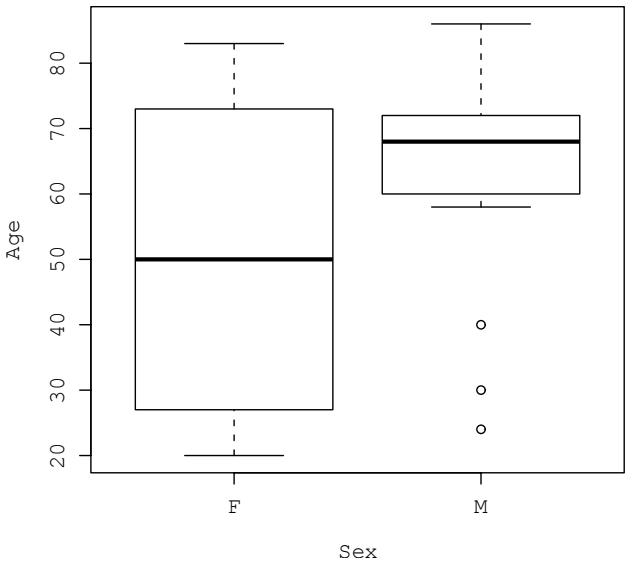


Figure 2

Ages of all informants, plotted against sex.

3 Ritual Plant Knowledge in Shaxi

In total, 375 use reports of 24 plant species in 16 botanical families were documented. Table 1 gives an overview of the species, their uses, and habitats. Knowledge on specific ritual plants differs considerably among the informants. Figure 3 shows a list of all species with five or more use reports, together with an agreement ratio of all informants who mentioned the respective species. The ratio measures the degree of agreement among the informants on whether specific species are used as ritual plants. Overall, 15 of the 21 species show an agreement of 50% or more. *Cupressus funebris* is the species with the highest agreement ratio (90%), indicating that most of the informants agreed on its use as a ritual plant. On the contrary, the use of *Cinnamomum glanduliferum* (23%) as ritual plant is controversial, as some informants questioned its ritual use. *Lyonia ovalifolia* (30%) and *Ternstroemia gymnathera* (50%) are two species that hint at the existence of generalist and specialist knowledge in the domain of ritual plants. Both species have low agreement ratios, no conspicuous smell, and were initially mentioned by the informant who produces incense for trade. These species are thus possibly used to stretch incense mixtures. Further and detailed information on plant uses is presented in the following.

3.1 Use Categories of Ritual Plants

An overview of the different use categories of the ritual plants in the Shaxi valley is presented in Table 2. The categories are based on interviews and observed uses. These categories are ‚incense plants', which are either burned as joss sticks or used in a censer, ‚ghost plants', which are used for the communication with spiritual entities, and ‚special food plants' consumed during the Dragon Boat Festival. One species is further planted on the tops of graves to support family development.

3.1.1 Uses of Incense

The category of incense plants includes 16 species from 12 different families, with an accumulation of Cupressaceae species (4 spp.). It comprises trees (7 spp.), shrubs (5 spp.), herbs (4 spp.), and one grass. The used plant parts are the leaves (9 spp.), branches (2 spp.), tubers (2 spp.), wood (2 spp.), root (1 sp.), aerial parts (1 sp.), the shoot axis (1 sp.), and the culm (1 sp.).

The species are always used as mixtures and are either burned in the form of powders in a censer or as joss sticks. According to most informants, the smell of the smoke is the main criterion for the selection of incense plants.

Table 1

The Documented plant species.

Scientific name	Family	Specimen number	Habit	Habitat	Local names[1]	Parts used	Uses[4]
Artemisia argyi Leveille et Vaniot	Asteraceae	100616-1/1	Herb	Fields	àiyè[3]	Aerial parts	RIT (MED), decocted together with other plants, drunk as tonic and against diarrhea[3]. Only used during Dragon Boat Festival.
Artemisia sp1	Asteraceae	100523-4/1 100530-1/1	Herb	Fields	bǎihāozǐ	Aerial parts	RIT, dried and rolled to balls burned as incense in a censer; OTH, leaves bagged and hanged around the neck as scented sachet[2,3], shoot axis dried used as chop sticks[2,3], whole plant placed in rice field as pesticide[2,3].
Artemisia sp2	Asteraceae	100528-1/1 100530-1/2	Herb	Fields	hēihāozǐ, qīnghāo	Shoot axis, Aerial parts	RIT, dried shoot axis used as stick for joss stick production[3]; MED, aerial parts topically applied against inflammations[2,3] and to stop bleedings[2,3]; OTH, aerial parts steamed to clean air[3], aerial parts rubbed to clean plates[2,3].
Basella alba Linnaeus	Basellaceae	100523-1/1	Herb	Villages	téngqī	Tuber	RIT, dried and powdered used as glue for joss stick production; CUL, tuber edible[2,3].
Bambuseae	Poaceae	100609-5/1	-	Villages	zhúzi	Culm	RIT, dried, split culms used as sticks for joss stick production.
Chamaecyparis cf. *obtusa* (Siebold & Zuccarini) Endlicher	Cupressaceae	100530-1/4	Tree	Villages	biǎnbǎi	Branches, Wood	RIT, dried and powdered branches and wood used as incense[2]; OTH, wood used to build coffins[2,3].
Cinnamomum glanduliferum (Wallich) Meisner	Lauraceae	100612-3/1 100607-2/1	Tree	Villages	xiāngzhāng	Fruits, Leaves, Wood	RIT, leaves dried and powdered used as incense[2]; CUL (MED), fruits edible, chewed against stomach ache[2]; OTH, wood is insect repellent therefore used to build containers for clothes[2,3].

Table 1

(continued)

Scientific name	Family	Specimen number	Habit	Habitat	Local names[1]	Parts used	Uses[4]
Cornus oblonga var. *oblonga* Wallich	Cornaceae	100529-3/1 100608-1/1	Shrub	Mountains	luceizi[3], yiguizi[3]	Leaves, Wood	RIT, leaves dried and powdered used as incense; FUE, wood used as firewood[2,3].
Cupressus funebris Endlicher	Cupressaceae	100523-3/1 100608-1/3	Tree	Villages	xiubai, sōngbǎi, xiāngbǎishù	Leaves (Branches), Wood	RIT, leaves dried and powdered used as incense; wood chopped to match-sized pieces used as incense[3]; OTH, wood used to build coffins[2,3] and construct houses[2,3], branches placed in rice fields as pesticide[2,3].
Elsholtzia cf.	Lamiaceae	100618-1/1	Herb	Villages	zélán[3], cháiláng[3]	Leaves	RIT (MED), decocted together with other plants, drunk as tonic and against diarrhea[3]. Only used during Dragon Boat Festival.
Gaultheria fragrantissima Wallich	Ericaceae	100530-1/6 100619-1/1	Shrub	Mountains	fāngxiāngyóu	Aerial parts, Leaves, Fruits	RIT, leaves dried and powdered used as incense; CUL, fruits eaten raw[2,3]; MED, decoction of leaves used for postnatal washing[2,3]; OTH, leaves steam destilled to produce fragrant liquid[3], aerial parts placed in rice fields as pesticide[3].
Gonostegia hirta (Blume ex Hasskarl) Miquel	Urticaceae	100601-1/1	Herb	Villages	mùjué, nuòmǐcǎo[3]	Tuber (Leaves)	RIT, dried and powdered used as glue for joss stick production.
Imperata cylindrica (Linnaeus) Raeuschel	Poaceae	100527-1/1 100608-1/5 100609-1/2	-	Fields, Mountains	zǐsūncǎo	Whole plant	RIT, planted on top of graves to support prosperous family development.
Juniperus formosana Hayata	Cupressaceae	100530-1/3	Tree	Villages	cisong[3], cìbǎi, shānshù[3]	Leaves	RIT, leaves dried and powdered used as incense.
Juniperus squamata Buchanan-Hamilton ex D. Don	Cupressaceae	100530-1/5	Tree	Villages	cìbǎi, shānshù[3]	Leaves, Wood	RIT, leaves dried and powdered used as incense[2], wood chopped to match-sized pieces used as incense[3].

Table 1

(continued)

Scientific name	Family	Specimen number	Habit	Habitat	Local names[1]	Parts used	Uses[4]
Ligustrum cf. *sempervirens* (Franchet) Lingelsheim	Oleaceae	100529-2/1 100602-1/1 100608-1/4 100622-1/1	Shrub	Mountains	dongbuxiu, waibeizi[3], dòubànxiāng, xiāngyè	Leaves	RIT, dried and powdered used as incense.
Lonicera japonica Thunberg	Caprifoliaceae	100618-1/4	Vine	Villages	jīnyínhuā[3]	Branches	RIT (MED), decocted together with other plants, drunk as tonic and against diarrhea[3]. Only used during Dragon Boat Festival.
Lyonia ovalifolia (Wallich) Drude	Ericaceae	100609-4/2	Shrub	Mountains	xiumulu[3], geizimeimeixi[3]	Leaves	RIT, dried and powdered used as incense[2,3].
Pinus yunnanensis Franchet	Pinaceae	100529-4/1	Tree	Mountains	sōngshù, sōngbǎi[3]	Root	RIT, dried and powdered used as incense, used as fire powder on Torch Festival[2].
Pistacia weinmanniifolia J. Poisson ex Franchet	Anacardiaceae	100609-2/1	Shrub	Mountains	aixiang[3]	Branches	RIT, dried and powdered as incense.
Populus sp.	Salicaceae	100608-1/2	Tree	Mountains	baizou, baizong, báihuà[3], báichá[3], báiyángshù[3]	Branches	RIT, inserted into holes of gates and walls to prevent evil spirits and small animals from entering.
Prinsepia utilis Royle	Rosaceae	100529-1/1	Shrub	Mountains	z(h)ongdaqi, qīngcìguǒ, qīngpíshù[3]	Branches, Fruits (Seeds)	RIT, inserted into holes of gates and walls to prevent evil spirits from entering; CUL, fruits (seeds) collected and pressed for oil production, young leaves edible[2,3]; MED, seed-oil rubbed on skin against-inflammations[2,3].
Taraxacum sp.	Asteraceae	100618-1/2	Herb	Fields, Mountains, Villages	púgōngyīng	Whole plant	RIT (MED), decocted together with other plants, drunk as tonic and against diarrhea[3]. Only used during Dragon Boat Festival.

Table 1

(continued)

Scientific name	Family	Specimen number	Habit	Habitat	Local names[1]	Parts used	Uses[4]
Ternstroemia gymnathera (Wight & Arnott) Beddome	Theaceae	100609-4/1	Shrub	Mountains	azijixiu[3], xiangye	Leaves, Aerial parts	RIT, leaves dried and powdered used as incense[2]; OTH, aerial parts placed in rice fields as pesticide[3].

[1] Local names are transcribed using *pinyin* without tones for Bai names, and with tones for Han names.

[2] Use not observed during field work.

[3] Information mentioned by less than three informants.

[4] CUL, culinary use; FUE, fuelwood; MED, medicinal use; OTH, other uses; RIT, ritual use.

Table 2

Ritual plant categories based on interview and observation data.

Use categories		Species
Ritual plants		
Incense		
Burned in censer		
	Powders	*Chamaecyparis* cf. *obtusa* *Cinnamomum glanduliferum* *Cornus oblonga* var. *oblonga* *Cupressus funebris* *Gaultheria fragrantissima* *Juniperus formosana* *Juniperus squamata* *Ligustrum* cf. *sempervirens* *Lyonia ovalifolia* *Pistacia weinmanniifolia* *Ternstroemia gymnathera*
	Woods	*Cupressus funebris* *Juniperus squamata*
	Combustible agent	*Artemisia* sp1
Joss stick production		
	Sticks	*Artemisia* sp2 Bambuseae spp.
	Glues	*Basella alba* *Gonostegia hirta*
	Powders	*Cupressus funebris* *Pistacia weinmanniifolia* *Ternstroemia gymnathera*
	Combustible agent	*Pinus yunnanensis*
Ghost plants		*Populus* sp. *Prinsepia utilis*
Special food plants		*Artemisia argyi* *Elsholtzia* cf. *Houttuynia cordata*[*] *Lonicera japonica* *Mentha* sp.[*] Poaceae[*] *Taraxacum* sp *Zingiber* sp.[*]
Other		*Imperata cylindrica*

* No voucher specimen collected.

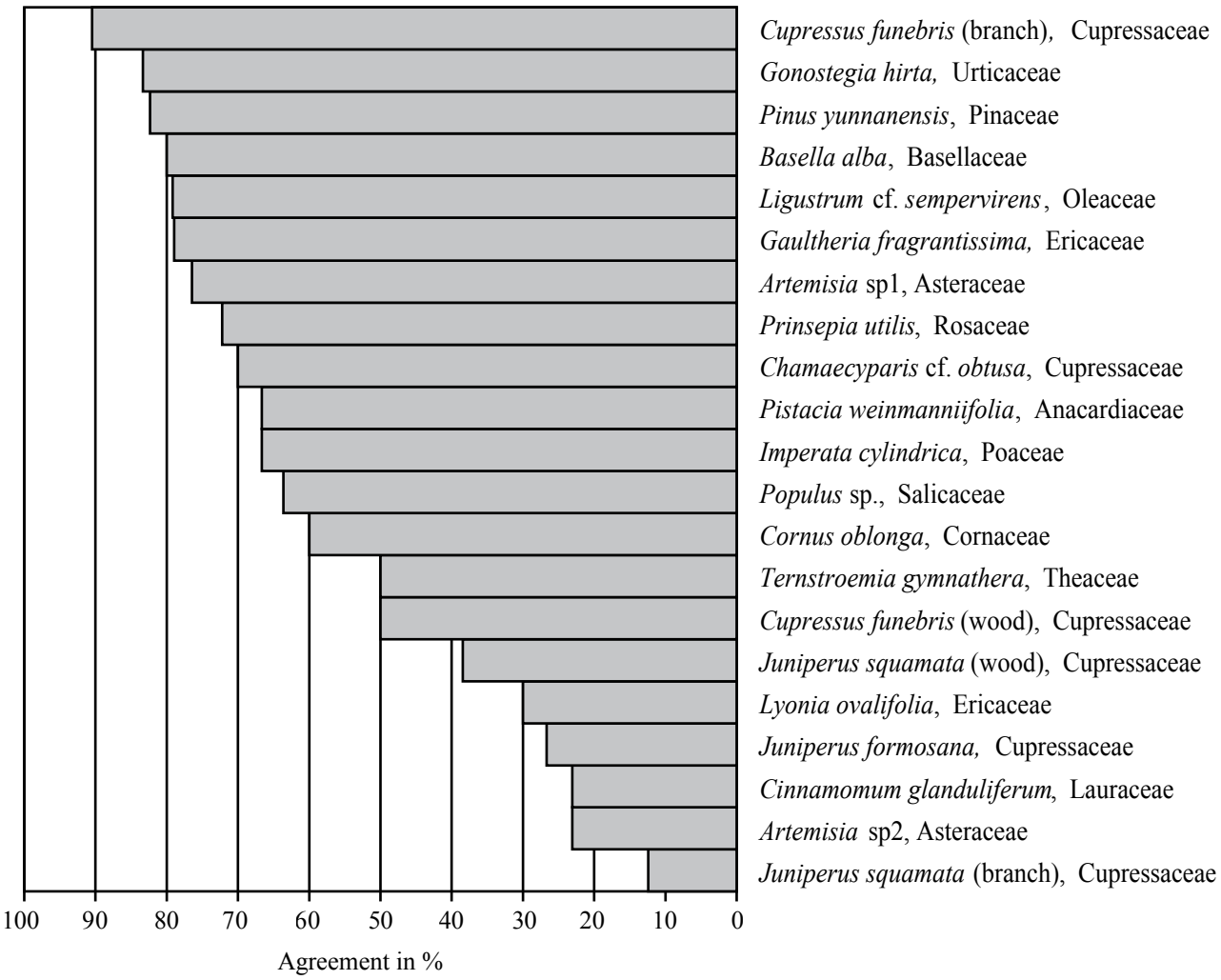


Figure 3

Agreement ratios of informants on ritual plant species with five or more use reports. Agreement ratios are calculated as the percentage of the number of informants who identified a specific species as ritual plant divided by the number of informants totally asked.

Incense Powders Burned in a Censer

For the burning of incense powder in a censer, three small match-sized pieces of *Juniperus squamata* or *Cupressus funebris* wood are placed on an incense heap. Then, a dried ball of *Artemisia* sp1 is lit and added to ignite both powder and wood (Fig. 4A). According to Chen Baoying,[8] *Cupressus funebris* wood is easily available and therefore more widely used, whereas that of *Juniperus squamata* has the better smell and is only used on special occasions. Furthermore, Chen Baoying explained that *Juniperus squamata* is more widely used in Tibetan areas, where, in general, better smelling incense is used. Regarding the special role of *Juniperus squamata* wood, her statement fits the observations in various temples in Shaxi: While incense powder, *Artemisia* sp1, and *Cupressus*

8 A Buddhist nun and custodian at the Haiyun Temple in Shibaoshan, Bai.

funebris wood were available free-to-use in almost all surveyed temples, the more exclusive wood of *Juniperus squamata* was only found in the uppermost temple of Shibaoshan. [9] In such very well equipped temples, incense powders are usually stored in wooden baskets (Fig. 4B) together with wooden spoons, which help to make use of the powder. In more simply furnished temples, the same materials are stored in plastic containers.

While smaller censers can usually be found in the prayer halls of temples, the larger, head-high incense burners are placed in the middle of temple courtyards (Fig. 4C). In these burners, larger amounts of incense are burned with small limbs of *Cupressus funebris* without *Artemisia* sp1.

According to some informants, incense mixtures are sold by regional wholesalers (Fig. 5A) with better access to resources, especially *Cupressus funebris* (Fig. 5B,C). A sale of these mixtures was said to also take place at the local weekly market, but was never observed during field studies. As mentioned by one informant, these powders are only sold at the market prior to larger festivals. One such wholesaler, a woman living in Jianglehe, was met, but due to time constraints, no interview was carried out. At this informant's home, large amounts of drying *Cupressus funebris* branches and wood were stored. She explained that her plant material originates from another township, since the material available in Shaxi is scarce. Her statement fits the observation that *C. funebris* cannot be found in the wild, but only in some schoolyards and temple compounds of Shaxi.

Incense burned as Joss Sticks

During field research, the production of incense sticks was observed on four occasions. The producers were Bai women between the ages of 54 and 80 years, and they produced the sticks in similar ways. Two kinds of sticks, red and green ones, are locally produced, traded, and used. For the production of red sticks, red cotton paper is laid out on a solid base and fixed on one side with a needle or a weight (Fig. 6A,B). Then, incense powder is evenly distributed over the paper. A wooden stick of about 50-55 cm length, made of split bamboo culm, a shoot axis of *Artemisia* sp., or other available wood, is held against the paper at an angle of ca. 30 degrees. The tip of the paper is folded over the stick, closing the upper end of the incense stick. Then, the stick is thoroughly rolled over the paper until the entire paper is twisted around. The remaining free tip of the paper is then glued onto the stick with an adhesive consisting of water-solved wheat flour.

For the production of green sticks, glue instead of paper is used to attach the incense powder to the stick. The same kinds of wooden sticks are dipped in water and a sticky powder, so that the sticks' surfaces become gluey. Sticky powders are made of sliced, dried, and later powdered tubers of either *Gonostegia hirta* or *Basella alba*. *Gonostegia hirta* is a formerly cultivated species that

9 Jindingsi, or the Golden Peak Temple, is a large but dilapidated and abandoned temple situated at an elevation of approx. 2700m a.s.l.. At the time of fieldwork it was undergoing partial restoration.

Figure 4

A Incense is burned in a small censer. Clumped aerial parts of *Artemisia* sp. ignite both powder and wood.

B Benzhu temple entrance in Sideng. Bai woman spoons incense from a wooden basket on to a smoldering heap of *Artemisia argyi*.

C Large incense burner in the Haiyun temple courtyard. Bai woman adding incense powder to smoldering *Cupressus funebris* limb. (all by Staub 2010).

Figure 5

A Incense producer from Dongnan village harvesting *Cupressus funebris* from a nearby schoolyard.

B,C Two fragrant incense plants: *Cupressus funebris* (Cupressaceae; left) and *Gaultheria fragrantissima* (Ericaceae; right; all by Staub 2010).

Figure 6

A, B For red joss stick production, cotton paper is folded over a stick, and wrapped around it (both by Staub 2010).

nowadays can be found in abandoned fields and is preferred over the weedy growing *Basella alba* because of its better adhesive quality. After becoming gluey, the sticks are again dipped in water and covered with dried root of *Pinus yunnanensis*, which improves combustibility.[10] Once again, the sticks are dipped into water and covered with incense powder. The procedure of glueing incense powder onto the sticks is repeated until the sticks are of the desired thickness. Finally, the sticks are kneaded to straighten their shape and let to dry. The red and green sticks are sold by the producers for approximately 1 Yuan [11] per bunch of 20 sticks at the local weekly market (Fig. 7A,B).

The plant material is usually collected by the producers themselves in the surrounding fields and mountains. Unfortunately, none of them could be accompanied, since the collection of materials happens during less busy times, i.e. in winter.

Species Composition

Eight different powders for censer use and three different ones for joss-stick production were collected from temples, incense users, and producers. Table 3 shows the species composition of the powders. In all but one powder, *Cupressus funebris* is present, suggesting its role as basic ingredient of the mixtures. Regarding powders for censer use, *Gaultheria fragrantissima* and *Ligustrum sempervirens* are also frequent components. The central role of these three species is also supported by interview statements and their high agreement ratio. One powder for joss stick production, besides *Cupressus funebris*, also contains amounts of *Pistacia weinmanniifolia* and *Ternstroemia gymnathera*, two species with intermediate agreement ratios of 67% and 50%, respectively.

Both the joss-stick and the censer-use mixture compositions vary. However, both have *Cupressus funebris* as a basic ingredient in common. Although eleven species were named to be used as incense, only five are identified as compounds of the collected incense powders. Why the remaining six species do not occur in the mixtures is uncertain. Possible explanations are that the informants did not know the exact composition or that they pretended not to know, in order to keep the details of their mixtures secret. Other potential explanations are that species which are not present in the mixtures are of facultative use (i.e., if other species are not available) or that they are used intentionally to stretch incense.

Confronted with the question whether some species are used to stretch or fake the powders, Ouyang Yingqi[12] explained that *Cornus oblonga*, *Ternstroemia gymnathera*, *Lyonia ovalifolia*, *Ligustrum sempervirens*, and *Cinnamomum glanduliferum* are indeed such species. A different opinion

10 *Pinus yunnanensis* root powder was also mentioned to be used as flash-producing fire powder at the Torch Festival.

11 In June 2009, 1 Chinese Yuan was equivalent to 0.146 USD.

12 Bai woman, resident of Sideng; 70 years old, retired.

Figure 7

A The materials for the production of red joss sticks comprise dry shoot axis (I), red cotton paper (II), wheat flour glue (III), sticky tubers (IV), dry *Pinus yunnanensis* root (V), and incense powder (VI; by Staub 2010).

B Joss-stick sale at the local weekly market in Sideng (by Ehrlert 2010).

Table 3

Compositions of the collected incense mixtures.

Mixture Number	*Cupressus funebris*	*Ligustrum sempervirens*	*Gaultheria fragrantissima*	*Pistacia weinmanniifolia*	*Ternstroemia gymnathera*
	Mixture constituents				
C1	x		x		
C2	x*	x*			
C3	x	x	x		
C4	x	x*			
C5	x				
C6			x		
C7	x*	x*			
C8	x				
S1	x				
S2	x				
S3	x			x	x

C Powders for censer use
S Powders for joss stick production
* Information gained through examination of the mixtures by the author

was expressed by Fang Qingmei,[13] who claimed that because of the currently increasing pressure resulting from the large number of incense producers, people were compelled to use the materials that are available. As a result of this, there are many ways of mixing species together.

3.1.2 Ghost Plants

Observations and interview data suggest that *Prinsepia utilis* and *Populus* sp. can be placed in the category of ghost plants. The uses of both species to ward off evil spirits, ghosts, or bad things were mentioned by many informants, and both species were observed to hang on many walls and gates of houses in Shaxi. Both species occasionally occur in the eastern mountains, where they are collected for use.

As mentioned by many informants, *Prinsepia utilis* branches are stuck into cracks in gates or house walls on the 1st of July (Fig. 8A). The 30th of June and the 14th of July were each mentioned once as alternative dates to hang up the branches. In any case, the use of *P. utilis*, according to Dong

13 Bai woman, resident of Changle; 38 years old, farmer.

Jinfang,[14] is connected to the Ghost Festival, which takes place on the 14th of July. Zhang Kaipei[15] explained that on the 1st of July, branches of *P. utilis* are stuck into holes of house and room walls to prevent the ghosts that are released from heaven between the 1st and the 15th of July from entering.

Like *Prinsepia utilis*, branches of *Populus* sp. were often observed to be stuck into house gates or holes of outer house walls (Fig. 8C). *Populus* sp. branches are hung up to keep malevolent spirits outside. Other uses of theses branches are that they are hung up at the beginning of summer to prevent snakes and small animals from entering, or that they are attached to entrance gates on the 30th of June to keep unwelcome people outside.

3.1.3 Soup Plants

Soup plants are a category of eight species which are all used on Dragon Boat Festival[16] (Duanwujie). The soup is a decoction of all species and is prepared and consumed by the festival participants. According to Shi Ximei[17] , the soup is especially effective as a tonic and against diarrhea, but only if the plants are collected and cooked and the soup is consumed on Dragon Boat Festival. The local names of all species were documented, but due to time constraints, herbarium specimens of only four of eight species could be made, and some of the species were not identified at species level.

3.1.4 Other Plants

The use of *Imperata cylindrica* was directly observed on the occasion of a funeral; then it was planted on top of the grave directly after the burial of the deceased person (Fig. 8B). On top of a grave this grass is believed to support the prosperous development of the family, especially if it has grown well and developed many stolons. The use and meaning of this species are also reflected in its local name, Zisuncao, meaning the child‘s and grandchild‘s grass. The planting of *Imperata cylindrica* on top of graves seems to be a widespread practice that was observed in many villages of Shaxi.

3.2 Reasons for Incense Use

The contexts of the documented incense uses are diverse and include aspects of meaning, purpose, time, and place. In interviews, informants mentioned various reasons for which incense is burned. Usually, it is burned for the communication with spiritual entities and fumigations for personal well-being.

14 A Bai woman, resident of Sideng; 27 years.

15 A 68-year-old Bai man and temple custodian of one of Changle‘s Benzhu temples.

16 The mainly mentioned Chinese traditional festivals are briefly described in the appendix.

17 A Bai woman, resident of Diantou; 48 years.

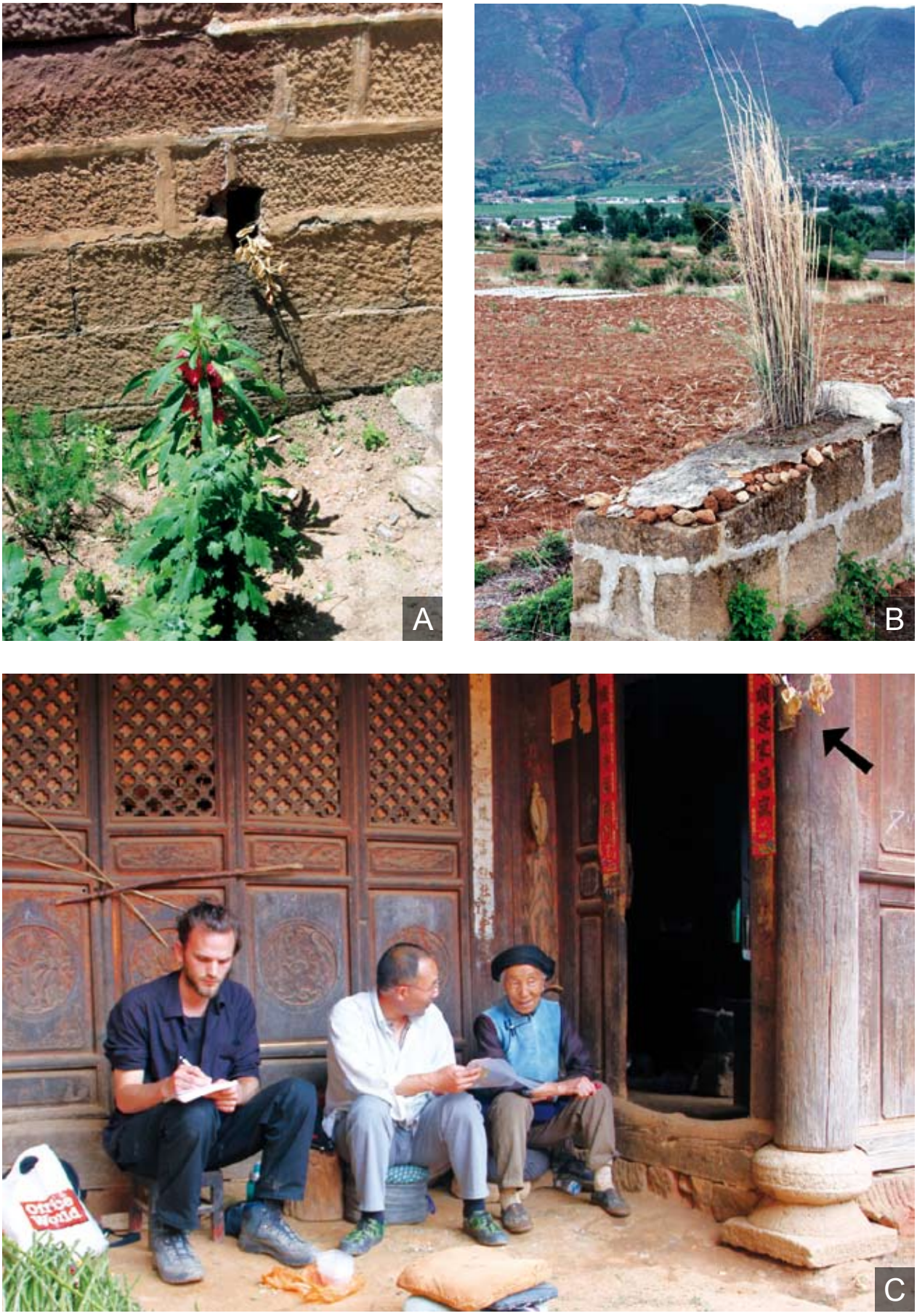


Figure 8

A *Prinsepia utilis* branch stuck into the water drain of a house to ward off ghosts (by Staub 2010).

B *Imperata cylindrica* planted on a grave to support prosperous development of the family (by Hess 2010).

C Interview in front of the house of an incense producer. Incense and *Populus* sp. branch are placed in a holder at one side of the entrance (indicated by arrow; by Hess 2010).

In almost all documented contexts, not the type of incense seems to be important, but rather that it is burned at all. Although no fundamental difference between sticks and powders was found, certain differences in their practical functionality were observed: Sticks are usually preferred for outside use, because they are better suited to weather influences, and because no expensive censer needs to be used. On the contrary, powders tend to be used inside temples and houses, where the necessary censers are available.

3.2.1 Communication with Spiritual Entities

The communicative act with spiritual entities was the most frequently mentioned reason for fumigations. The places for these communicative acts are for example graves, temples, and stoves in kitchens, of which each is connected to a different myth about the spirits that can be called there. These places and spirits are described below.

Fumigations inside the House

The household use of incense takes place on a daily or periodical basis, usually in the form of burning incense sticks, and was mainly observed at Yang Lairui‘s [18] home. Regarding the times of day, fumigations can, for example, be performed in the morning before breakfast, at noon before lunch, and in the afternoon – but never in the evening. Typical days of usage are traditional holidays like the Ghost Festival (Zhongyuanjie), Spring Festival (Chunjie), Dragon Boat Festival (Duanwujie), Tomb Sweeping Day (Qingmingjie), and the Double Ninth Festival (Chongyangjie).

The most conspicuous place for incense burning is at the gates of a house, where incense sticks are placed in a special holder fastened to one side of the gate. Yang Lairui explained that the gates are defended by two gate keepers, known as Menshen. [19] They prevent bad influences from entering her house and the courtyard. Usually, she burns incense and worships the gate keepers on the 1st and the 5th of each month.

Incense is also burned on a small altar close to the stove in the kitchen of a house [20]. As mentioned by two informants, this is a place to worship Zaojun, the God of the Kitchen. According to Yang Lairui, the legend of Zaojun states that this god travels from heaven to hell three times a day to report the behavior of the household members. All actions of the individuals are recorded, and burning incense intends to soothe the god. According to Zhang Dongmei, [21] the same altar is also a place for ancestors to meet the household members and to enjoy a meal. Incense is thus burned to invite the dead ancestors.

18 Key informant and member of the host family. Bai woman, 69 years old, resident of Sideng.

19 Brief descriptions of the deities can be found in the appendix.

20 Another altar was seen on the upper floor of Yang Lairui‘s home. The old wooden altar with sophisticated wood carvings was an item not observed in other houses. The altar is decorated with pictures of dead relatives, unburned cigarettes, as well as burned and unburned incense sticks in holders. According to two informants, such an altar constitutes a place of worship of ancestors and dead compatriots.

21 Bai woman, 22 years old, resident of Sideng.

Fumigations at Temples

Communal incense use usually takes place on special occasions, such as ceremonies in temples or during funerals. Both incense forms, sticks and powders, are used. Powders are predominately used inside temples, where the necessary censers and incense burners are available. Sticks are used outside as well as inside the temples. Fumigations in temples were observed on three different occasions, i.e. during Dragon Boat Festival, during a Mamahui, [22] and on the 1st day of the 5th month in the Haiyun temple in Shibaoshan. In the following, the use of incense plants during the Dragon Boat Festival is described in detail.

Dragon Boat Festival is celebrated on the 5th day of the 5th month of the lunar calendar in Sideng's Benzhu temple, [23] which is situated at the eastern edge of Sideng, close to Heihui river. Informants described the reason for the ceremony to be the worship of Shennong, the God of agriculture and medicine, as well as other deities represented by the statues of the temple. Some participants mentioned Shennong's actual birthday to be one week earlier, but as the villagers were all very busy with harvesting, the celebration was postponed and combined with Dragon Boat Festival. The festival started around 8 o'clock in the morning and lasted until 7 o'clock in the evening. The majority of participants arrived before noon, and most of them stayed until the evening. According to the organizers, at least 340 persons participated in the festival, which represents the number of persons who had donated money for the commune. Most participants were roughly of the age of 40 years or older. Both sexes were more or less equally represented. People participated in the festival not only because it is a religious ceremony, but also as an occasion to meet other people, to chat, and play Majiang. The function of temples as meeting places for older generations was also observed during daily life in other temples in Shaxi.

During the festival, the participants folded paper art, performed dances with paper flower bouquets, worshipped the deities, and took part in a ceremony. Besides these activities, three main meals, various types of food offerings, and a special soup were prepared by the participants (Figs. 9A-C).

Besides the extensive use of incense, eight species for the preparation of a special soup, one species to produce air-cleansing steam, and the use of a wood to produce some sort of holy-water were observed.

The earthy, fragrant smell of cypress was the dominant smell inside and around the temple compound during the whole festival, enshrouding all participants in a shared atmosphere of smoke. The

22 Gatherings of mainly women above the age of 25 in local temples. The gatherings include singing, prayer, and preparation of food offerings for the deities.

23 A central aspect of Bai religion is the belief in village-specific deities, called Benzhu (Katzen 2002). Benzhu deities were translated as ‚patron gods' and are worshipped in specific temples, of which each village usually has one (Schmitt 2007).

Figure 9

A Three Buddhist masters leading the ceremony on the Dragon Boat Festival (Duanwujie).

B Offerings placed in front of a statue of Shennong, the God of medicine and agriculture.

C Bai Women taking part in the ceremony in Sideng‘s Benzhu temple on Dragon Boat Festival (all by Hess 2010).

smoke was emitted by two large incense burners and numerous small censers. Of the two larger burners, one was situated outside of the compound, the other one in the middle of the courtyard. The small censers were placed in front of the different deity statues in the prayer halls.

The burner outside of the temple allowed the people to clean their hands with smoke before they entered the temple for the first time of the day or after using the toilets situated outside. Yang Lairui explained that before entering the temple, hands, clothes, and mind need to be clean. It was observed, however, that by far not all participants followed these rules. Similar rules, according to Yang Lairui, also apply for incense producers: Women having their menstruation should not produce incense, and incense producers should not visit a place where a cow or pig is giving birth. Either case is perceived as unclean, and incense production has to be suspended.

Upon entering the temple, many participants headed directly to the large incense burner in the middle of the courtyard. They folded their hands and bowed in front of the burner, placed red joss sticks or poured incense powder onto an incense heap and then kowtowed in front of the burner. Red sticks are preferred for this, because the color symbolizes harmony, but green sticks may be used. The custodian periodically checked and emptied the censers.

The courtyard of this Benzhu temple looks similar to those of other temples in Shaxi: The central and square courtyard is flanked by two sheltered areas equipped with tables and chairs. Diverse colorfully flowering plants and shade-giving cypress tree species are planted in pots and in the flower beds of the courtyard.

Incense is also used in smaller censers placed on altars in front of the different deities inside the prayer halls. As an indirect witness of years of incense and candle use the inner surface of the walls and roofs of these halls have turned black from the large amount of covering soot. On these altars, various different offerings can be found; they comprise different types of candles, paper art, foods, cigarettes, bowls containing tea or water, and plastic flowers. Incense powder is poured into the small censers in front of the deities in the same way as described for the courtyard burner. Many participants were asked for the composition of their brought-along powders, but none could name the constituents. The powders were all bought from a wholesaler living in another township.

Small paper foldings symbolizing flowers and crowns were made by the participants around noon, so that they could be burnt in the large central burner during the afternoon following the main ceremony. The ceremony took place in the main prayer hall and consisted of the collective chanting of religious verses led by three Buddhist masters and backed by percussion. The percussion consisted of cymbals (Bo) played by two masters and other participants, a large drum (Gu) played by a man,

and an instrument called wooden fish (Mu Yu) played by many singing participants. Some participants performed Bai dances to the music in the courtyard while holding paper flower bouquets that had been especially produced for this day.

Except for the use of incense and the cooking of a special soup, which were already described above, other plants were ritually used at the festival. Aerial parts of *Artemisia argyi* were placed on a hot iron plate over which water was poured to produce fragrant steam. This steam-device was held by an iron handle and carried around the temple compound. The steam is reportedly used to cleanse the ambient air of crowded temples.

Another plant use is that of a wood, allegedly wood of *Cupressus funebris*: A small piece of approx. 5cm length and 1cm width was put in a bowl filled with water to produce a sort of cleansed, holy water. According to the custodian, this water can be sprinkled dropwise on sick persons to bring healing or to treat minor discomfort.

Fumigations at Graves

Graves are another important site for the use of incense sticks. Due to the danger of wildfires, the sticks are not burned, but only placed on the graves (Fig. 10A). Based on observations at gravesites in the three villages Sideng, Diantou, and Hongxin, all situated in different parts of Shaxi, the placement of joss sticks seems to be a widespread custom. According to Zhao Zuoshan, there is a series of dates on which incense should be brought to the graves by the relatives of deceased persons. These dates are, one day, three days, one week, three weeks, and 100 days after the person died, and additionally every 1st and 5th of June, and Tomb Sweeping Day.

Fumigations on Funerals

Also funerals involve the use of incense, as observed at the ceremony for a member of the Bai. An initial ceremony at Sideng‘s old market place took place in the morning and was followed by the procession towards upper Diantou village, the deceased’s former place of residence, where his remains were finally buried at the foot of the western mountain range. During the initial gathering in Sideng‘s old market place, a censer, placed approx. 10 meters apart from the crowd, emitted modest amounts of incense smoke. The use of green sticks, as announced by Liu Fangyu, was not observed. Neither red nor green sticks were used.

Fumigations at Trees and special Sites

In Sideng, burnt and unburnt joss sticks were observed in several places. One such place was at the northern end of Jianglehe at the site of a big and ancient tree. When joss sticks are placed and burned at such sites, Chen Baoying explained, the intention is to worship the Tree God.

Another site with traces of past incense use is situated close to the graveyard in the south of Sideng and looks like an old, empty tomb. Yang Lairui explained the meaning of this site as a place for the worship of the Mountain God or Guanyin. These deities, she mentioned, are preferably called for blessings before departure or after returning from the mountains.

Fumigations on Weddings

Weddings are another occasion during which fumigations are performed, preferably using incense sticks made of bamboo, since these curl with combustion, if properly produced (Fig. 10B). The curling of the stick, a desirable symbol of luck, happens if the bark of the bamboo culm was peeled off correctly.

Fumigations at Wells

Incense is also burned at wells, where, according to Yang Lairui, it can be used to show respect to Long Wang, the king of dragons (Fig. 10C). She recounted a myth about such a well in Changle, which is inhabited by dragons. These dragons are said to have lent plates and bowls to people who had invited guests but did not own enough dishes. When one person didn‘t bring back the borrowed dishes, the dragons stopped lending the plates and bowls and are now hiding in the well. Nowadays, when people invite guests for a meal, they can go there to worship the dragons and ask for a blessed meeting by using incense.

3.2.2 Fumigations for Well-being

Some informants mentioned the influence that fumigations have on the well-being of the user. Ouyang Ruyao,[24] for example, explained that fumigations in combination with the chanting of certain verses and kowtowing can be applied by women to heal sick family members. According to him, these actions are seen as an offering for bad, old ghosts that cause diseases and can be driven out this way. Zhang Kaipei,[25] explained the linkage of fumigations and personal well-being through mental aspects: People who burn incense just feel happier, and this improves personal health. Chen Baoying,[26] underlined that incense has no effects on deities, but rather on the fumigating person, mainly as a way to strengthen self-awareness.

24 Temple custodian of Sideng‘s main Benzhu temple; M, 75, Bai.

25 Temple custodian of Changle‘s main Benzhu temple; 68 years old, Bai

26 A Buddhist nun and custodian at Haiyun Temple in Shibaoshan; 55 years, Bai.

Figure 10

A Joss stick offerings at gravesites are left unburned due to wildfire hazard.

B Joss sticks in a can. The curled shape of the burned stick is a symbol of luck (indicated by arrow).

C Remains of past incense use at a well (indicated by arrows; all by Staub 2010).

„Burning incense has five main effects:
- It is a statement of not doing bad things any more.
- Through the burning of incense you settle down.
- Through the burning of incense you get rid of hardness.
- Burning incense increases wisdom
- Through the burning of incense you get rid of the feelings about precious old things.“ (Chen Baoying, Buddhist nun and custodian at Haiyun Temple in Shibaoshan; 55 years, Bai; [passage recited from a notebook])

Several informants ascribed pharmacological activity to the smoke of incense: Wang Fang,[27] mentioned the effect of incense smoke to clean the air, and in in that sense of killing germs. A similar statement was made by Zhao Zuoshan,[28] who mentioned that smoke can clean the air in crowded rooms like temple halls.

3.2.3 Superstition and Witches

Different informants expressed different opinions on how offerings should be made. Li Jiansong [29] stated that incense is only effective when it is bought. Ouyang Ruyao, the custodian of Sideng‘s Benzhumiao, uttered that there is no difference between the offering of incense and other goods, like cigarettes or food.

Besides the general consent that the practiced fumigations in Shaxi are traditionally linked with religion, some informants mentioned superstitious aspects.

„I don‘t burn incense by myself and think that young people in general have little time to burn incense. The young people don‘t believe in superstition and don‘t belong to a religion. Nonetheless, I feel comfortable when smelling it. In my family, my mother burns incense, and, in general, older women do it. They are all victims of superstition [mixin]. The younger generation has experienced another education than the older women, so they do not believe in Buddhism anymore.“ Wang Fang (F, 23, Bai, Sideng)

Another member of ‚the younger generation‘, however, has a different opinion about superstition:

„In general, old people burn incense and visit temples, because they believe in superstition. My opinion about the burning of incense is somewhere between superstition and belief. On the one hand, when I was sick and my grandmother burned incense and emptied out a bowl of rice for me, my health improved – on the other hand, I think that the witches [tiaoshenpo] are just telling half-truths. They are fortune-tellers telling the future by chance.“ Ouyang Dan (F, 22, Bai, Sideng)

In many interviews, the local witches were a controversial subject, regarding their role in relation to their religion. The following two statements show the participants’ negative perception of witches:

27 Female pharmacy student, 23 years old, Bai and daughter of the pharmacy owner Yang Wanlin.

28 Bai man, resident of Changle, 86 years old.

29 Bai man, resident of Changle; 40 years old.

„I don‘t think that burning incense is superstition. It is a tradition. Witches are the real superstition. The locals are also afraid of Heimajiangjun [literally the commander on the black horse], because he sacrificed his life for ours. If someone goes out and is caught by the commander, they have to offer Badawan [an eight-bowl feast] and alcohol to the witches. This is what I think is superstition.“ Zhao Zuoshan (M, 86, Bai, Changle)

„Law can‘t limit things, but superstition can. Whether the burning of incense is superstition or not, depends on the person. If it‘s burned in a temple by old women, then it is superstition. But not all burning at the temples is superstitious. If you believe in Buddha and burn it because of your worship, then it‘s no superstition. If you burn it in a temple with witches, that is superstition, because they have nothing to do with Buddhism. Buddhism is against the witches. They make more money than a retired official.“ Zhang Genshou (M, 75, Bai, Changle)

These ‚witches‘, according to Yang Lairui, are sometimes invited by families for their attributed abilities to communicate with ancestors or for telling the future. At the Mamahui in one of Aofeng‘s Benzhu temples, the activity of one of these witches was observed: The witch was asked to communicate with the clients’ ancestors. The gathering of mostly females consisted of the joint preparation of meals and food offerings and the ceremony. While kneeling on the floor, the witch freely chanted spiritual Baic verses for at least an hour and was accompanied by the singing of the other women. In her hands she held an incense stick which she quickly swayed back and forth. Her continuous singing and her repeated gasping for air suggested that she had entered a trance. Unfortunately, no interview data concerning this was collected.

3.2.4 Ethnicity-dependent Use?

Two informants, one Han and one Yi, were asked whether the documented plants are solely used by the Bai. The 77-year-old Han Zhang Qiying,[30] stated that the local ritual plant knowledge is not unique to the members of the Bai, but is also common among the Han in the valley. The Yi Lu Huaizong,[31] mentioned that ritual plant knowledge is scarce among the local Yi in Shaxi. The only use he knew of was the offering of incense to the Mountian God as a means to support the healing of a sick family member. He also mentioned that a witch had once suggested the performance of a ritual for a sick person. Since the family members did not know how to conduct the ritual, it had to be performed by an invited Lisu person.

3.3 Incense Uses outside Shaxi

Some of the documented uses are also described in other ethnobotanical studies of the Hengduan mountain region. An earlier study on local medicinal plant knowledge in Shaxi (Ineichen 2007)

30 Male temple custodian of a temple in Hongxin; 77 years old, Bai.

31 Male Yi member, farmer, 62 years old.

describes the use of *Artemisia* sp. and *Cupressus funebris* as incense plants in consistence with the results of this study. Studies from the Shuiluo valley in Sichuan Province also describe similar uses to the ones that are presented in this study (Büeler 2010, Weckerle et al. 2006). In Shaxi as well as in the Shuiluo valley, *Cupressus funebris*, *Pistacia weinmanniifolia*, *Juniperus squamata*, and *Cornus oblonga* are used as incense. In Shaxi, however, these species are burnt dry, powdered, and mixed, whereas in Shuiluo they are applied fresh or dried, whereby the whole branches are commonly used, rather than making mixtures. In addition, all of these species are used both as incense and as decoration to invite deities in Shuiluo, while their ritual use is limited to the use as incense in Shaxi. Although *Pinus yunnanensis* is used as incense in Shaxi as well as Shuiluo, their uses are very dissimilar: While the root is used as side material for joss stick production in Shaxi, its branches are burned as incense in Shuiluo. In Shuiluo, incense species are selected for their habitat as well as the smell and the color of their smoke, whereas in Shaxi, the smell seems to be the only important factor.

The uses of *Juniperus* spp. and *Artemisia* spp. for medicinal, ritual, or magic purposes are widely distributed throughout Europe, Asia, and North America (Moerman 2009, Rätsch 1998:306). In Nepal, *Juniperus squamata* is used as incense (Bhattarai et al. 2006), and according to Rätsch, (2009:178) it belongs to the most important incense species of Tibet. Regarding the use of *Juniperus squamata*, the literature data fits the findings of the present study. For the remaining species, no information was found in the literature.

4 Conclusions

The inhabitants of Shaxi use a variety of ritual plants, especially incense plants, both on communal and household level. The documented incense plants were never used solely, but only in mixed powders or in the form of joss sticks. Ritual fumigations are mainly conducted for the communication with ancestors, ghosts, and deities, and in some cases also for personal well-being and to strengthen self-awareness. Some informants mentioned pharmacological effects, and some dismissed the fumigations practiced by others as superstition. Incense use was documented in diverse contexts. Among these contexts, no significant differences regarding the type of used incense, but differences in the contexts of place, time, and meaning of the use were found. The foremost quality for which species are selected as incense seems to be the smell of their smoke. Interview data and the incense powder compositions strongly suggest that *Cupressus funebris*, *Gaultheria fragrantissima*, and *Ligustrum sempervirens* are the central incense species. The roles of the other species remain unclear. Possible roles of these species range from being used to stretch incense powders to serving as substitutes for other, unavailable species.

Similar uses of Cupressus funebris, Pistacia weinmanniifolia, Juniperus squamata, and Cornus oblonga were also reported from the Shuiluo Valley in the Hengduan mountain range. Juniperus squamata is used as incense in even wider parts of the Himalayas. These finding indicate that the documented incense plant knowledge probably does not constitute exclusive knowledge of the inhabitants of Shaxi. The distribution of knowledge among the informants in terms of their age, sex, ethnicity, and job specialization remains unclear.

Further investigations on ritual plant use in Shaxi should focus on these unanswered aspects of ritual plant knowledge, in particular its distribution both within and between ethnic groups and across different villages or places in general. For this, the Cultural Domain Analysis provides the proper toolkit for collecting standardized and comparable data. By using techniques like pile sorts and ranking tasks, a more detailed insight into the knowledge about ritual plants could be gained. Further research should also investigate the already documented uses in more detail and document yet unknown contexts of use

5 Chemical Characterization of the Incense Smokes

The first part of this study shows that ritual uses of smoke can be embedded into multifaceted cultural contexts. Smoke can, however, also be of pharmacological significance, transporting pharmacological principles, olfactory compounds, and pheromone-like substances (Rätsch 2006:28-29). As a vector for drug administration, plant derived-smokes are used for a wide range of indications in different medicinal systems around the globe (Braithwaite 2008, Mohagheghzadeh et al. 2006). These two aspects of smoke, the pharmacological and the cultural, can blend or intertwine, such as with the ancient use of Tobacco as incense, medicine, and for religious purposes (Robicsek 2004). In medicine, the intertwining of cultural and pharmacological aspects of healing has been put forward with the concepts of the placebo effect, and later, the meaning response (Moerman and Jonas 2002). The meaning response conceptualized how both the administered drug and the cultural meaning of the treatment context influence the efficacy of a medicinal treatment on a person. Therefore, in analogy to medicine, it might be argued that the effects that rituals have on human beings are also dependent on both the cultural and the pharmacological context.

This part of the study aims to characterize the volatile smoke compounds of eleven incense species from Shaxi using the headspace sorption method. Particular goals were to quantify and qualify the detectable volatile organic compounds (VOCs) in the smoke of eleven incense species, to characterize the different species based on their volatile profiles and to discover potential implications that the detected VOCs have on the cultural use context.

Headspace sampling techniques are widely applied for investigations on VOCs in areas such as floral scent ecology, perfume industry, or food chemistry (e.g. Kaiser 2006; Schiestl et al. 2010, Zhang et al. 2011). Previous studies on the chemical investigation of incense smoke mainly used steam distillation, solvent-extraction, or the solvent-free solid-phase microextraction for VOC collection (SPME; e.g. Lombarduzzi 2010, Tran 2007, Case 2002, Roveri 1997). As far as is known, no study has so far been conducted using the quantitative dynamic headspace sorption method for the investigation of VOCs in incense smoke.

5.1 Smoke Collection

Smoke of the incense plants was collected using the dynamic headspace sorption method (Huber et al. 2005), using a glass filter filled with 4mg of Porapak Q (Mesh size 80/100; Alltech Associates Inc., Deerfield, IL, USA) enclosed by a layer of quartz wool and glass beads (0.3mm, Merck KGaA, Darmstadt, Germany) on both sides. One adsorbent trap was placed inside a polyethylene terephta-

late (PET) cooking bag that was closed at one end. One gram of plant material was burned in a fuming hood using a butane gas-fuelled micro torch (Prince, Micro Torch GT-3000, Japan). Once the flame died out and the plant material smoldered, the bag was placed over the smoke plume, and 1.5l of air was drawn through the filter which was connected to a battery-operated vacuum pump (Personal Air Sampler; SKC Inc., Eighty-Four, PA, USA) using PTFE tubing (Maagtechnic, Dübendorf, Switzerland). Before use, all the filters were cleaned with 100µl acetone and 300µl hexane and left to dry. Surrounding air samples were taken as control samples for ambient contaminants. After sampling, the trapped volatiles were eluted with 50µl of a hexane. All samples were stored in sealed glass vials at -20°C for subsequent gas chromatographic (GC) analysis.

5.2 Chemical Analysis

Quantitative analysis of the smoke samples was conducted using gas chromatography with flame ionization detection (GC-FID; Agilent 6890N; Agilent Technologies, Palo Alto, CA, USA). The GC was equipped with an HP5 column (5%-Phenyl-methylpolysiloxane, 30m x 0.32mm i.d. x 0.25µm film thickness; Agilent Technologies, Palo Alto, CA, USA). Hydrogen served as carrier gas at a flow of 1.8 ml min^{-1}. To all samples, 100ng of n-octadecane (purity 99.8%; Fluka, Buchs, Switzerland) was added as internal standard. One microlitre of each sample was injected pulsed splitless (inlet temperature 300°C). The oven was programmed to heat from 50°C to a maximum temperature of 300°C at a rate of 10°C·min^{-1}; the oven was then kept at 300°C for a 3 min. post run. Chromatogram outputs were recorded by the Chemstation program (Agilent Technologies, Version E. 02.00.493) for qualitative and quantitative analysis.

The volatile compounds were identified using gas chromatography-mass spectrometry (GC-MS). The GC-MS runs were performed on an Agilent 6890 N gas chromatograph coupled with an Agilent 5975 Mass Selective detector (GC; Agilent Technologies, Palo Alto, CA, USA) equipped with an HP5-MS column (5%-Phenyl-methylpolysiloxane, 30m x 0.32mm i.d. x 0.25µm film thickness; Agilent Technologies; Agilent Technologies, Palo Alto, CA, USA). Helium served as carrier gas. One microlitre of each sample was injected pulsed splitless (inlet temperature 300°C). The oven was programmed to heat from 50°C to a maximum temperature of 300°C at a rate of 10°C min^{-1}; the oven was then held at 300°C for a 3 min post run.

The compounds were tentatively identified by using spectral data from the Nist chemical library (Version 05a). Authenticated reference samples run on both the GC and GC-MS system helped to identify and assign peak identities.

Table 4

The volatile compounds of the incense species.

RT[a] (min)	Compound[b]	*Artemisia* sp1	*Chamaecyparis obtusa*	*Cornus oblonga*	*Cupressus funebris* (br)	*Cupressus funebris* (w)	*Gaultheria fragrantissima*	*Juniperus squamata* (w)	*Ligustrum sempervirens*	*Lyonia ovalifolia*	*Pistacia weinmanniifolia*	*Ternstroemia gymnathera*
3.49	α-Pinene[c]	ND	5.72±1.00	ND	9.16±2.58	ND	ND	ND	ND	ND	19.52±2.89	ND
4.04	Benzaldehyde[c]	ND	ND	1.61±0.18	ND	ND	ND	ND	5.51±0.22	0.82±0.06	ND	ND
4.31	β-Phellandrene	ND	ND	ND	1.57±0.17	ND	ND	ND	ND	ND	ND	ND
4.37	β-Pinene[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.47±0.34	ND
4.66	β-Myrcene[c]	ND	1.62±0.29	ND	ND	ND	ND	ND	ND	ND	1.72±0.16	ND
4.90	α-Phellandrene[c]	ND	0.47±0.08	0.22±0.02	0.41±0.02	ND	ND	ND	ND	0.30±0.02	0.73±0.05	0.20±0.01
5.34	S-Limonene[c]	4.02±0.62	2.94±0.48	0.27±0.04	5.29±0.42	ND	0.42±0.05	ND	0.35±0.02	0.44±0.03	3.97±0.53	0.31±0.03
5.60	Phenylacetaldehyde	ND	ND	3.38±0.41	ND	3.33±1.06	3.04±0.56	ND	2.39±0.23	ND	2.82±0.62	1.46±0.11
6.38	Guaiacol	0.78±0.13	0.90±0.14	ND	2.09±0.14	ND	0.80±0.06	ND	ND	1.24±0.07	0.41±0.06	ND
7.01	Ocimene	ND	1.17±0.16	ND	1.17±0.13	ND	ND	ND	ND	ND	1.98±0.33	ND
7.71	Umbellunone	ND	ND	ND	1.38±0.10	ND	ND	ND	ND	ND	ND	ND
7.85	Azulene/Naphthalene	ND	1.23±0.54	1.77±0.11	1.82±0.54	0.10±0.03	1.03±0.06	ND	1.78±0.37	1.32±0.08	0.73±0.05	1.11±0.16
7.95	Dodecene	0.87±0.10	0.36±0.08	0.44±0.02	0.37±0.02	ND	0.27±0.05	ND	0.81±0.07	0.35±0.03	0.34±0.02	0.83±0.11
8.03	Methylsalicylate[c]	ND	ND	0.91±0.11	ND	ND	12.28±1.30	ND	ND	ND	ND	ND
8.32	Cinnamaldehyde	ND	ND	1.32±0.09	ND	ND	1.17±0.09	ND	3.58±0.26	ND	1.56±0.11	1.92±0.12
9.22	Ethylguaiacol	0.51±0.07	ND	ND	0.67±0.06	ND	0.87±0.08	ND	ND	1.02±0.04	0.56±0.04	ND
9.35	Tridecene	0.59±0.06	ND	0.39±0.02	0.68±0.04	ND	0.47±0.05	ND	ND	ND	ND	0.67±0.09
9.41	Indole[c]	0.97±0.07	0.47±0.06	ND	ND	ND	ND	ND	ND	0.98±0.04	0.53±0.03	0.97±0.05
9.68	Vinylguaiacol	0.77±0.09	0.58±0.10	0.51±0.06	0.84±0.10	1.67±0.72	0.89±0.07	ND	1.31±0.14	1.31±0.05	0.68±0.05	1.13±0.05
10.25	Eugenol[c]	ND	ND	ND	0.27±0.02	0.58±0.22	0.50±0.03	ND	0.86±0.04	ND	ND	ND
10.66	Tetradecene	0.92±0.13	0.53±0.04	0.25±0.01	0.36±0.04	ND	0.30±0.04	ND	ND	0.35±0.04	0.25±0.03	0.54±0.07
11.02	α-Cedrene	ND	1.13±0.09	ND	ND	ND	ND	2.42±0.27	ND	ND	ND	ND
11.10	β-Caryophyllene[c]	ND	3.03±0.25	ND	0.83±0.08	ND	ND	3.98±0.43	ND	ND	0.66±0.01	ND
11.41	Isoeugenol[c]	0.57±0.10	ND	ND	1.01±0.05	1.12±0.38	0.83±0.04	ND	0.74±0.06	0.86±0.03	ND	ND
11.52	UST1	ND	2.04±0.15	ND	0.58±0.12	ND	ND	2.23±0.20	ND	ND	ND	ND
11.88	Pentadecene	0.90±0.09	0.49±0.04	0.26±0.01	0.36±0.02	ND	0.34±0.04	ND	0.37±0.02	0.45±0.05	0.31±0.03	0.61±0.06
11.98	Pentadecane	0.32±0.05	ND	0.24±0.02	ND	ND	0.38±0.03	ND	ND	ND	0.37±0.03	ND
12.13	β-Bisabolene	ND	ND	ND	ND	1.47±0.52	ND	ND	ND	ND	ND	ND
12.22	γ-Cadinene	ND	0.69±0.05	ND	1.23±0.12	ND	ND	ND	ND	ND	ND	ND
12.33	δ-Cadinene	ND	0.87±0.07	ND	1.64±0.14	ND	ND	15.58±0.76	ND	ND	0.26±0.02	ND
12.57	α-Calacorene	ND	ND	ND	ND	ND	ND	2.12±0.09	ND	ND	ND	ND
13.03	Diethyltoluamid	ND	ND	ND	ND	ND	0.36±0.03	ND	0.35±0.03	ND	0.16±0.02	0.43±0.03
13.27	Cedrol	ND	3.42±0.42	ND	0.23±0.04	ND	ND	4.73±0.36	0.36±0.04	ND	0.28±0.08	ND
14.04	Cadalene	ND	ND	ND	ND	ND	ND	1.77±0.15	ND	ND	ND	ND
14.26	Methoxyeugenol	0.33±0.05	ND	ND	ND	ND	ND	ND	ND	0.44±0.02	0.19±0.19	0.31±0.02
14.82	Tetradecanoic acid	0.10±0.02	0.16±0.04	0.29±0.04	0.14±0.02	ND	0.37±0.04	ND	0.20±0.02	0.35±0.02	0.11±0.11	0.32±0.02
15.10	Anthracene/Phenanthrene	0.59±0.26	0.26±0.09	0.36±0.01	0.17±0.04	ND	0.27±0.01	ND	0.41±0.10	0.23±0.01	0.15±0.15	ND
16.81	Hexadecanoic acid	0.21±0.03	1.19±0.13	2.10±0.34	0.51±0.01	ND	1.13±0.23	ND	0.45±0.17	2.19±0.26	0.19±0.19	1.85±0.25

Amounts are given as mean relative areas and standard errors of means (n=10). a) Retention time in GC-FID; b) All compounds are not detected in the control samples; c) compound confirmed using reference substance; ND=not detected; UST=unknown sesquiterpenoid; (br) branch; (w) wood.

5.3 Statistical Analysis

For the analyses, the mean relative amounts and the standard errors of means of the detected compounds were calculated. Because different volatiles potentially originate from similar biosynthetic pathways and thus may constitute dependent variables, a principal component analysis (PCA) was performed to simplify the dataset and to extract independent factors with eigenvalues above one. The orthogonal rotation method varimax was used for the PCA, since it causes the variables to be more clearly associated with one or few factors, and the factors to be loaded with only a small number of variables (Schiestl et al. 2010). All statistical analyses were conducted using PASW statistics (Version 18.0.2).

5.4 Results and Discussion

In total, 38 compounds were tentatively identified in the smoke of the species (Table 4; for spectral data of the compounds see Appendix). Only the most abundant compounds with Nist library matchings of 90% or higher and retention times of up to 18 minutes were considered in the analysis. The identified compounds are monoterpenoids (10), sesquiterpenoids (7), linear hydrocarbons (6), methoxy phenolics (6), benzenoids (4), polycyclic aromatic hydrocarbons (PAH, 2), nitrogen-bearing compounds (2), and fatty acids (2). The number of detected compounds per species ranges from 25 in *Pistacia weinmanniifolia* to six in wood of *Cupressus funebris*. Generally, more compounds were detected in smokes of species of which the leaves are used as incense (15-25 compounds) than in smokes of species of which the wood is burned (6-7 compounds). Azulene and Naphthalene as well as Anthracene and Phenanthrene, respectively, could not be distinguished from each other in the analysis and are treated as one variable each. From here on, these four compounds are referred to as PAH‘s.

The different compound categories introduced above occurred with different frequencies in the smokes. The detected mono- and sequiterpenoids like Umbellunone or Cedrol showed high interspecific variation and often specifically occurred in only one or a few species. The detected linear hydrocarbons, PAH‘s, alkananoic acids, and some methoxy phenolics were detected consistently in most of the species, supporting Simoneit (2002), who regards members of these compound classes as typical products of biomass burning. Additionally, Benzaldehyde, Limonene, Anthracene, Phenanthrene, Naphthalene, Ethylguaiacol, and Guaiacol, were found to be compounds of odor-bouquets of typical burnt smells after accidental fires (Heitmann 2009). Since methoxy phenolics can be released through the combustion of lignin, these were expected to be detected in all species,

Table 5

Factor loadings of the variables on the ten extracted principal components (PC). The highest factor loadings are highlighted.

Variables	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
α-Pinene	-.065	.902	.180	-.070	-.093	.029	-.162	.017	.079	-.057
Benzaldehyde	-.142	-.186	-.104	-.174	.100	.724	-.049	-.273	-.025	.421
β-Phellandrene	-.072	.051	.942	-.066	.004	-.031	-.095	-.064	.047	-.083
β-Pinene	-.127	.844	-.184	-.087	-.101	.109	-.211	.091	.200	-.142
β-Myrcene	.139	.915	-.130	.092	-.023	-.091	.059	-.002	-.156	.112
α-Phellandrene	-.100	.873	.198	.042	-.125	-.100	.197	-.141	.049	-.022
S-Limonene	-.066	.521	.566	.395	-.015	-.147	-.255	.046	.083	.063
Phenylacetaldehyde	-.394	.012	-.320	-.341	.384	.190	-.089	.277	-.342	-.102
Guaiacol	-.050	.169	.755	.210	.103	-.286	.167	.109	.366	.157
Ocimene	.044	.915	.288	.025	-.041	-.041	-.059	.002	-.042	.022
Umbellunone	-.067	.037	.957	-.073	.004	-.040	-.066	-.065	.029	-.073
Azulene/Naphthalene	-.148	.105	.271	-.068	-.019	.276	.395	-.089	-.127	.532
Dodecene	-.273	-.084	.022	.774	-.069	.478	.010	-.119	-.044	.051
Methylsalicylate	-.070	-.156	-.022	-.166	.070	.060	.233	.877	.033	.028
Cinnamaldehyde	-.255	.066	-.225	-.068	-.006	.900	.058	.018	-.111	.047
Ethylguaiacol	-.226	.129	.279	.131	.087	-.170	.158	.395	.743	.058
Tridecene	-.291	-.296	.474	.546	-.162	.064	.016	.303	-.099	-.266
Indole	-.146	.150	-.265	.734	-.077	-.169	.211	-.252	.348	-.113
Vinylguaiacol	-.262	-.029	-.038	.102	.907	.099	.114	-.097	.070	-.049
Eugenol	-.132	-.190	.090	-.254	.778	.428	-.134	.128	-.106	.123
Tetradecene	-.103	.043	.121	.928	-.083	-.230	.059	.125	.023	.037
α-Cedrene	.958	-.026	-.089	-.099	-.106	-.117	-.062	-.056	-.083	-.037
β-Caryophyllene	.935	.185	.056	-.047	-.090	-.163	-.009	-.072	-.164	.024
Isoeugenol	-.239	-.242	.313	-.084	.811	-.047	-.085	.094	.265	.072
UST1	.911	.094	.113	-.005	-.060	-.201	.064	-.095	-.239	.089
Pentadecene	-.182	.010	.052	.939	-.047	.065	.073	.043	.090	.155
Pentadecane	-.297	.234	-.222	.219	-.161	-.017	-.243	.734	.094	.053
β-Bisabolene	-.121	-.068	-.150	-.196	.815	-.258	-.182	-.101	-.203	-.207
γ-Cadinene	.154	.196	.848	.069	.047	-.179	.136	-.107	-.237	.153
δ-Cadinene	.850	-.154	-.001	-.238	-.165	-.023	-.237	-.033	.126	-.201
α-Calacorene	.833	-.189	-.100	-.239	-.165	-.002	-.244	-.020	.150	-.214
Diethyltoluamid	-.164	-.050	-.160	.151	.067	.763	.227	.291	-.049	-.182
Cedrol	.933	.048	-.060	-.065	-.087	-.123	-.012	-.085	-.177	.040
Cadalene	.829	-.182	-.096	-.225	-.152	.009	-.234	-.013	.154	-.208
Methoxyeugenol	-.250	.042	-.260	.514	-.064	-.126	.178	-.236	.629	-.117
Tetradecanoic acid	-.264	-.107	.002	.178	-.031	.239	.791	.290	.198	.025
Anthracene/Phenanthrene	-.156	-.078	-.067	.125	-.079	-.009	-.086	.098	.045	.823
Hexadecanoic acid	-.192	-.120	-.072	.108	-.130	-.015	.874	-.056	.063	-.036

Table 6

List of the canonical discriminant functions.

Test of function	Wilks-Lambda	Chi-Square	df	Significance
1 to 10	.000	2274.960	100	.000
2 to 10	.000	1876.527	81	.000
3 to 10	.000	1522.611	64	.000
4 to 10	.000	1198.753	49	.000
5 to 10	.000	899.668	36	.000
6 to 10	.002	639.086	25	.000
7 to 10	.012	436.433	16	.000
8 to 10	.062	273.221	9	.000
9 to 10	.288	122.648	4	.000
10	.772	25.527	1	.000

Table 7

Species differentiation based on the CDA functions is significant ($p<0.05$).

Function	Eigenvalue	% of Variance	% of cum. Variance	Canonical correlation
1	56.112	33.6	33.6	.991
2	35.345	21.2	54.8	.986
3	25.787	15.5	70.3	.981
4	19.830	11.9	82.2	.976
5	13.090	7.8	90.0	.964
6	6.826	4.1	94.1	.934
7	4.243	2.5	96.7	.900
8	3.612	2.2	98.8	.885
9	1.680	1.0	99.8	.792
10	.296	.2	100.0	.478

especially species of which the wood is used. This was not the case for the *Juniperus* and *Cupressus* woods, suggesting that a considerable part of the total variation was caused by the different combustion properties of the species. Indeed, the species of which the wood is used as incense hardly burned, whereas the leafy species ignited and smoldered easily.

The species that produced the most pleasing smelling smokes were *Cupressus funebris* branch and wood, *Gaultheria fragrantissima*, *Juniperus squamata* wood, and *Pistacia weinmanniifolia*. Besides the above mentioned compounds originating from the combustion of lignin and contributing to typical burnt smells, the remaining compounds in the dataset, potentially responsible for the pleasing smells of the smokes, belong to the classes of benzenoids, monoterpenoids, N-bearing compounds, and sesquiterpenoids. Of these compound classes, the most abundant compounds were methyl salicylate (12.28±1.30%), detected in the smoke of *Gaultheria fragrantissima*, δ-Cadinene (15.58±0.76%), in the smoke of *Juniperus squamata*, and α-Pinene, and other terpenoids in the smoke of *Cupressus funebris* branches (9.16±2.58%) and *Pistacia weinmanniifolia* (19.52±2.89%). All three compounds are known to have nice smells and to be common components of essential oils. Therefore, these VOCs likely contribute to the nice smell of smoke of the respective species. This is supported by Pennacchio et al. (2010:13), who consider terpenoids, especially sesquiterpenoids, to be the compounds mainly responsible for the pleasant odor of incense. However, the compounds detected in this study do only represent the most abundant and most easily detectable compounds, which does not do justice to the fact that scent bouquets usually consist of diverse mixtures of compounds that are sometimes hard to detect (see Kaiser 2006).

Besides the odiferous compounds, another VOC of particular interest was Diethyltoluamid (DETA), which was found in the smoke of the *Gaultheria* (0.36±0.03%), *Ligustrum* (0.35±0.03%), *Pistacia* (0.16±0.02%), and *Ternstroemia* (0.43±0.03%) species. DETA is known as highly efficacious insect repellent and can, in certain doses, cause symptoms like lethargy, confusion, acute manic psychosis, and headaches (as reviewed by Katz et al. 2008).

5.4.1 Species Differentiation

The principal component analysis extracted ten principal components (PC) with eigenvalues over one, explaining 91.08% of the total variance in the dataset (Table 5). The factors tended to be loaded with sesquiterpenoids (PC 1), monoterpenoids (PC 2 and 3), alkenes (PC 4), methoxy phenolics (PC‘s 5 and 9), benzenoids (PC 6), and fatty acids (PC 7). Despite the relatively small sample size (n=10), limiting the validity of the analysis, a canonical discriminant analysis (CDA) was applied using the ten resulting principal components to differentiate the species based on multivariate VOC

comparison. Figure 11 shows the sample distribution with the first two CDA functions. The first function explains 33.6% and the second 21.2% of the total variance (Table 6), and both support the differentiation of the species (Table 4).

Based on their volatile profiles, the species were well clustered intraspecifically and separated interspecifically (Wilk's Lambda close to 0, $p<0.05$). *Chamaecyparis* and the woods of *Cupressus* and *Juniperus* were distributed closely, perhaps due to their close phylogenetic relationship, but possibly also due to a lack of variables in the dataset.

The *Gaultheria*, *Ligustrum*, and the *Cupressus* branch species were the best separated species in the CDA. This, together with the fact that the same species were frequently found in the incense mixtures for censer use, may hint at the preference of local incense producers for mixing species together that are different, e.g. in terms of the smell of their smoke. However, it is possible as well that these species just produced the strongest smoke samples and therefore were the easiest to discriminate in the analysis.

5.4.2 Methodological Discussion

The dynamic headspace sorption method was successfully adopted for the quantitative and qualitative analysis of incense smoke volatiles. This method enabled the characterization of 38 different VOCs from eleven species locally used as incense. Further, the collected data allowed the characterization and discrimination between the smokes of the different incense species.

Despite the detected VOCs, a large number of compounds could not be identified due to overlapping chromatographic peaks or poor signal-to-noise ratio, which lead to poor MS-spectral quality and reduced spectral library matchings. Methodological improvements of future research using the dynamic headspace sorption method for incense smoke collection could include: first, the burning process (i.e. the standardization in terms of burning duration and temperature) to minimize variation caused by different combustion properties of the materials; second, the addition of artificial reference substances to the plant material prior to the combustion to assess to what degree variation in the detected compounds is caused by chemical differences or different combustion properties of the species; third, multiple parallel samplings during the same combustion process to quantify the variation caused by smoke inhomogeneities; fourth, better separation of the peaks by gas chromatography through optimizing the separation program parameters.

6 Conclusions

Overall, the most frequently detected compound classes in the eleven sampled incense smokes were monoterpenoids (10), sesquiterpenoids (7), and linear hydrocarbons (6). The detected linear hydrocarbons, PAH‘s, alkananoic acids, and some methoxy phenolics were consistently detected in all, or almost all smokes and are known as generic product of burning biomass. Furthermore, Limonene, Anthracene, Naphthalene, Phenanthrene, Ethylguaiacol, and Guaiacol, likely contribute to the incense smell bouquets, since they have also been found in headspace samples of remains of accidental fires. The remaining compounds, such as the detected terpenoids and benzenoids, represent good candidates for being at least partly responsible for the pleasant smell of the smokes.

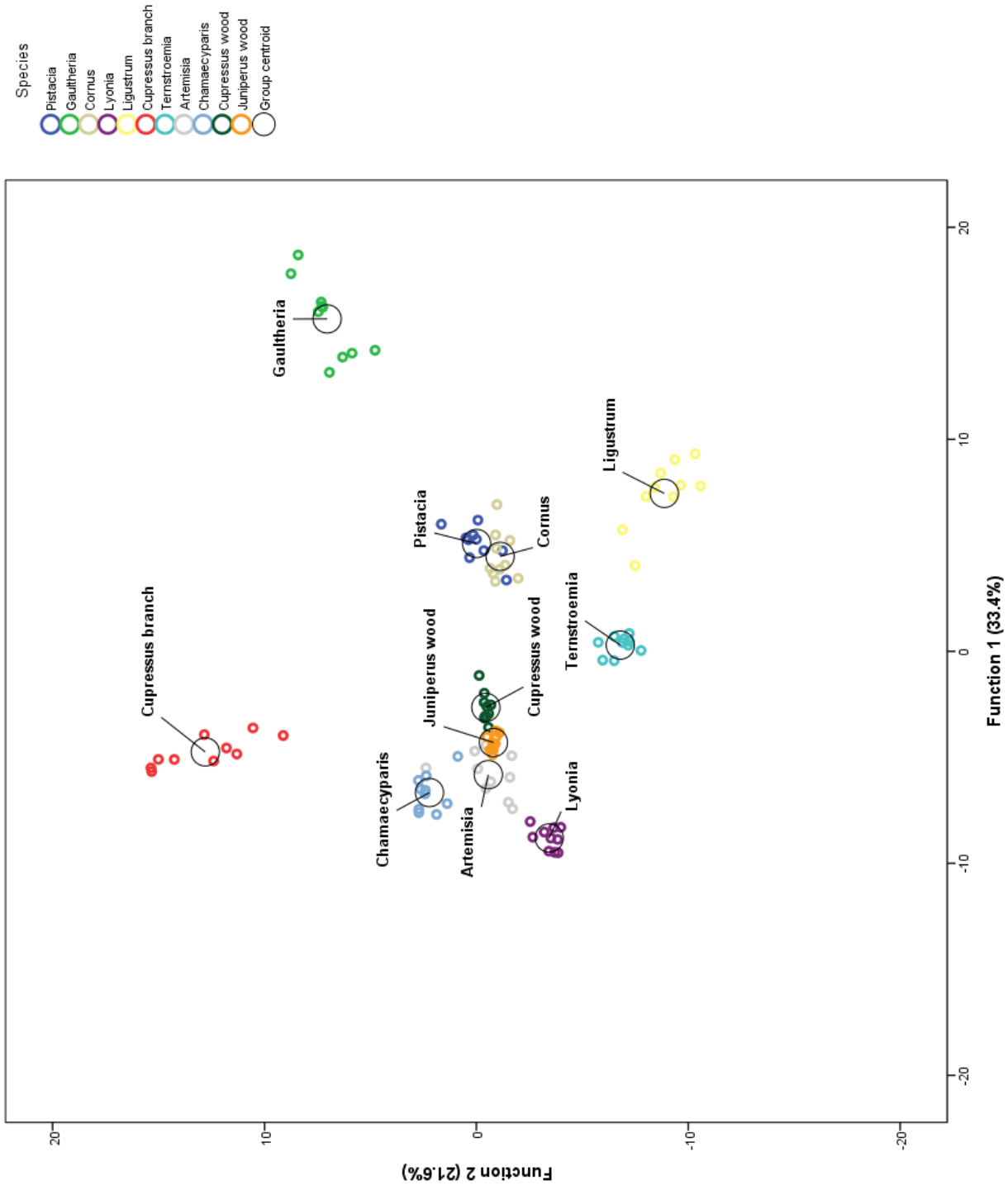
Besides these potentially fragrant compounds, Diethyltoluamid was detected in the smoke of four species and is known in literature as a potentially strong pharmacological agent. Whether the detected concentrations of Diethyltoluamid in the smokes are high enough to cause the ascribed pharmacological and insect repellent effects is unknown.

Based on their volatile profile, the most differing of the eleven species were *Cupressus funebris*, *Gaultheria fragrantissima*, and *Ligustrum sempervirens*, while the remaining eight species were clustered together more closely. At the same time, *Cupressus funebris*, *Gaultheria fragrantissima*, and *Ligustrum sempervirens* were also found to be frequent constituents of incense mixtures, while – based on interview data – the roles of the other species remain unknown. Whether this parallel can be explained with the preference of incense producers to mix the most different species together (e.g. in terms of the smell of their smoke) remains unclear.

Since the collected incense species were selected by the inhabitants of Shaxi for the smell of their smoke, further research could as well refocus on odiferous volatiles in such smokes. The odiferous VOCs present in incense smokes could be identified using a gas chromatographic device coupled with an olfactometer (GC-O; see Heitmann et al. (2009)).

Figure 11

Distribution of all smoke samples based on the first two discriminant functions.



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Appendix I Terminology

Minorities

The government of China does not recognize the term indigenous people and rejects its concepts and definitions as used on an international level (Pan 2008). Instead, it refers to the diverse ethnic groups inhabiting China as minzu, a term translated into English as „nation“, „nationality“, „ethnicity“, or „people“ (Gladney 1994). The term became prominent in the early 1950s, when the Chinese administration started an official ethnic identification program (minzu shibie), intended to classify so-called minzu‘s.

Subsequently, 55 ‚ethnic minorities‘ were officially recognized in China, based on a simplification of initially 400 reported groups (Huang 2006). Inherent to the term ‘minority’ is that minorities are made minorities by the state and put into unequal power relations with the majority and the state (Tan 2008). Although this state-driven ethnic identification represents a simplification of reality, it is nonetheless seen as a stable basis for scholar discourse and a framework for the integration of fieldwork-derived rationale (Harrell 1984:12-13).

Tomb Sweeping Day

Qingmingjie, also called the Pure Bright Festival or Tomb Sweeping Day, is a traditional festival to worship the surviving ghosts of the ancestors. It takes place on the 106th day after winter solstice of the lunar calender (April 4th or 5th of the Gregorian calendar). Tomb Sweeping Day is based on the principal conception that the spirit of a dead person survives the body, and that spirits are superior to human and nature. Therefore, it is favorable to keep the ghosts of the deceased happy, especially if they have been neglected, or if the person has died a death that dooms them to eternal wandering. Qingmingjie ceremonies can include the tidying up of the family tomb and the surrounding area, the offering of foods, kowtowing, and the burning of candles, paper money, and incense. The original reason for the festival to take place between winter and spring is probably the general ‚rebirth‘ of nature from winter dormancy during this time. (Latsch 1986:46-54)

Dragon Boat Festival

Duanwujie, also called Dragon Boat Festival or Duan Yang (meaning the ‚upright sun‘), takes place on the 5th day of the 5th month and falls right into the middle of summer. The ceremonial

activities in ancient China evolved as a way to conciliate the River God. Dragons were believed to control the rivers, and thus the distribution of the rainfall, which is crucial for agriculture, especially during the following rainy season starting in the 6th month. The Dragons were propitiated to distribute rainfall evenly, and not in floods and droughts. Later, the festival turned into a ceremony in remembrance of Qu Yuan, a poet and political figure of the Chu State in the Warring States Period. (Latsch 1986:55-56)

Shen Nong

„Shen Nong [...] was an early deity, listed as one of the Shang Di (High Gods) of the Han royal house. He is regarded as the first farmer, the founder of natural medicine, and, as both a Daoist and popular religion deity, the God of husbandry or agriculture. He was worshipped in all parts of China and is probably the best-known of the Chinese culture heroes. His myth embodies the folk memory of the neolithic agriculturists. As a sagacious primeval ruler, he has been credited with inventing many of China‘s farming implements, introducing mankind to ploughs made of wood and to the art of cultivation of the five grains (Wu Gu): hemp, millet, rice, wheat, and pulse. He also established the concept of markets to exchange produce and is said to have invented pottery and the axe.
Legends describe how Shen Nong became the first to analyze the beneficial and harmful properties of herbs and to list their efficacy by testing hundreds of them on himself. He is said to have had a transparent stomach, so whatever he ate could be observed; he often nearly died from these tests, until finally one day he did, where upon his body turned black.“ (Stevens 2001:36-37)

Men Shen

„Door Goods or Door Generals, Men Shen [...] usually consist of a pair of spirits facing each other and can be fierce, or not so fierce, soldiers dressed in armour; a soldier and a scholar; or two mirror images of soldiers or scholar-officials facing each other. The majority of Door Gods have no legend, but the most common story in northern China about them describes how two mighty heroes, Generals Shen T‘u and Yü Lei, took up arms against the tens of thousands of wandering demonic spirits and successfully undertook their extermination. Huang Ti [...], in whose time they lived, gave orders that the entrance doors to his palace were to be painted with their portraits to keep out marauding and malign spirits.“ (Stevens 1997:177)

Long Wang

„Daoist mythology spells out the organization of the Celestial Ministry of the Waters, in which the ministers, the numerous Long Wang (Dragon Kings) [...], live in their own places at the bottoms of their oceans, lakes, and rivers. They visit the heavens during spring, but return to the deep early every autumn. Dragon Kings are the guardian spirits of oceans, lakes, and rivers, but in some areas they are believed also to be the direct cause of earthquakes, fogs, and damage to river banks. They are also responsible for the rain clouds and agricultural fertility resulting from adequate and controlled annual rainfall. As they are the moving spirits of storms and rain, Dragon Kings are also often blamed for floods and water catastrophes.“ (Stevens 2001:64)

Zao Jun

„Between the twelfth day of the final lunar month and Lunar New Year‘s Day, the Jade Emperor personally receives the annual report on every household from each individual Kitchen God [...]. This God of the Family Hearth (or Family Stove), known in Chinese as Zao Jun, is usually called the Kitchen God by foreigners. He is the most widespread of the deities found in Chinese homes, though he has nothing to do with either food or cooking. Rather, Zao Jun is the family tutelary deity in charge of the family‘s destiny and is a Celestial Inspector, the domestic representative of the Jade Emperor, who oversees and reports the behaviour of the family.

From these reports the Jade Emperor examines everybody‘s conduct and adds his comments to the dossier kept on every living person against the day of death, when each human is summoned to enter the Courts of the Underworld for judgement.“ (Stevens 2001:51)

Shan Shen

„Shan Shen, the God of the Local Mountain, is an impersonal deity who, like the Spirit of the Well, the God of the Bridge, and others, is an Earth God. These mythical spirits of the local hill or mountain are only rarely identified with a historical person or mythical creature, being simply the nameless Spirit of the Mountain. As keeper and controller of the hills, each is responsible for its mineral and arboreal wealth. Peasants pray to the Spirit Official of the inorganic matter of the hills so that he might reveal to them the treasures concealed within. Peasants and herbalists pray to Shan Shen to protect them against wild creatures before they venture on the hillsides to gather

firewood or medicinal herbs. The Spirits of the Mountain, Well, Bridge, and so on are nearly always represented by a dressed stone dedicated to and bearing a simple title, such as ‚The Spirit of This Mountain'." (Stevens 2001:32-33)

Appendix II Interview Guidelines

Leitfrage 1: Fragen zur Begründung der Verwendung		
Inhaltliche Aspekte	**Konkrete Nachfragen**	**Aufrechterhaltungsfragen**
Transfer Gründe	Warum nimmt man genau diese Pflanze (und nicht eine andere)? 你为什么用这个植物不用那个 Könnte man diese Pflanze durch eine andere ersetzen? 除了这个你可以用别的吗 Ist es wichtig, dass genau diese Pflanze verwendet wird? 用这个很重要吗 Kennst du Leute, die mit anderen Pflanzen räuchern? 你知道有人用别的植物 Kannst du sie mir zeigen? 你可以让我们看一看	Wo wachsen die Pflanzen? 你用的植物长在哪 Wer sammelt die Räucherpflanzen? 谁采那些做香的植物 Muss man beim Sammeln spezielle Regeln beachten? 采那些植物有什么规矩 Sammelst du die Pflanzen selbst? 你自己采那些植物吗 Ist es schwierig, die Pflanzen zu finden? 找到那些植物难吗

Leitfrage 2: Wissenstransfer		
Inhaltliche Aspekte	**Konkrete Nachfragen**	**Aufrechterhaltungsfragen**
Personen Alter Transfer	Woher kommt das Wissen? 你怎么知道那些植物 Seit wann räucherst du? 你从什么时候开始烧香 Von wem hast du es gelernt? 谁教你烧香 Wer interessiert sich für das Räuchern? 谁对烧香感兴趣 Gibts du das Wissen auch weiter? 你教什么人烧香	

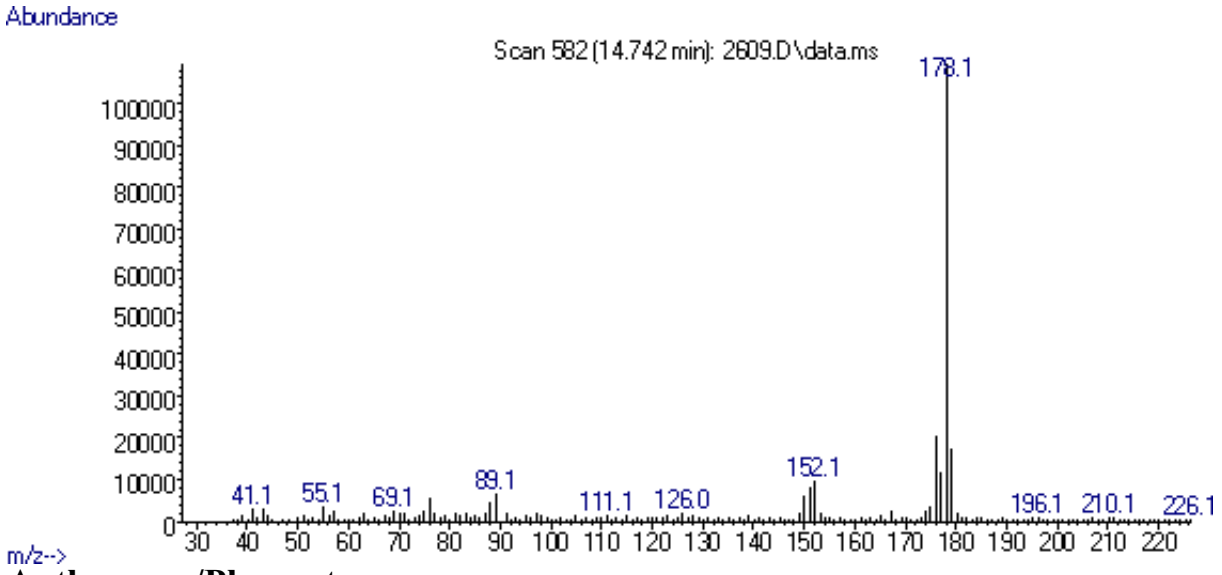
Leitfrage 3: Fragen zur praktischen Verwendung der Pflanzen		
Inhaltliche Aspekte	**Konkrete Nachfragen**	**Aufrechterhaltungsfragen**
Praxis Kontext Ort Zeit Gegenstände	Wer nimmt an einer Räucherung teil? 你和谁一起烧香 Gibt es Rituale, die vor, während oder nach Räucherungen stattfinden? 烧香以前或以后有特别的活动吗 Wie funktioniert das Räuchern genau? 你怎么烧香 Zu welchen Zeitpunkten werden Pflanzen geräuchert? Tags oder nachts? 烧香有特别的时间吗 Wo wird geräuchert? 你在什么地方烧香 Welche Gegenstände werden gebraucht zum Räuchern? 你烧香用特别的工具吗 Muss es besonders stark rauchen oder reicht es, wenn man sie einfach verbrennt? 你怎么知道这种香好 Gibt es Zeremonien beim Räuchern? 烧香的时候有什么仪式	Dürfen nur bestimmte Personen die Räucherungen machen? 烧香有固定的人吗 Gibt es Zeiten, in denen man auf keinen Fall räuchern darf? 什么时候不能烧香 Müssen diese Gegenstände gesegnet/gereinigt werden? 你需要准备那些工具吗 Räuchert man alleine oder gemeinsam? 你自己烧香或者和别人一起 Wie oft wird geräuchert? 你常常烧香 Gibt es spezielle Orte wo Räucherungen stattfinden? 你知道特别的地方可以烧香 Wird draussen oder drinnen geräuchert? 你在外边还是里边烧香 Darf man während des Räucherns reden? 烧香的时候你念什么 Singst du beim Räuchern? 烧香的时候你唱什么 Wie fühlst du dich dabei? 烧香的时候你有什么感觉 Gibt es Leute, die nicht an einer Räucherung teilnehmen dürfen? 有没有人不能参加 有没有人不允许 Wer, neben dir, räuchert sonst noch? 除了你还有谁可以烧香 Wirfst du dich beim räuchern nieder? 烧香的时候你磕头吗 Warum? 为什么要磕头

Leitfrage 4: Weltanschauung der praktizierenden Person		
Inhaltliche Aspekte	**Konkrete Nachfragen**	**Aufrechterhaltungsfragen**
Glaubens-aspekte Religion Empfundener Duft	Bist du ein gläubiger Mensch? 你有信仰吗 Hat das Räuchern etwas mit Religion zu tun? 烧香和信仰有什么关系 Haben diese Pflanzen einen Geist in sich? 这些植物里面有神吗 Welche Rolle spielt der Geist dieser Pflanzen? 这些神起什么作用 Hat der Rauch eine Seele? 烟有没有神 Duften die Pflanzen oder stinken sie eher? 这种植物的味道好不好	Sprichst du beim Räuchern mit Geistern? 烧香的时候你对神说什么

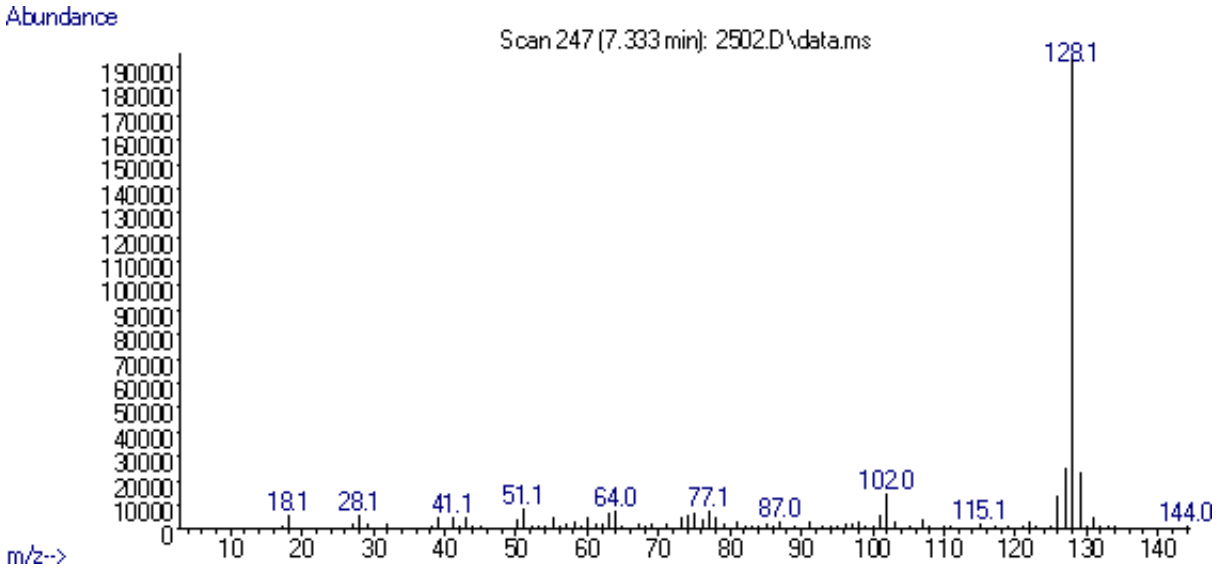
Leitfrage 5: Soziale Stellung und Ökonomie		
Inhaltliche Aspekte	**Konkrete Nachfragen**	**Aufrechterhaltungsfragen**
Beruf Netzwerk Ansehen Ruf des Räucherns	Was denken die anderen, warum du räucherst? 你烧香的时候别人怎么想 Was würden die anderen denken, wenn du nicht räuchern würdest? 如果你部烧香别人怎么想 Kennst du jemanden, der/die nicht räuchert? 你知道不烧香的人吗	

Leitfrage 6: Fragen zur theoretischen Verwendung (Wirkung, Bedeutung, Grund,...)?		
Inhaltliche Aspekte	**Konkrete Nachfragen**	**Aufrechterhaltungsfragen**
Welche Pflanzen Präparierung Wirkung Zweck Bedeutung	Welche Räucherpflanzen kennst du? 你做香用什么植物 Welche Pflanzenteile werden geräuchert? 那部分 Wie werden sie präpariert? 你怎么加工 Für welche Wirkung werden sie geräuchert? 烧香的作用是什么 Wie merkt man, ob die erhoffte Wirkung eingetroffen ist? 你怎么知道烧香有作用 Hat das Räuchern eine Bedeutung? 烧香的意思是什么 Warum wird geräuchert? 你为什么烧香 Was löst das Räuchern bei dir aus? 烧香给你什么感觉 Woran erkennt man die Pflanzen, wenn man sie sammelt,kauft? 你怎么知道这种植物可以烧	Wird ausser Pflanzen noch anderes zum Räuchern verwendet? 除了植物还用什么东西 Gibt es Räucherungsmischungen? 需要混合植物吗 Welche ist deine Lieblings-Räucherpflanze? 你最喜欢烧什么香 Kann/Darf man mehrere Pflanzen gleichzeitig räuchern? 同时还烧别的植物 Was ist der Zweck des Dufts? 烧香有什么好处 Was ist sonst noch wichtig? 烧香的时候还需要做什么 Was passiert Leuten, die nicht Räuchern? 如果你不烧香会发生什么 Kann man die Pflanzen auch sonst noch für etwas gebrauchen? 香除了烧还有什么用处

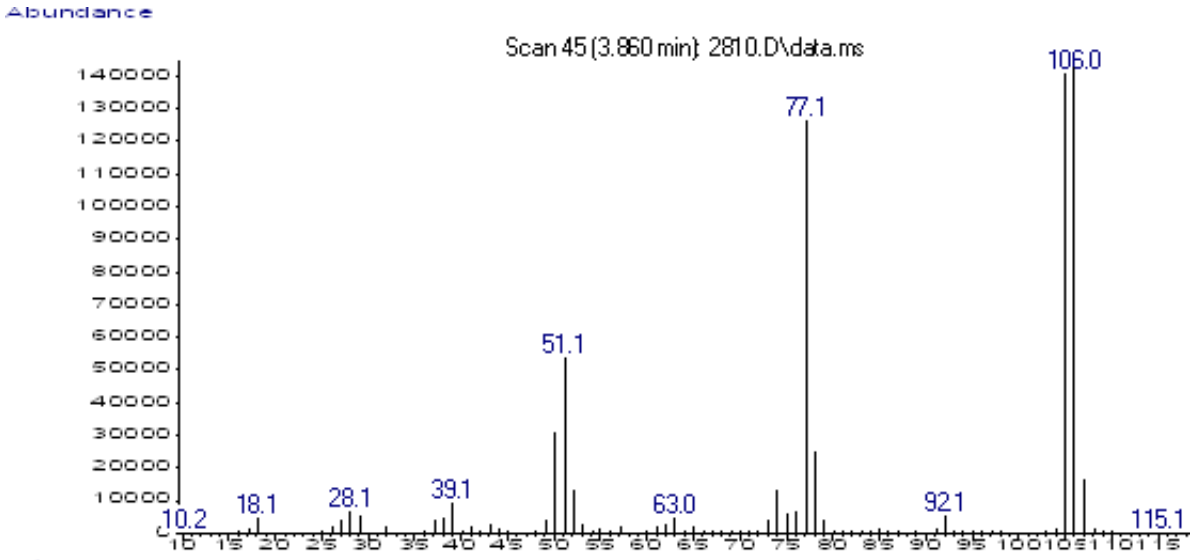
Appendix III MS-Spectra



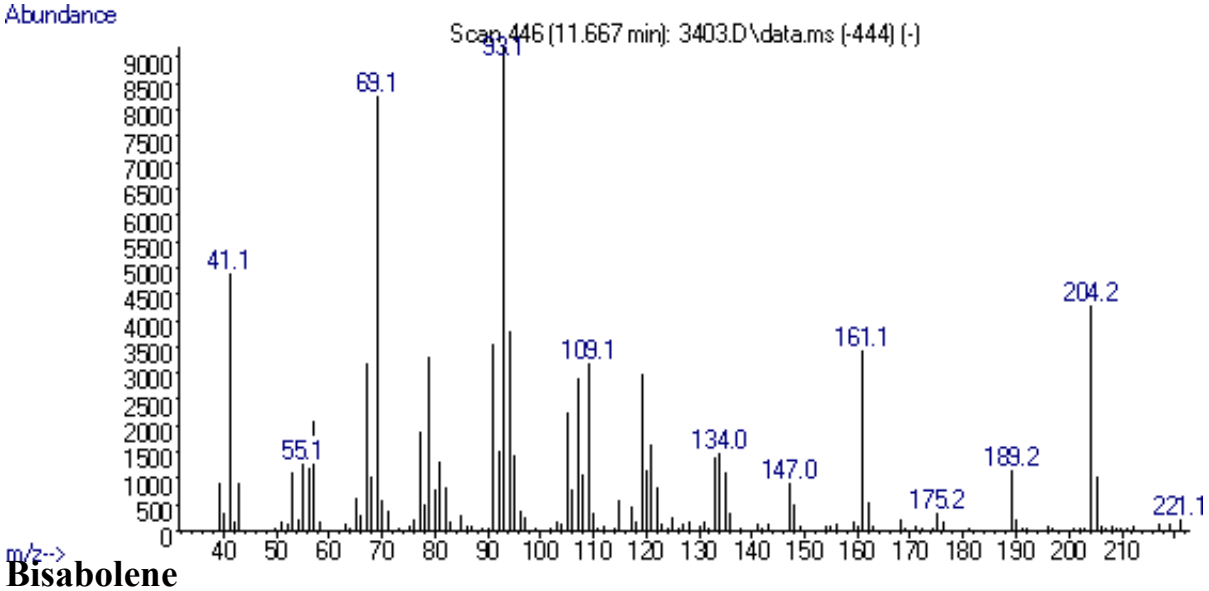
Anthracene/Phenantrene



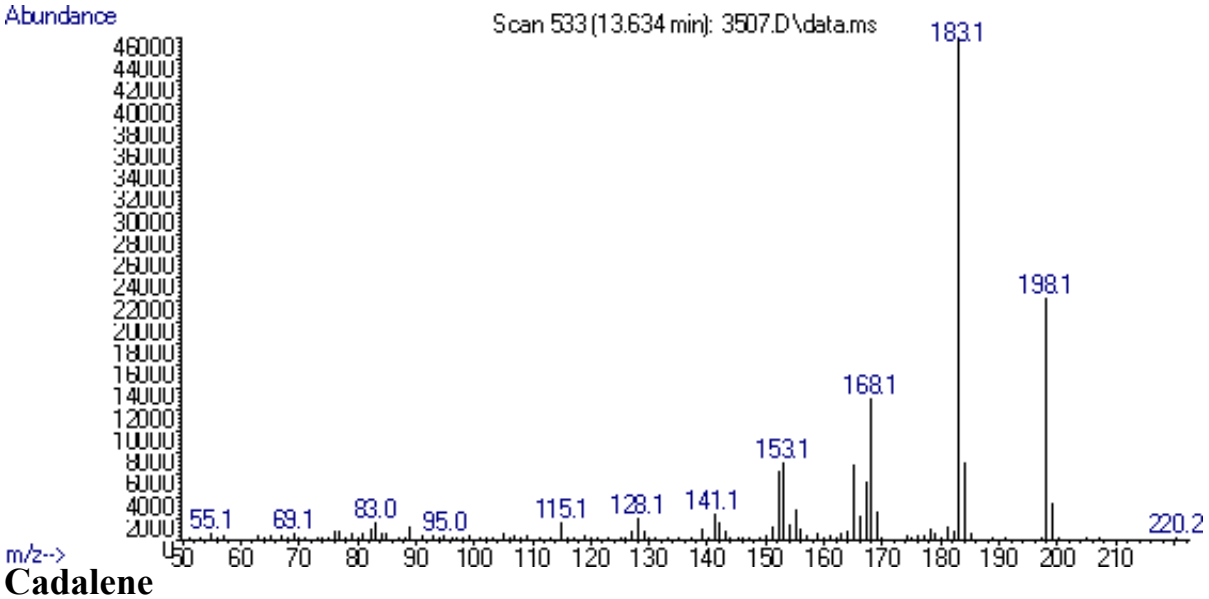
Azulene/Naphthalene



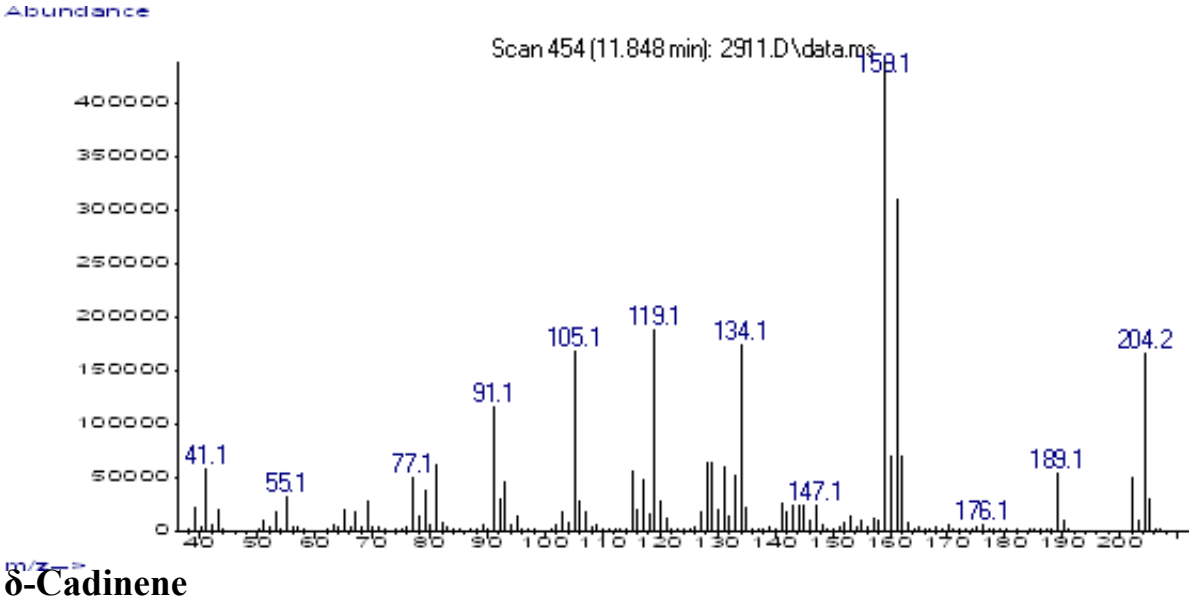
Benzaldehyde



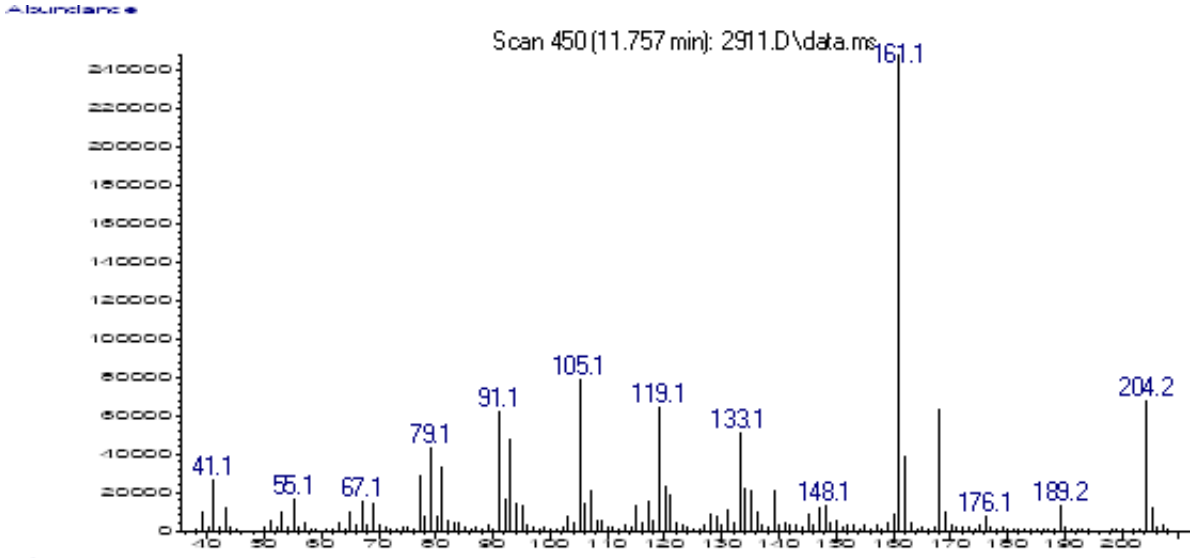
Bisabolene



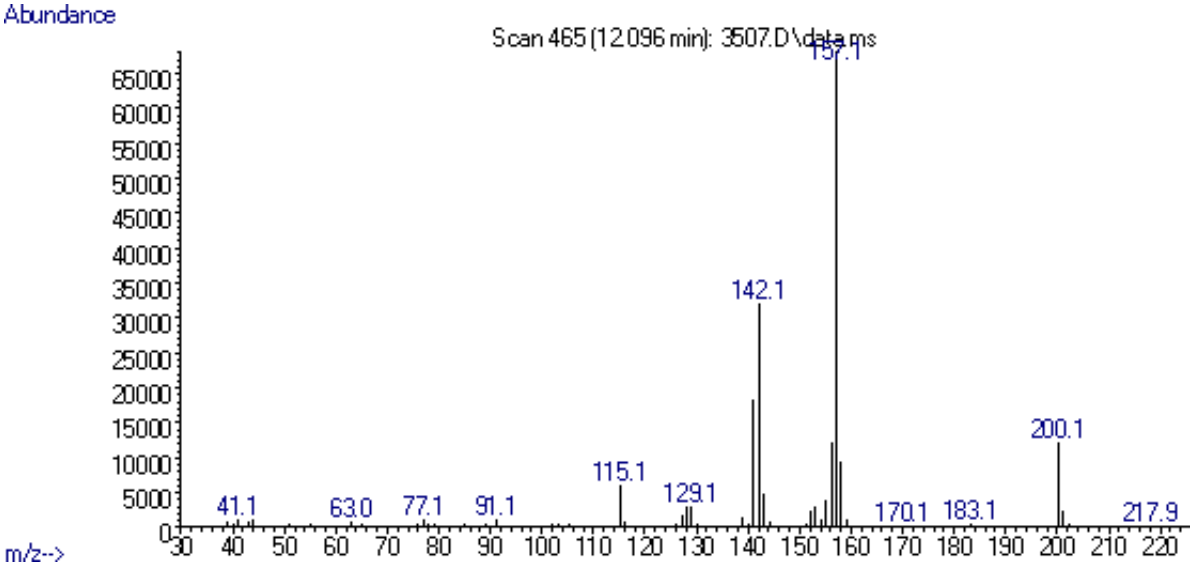
Cadalene



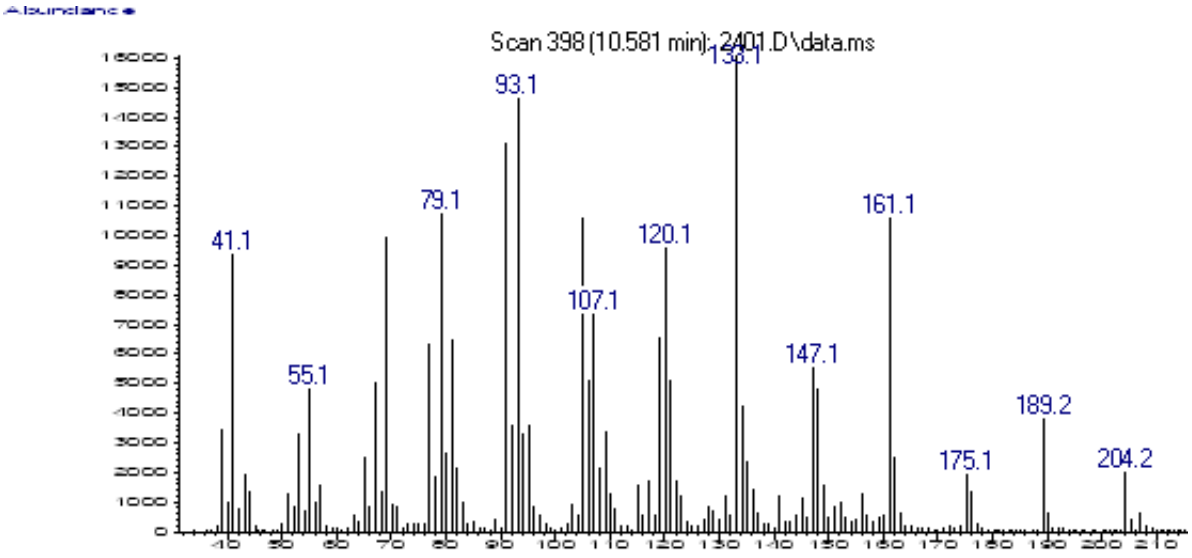
δ-Cadinene



γ-Cadinene

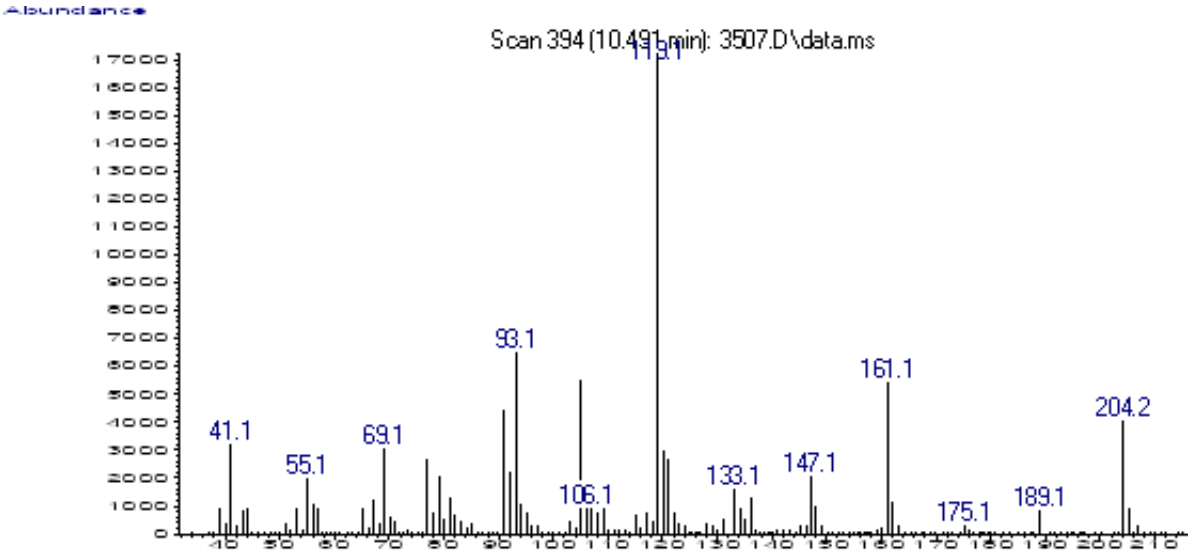


Calacorene

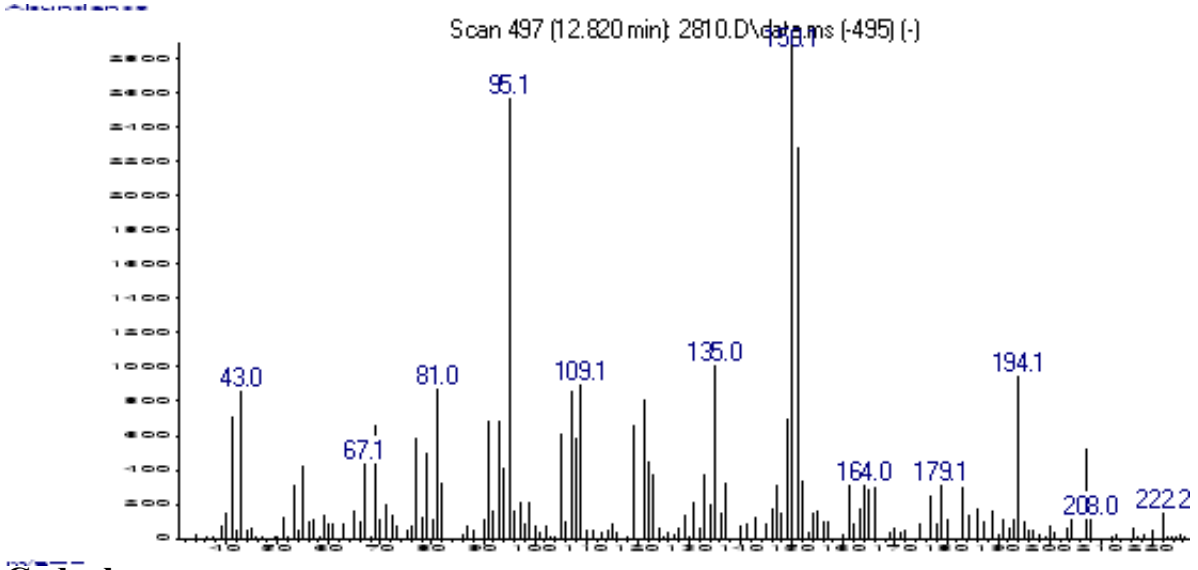


β-Caryophyllene

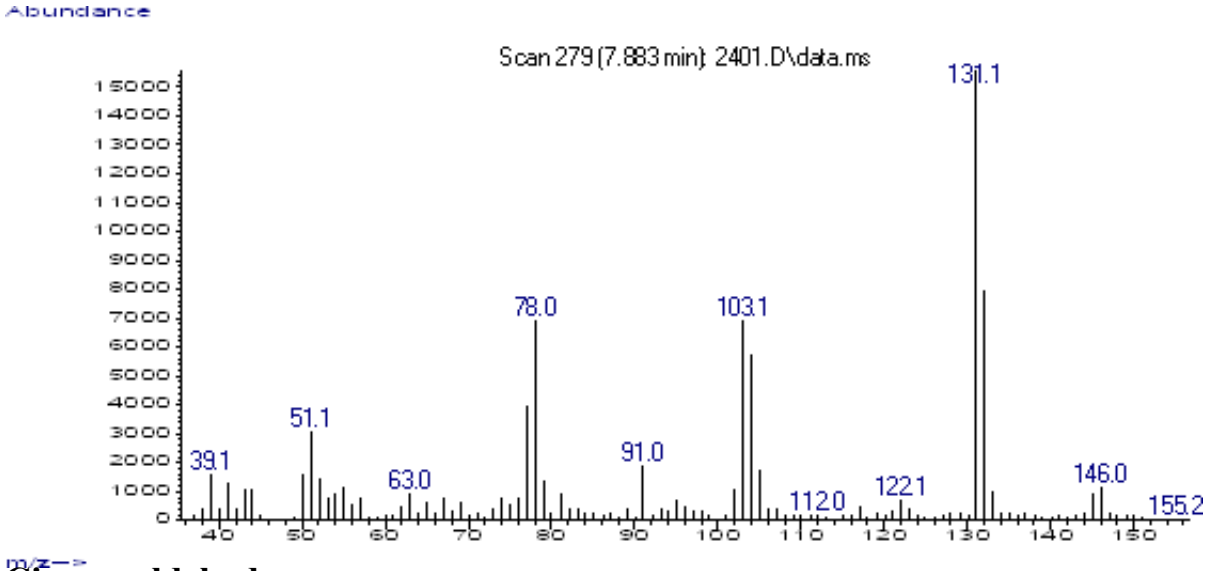
Anthracene/Phenantrene



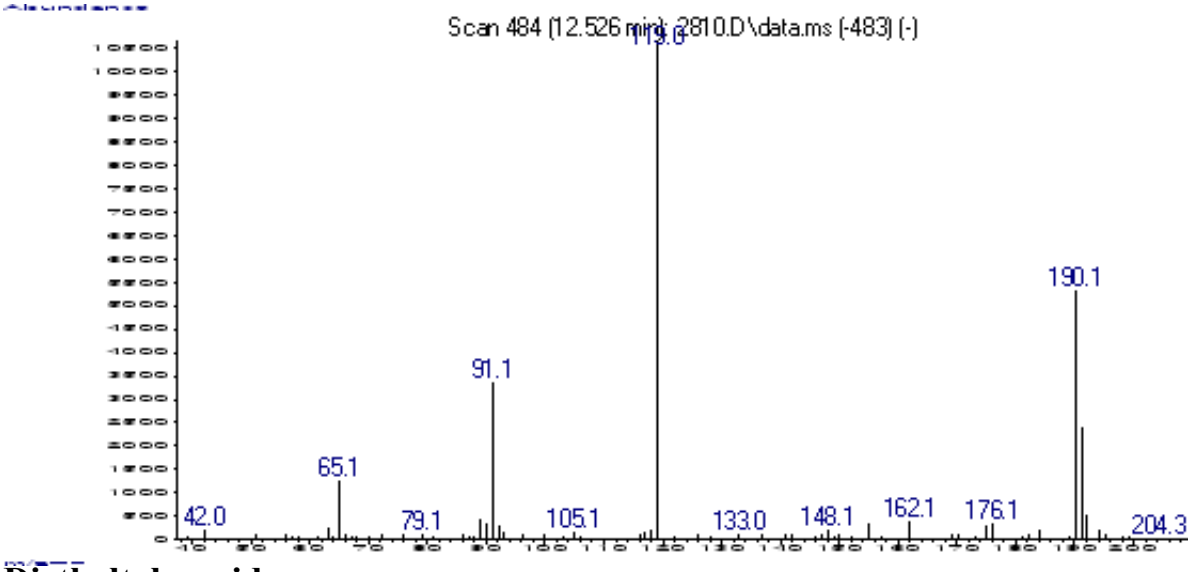
Cedrene



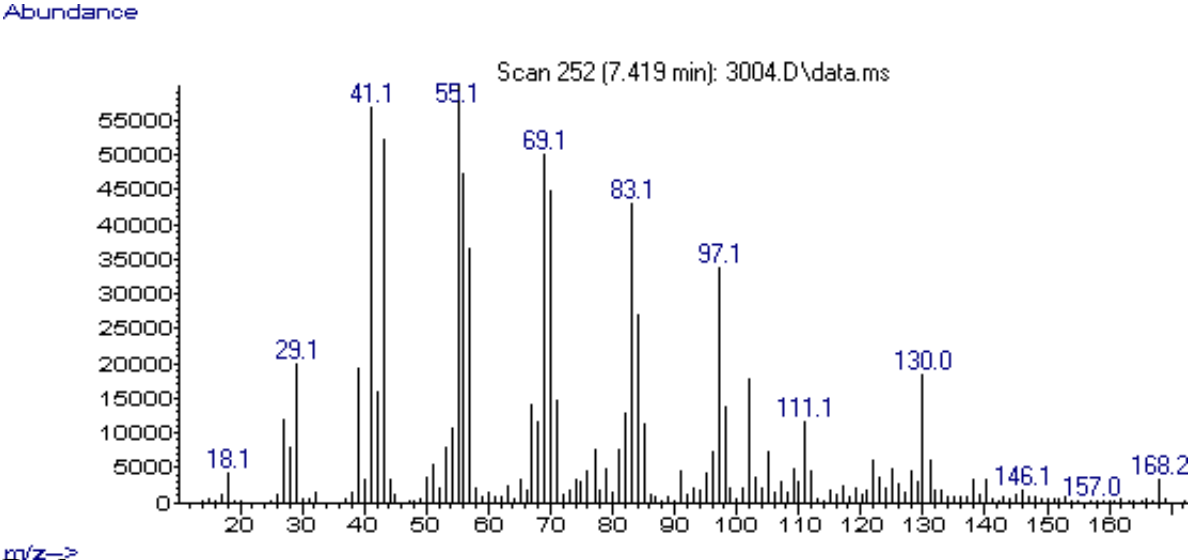
Cedrol



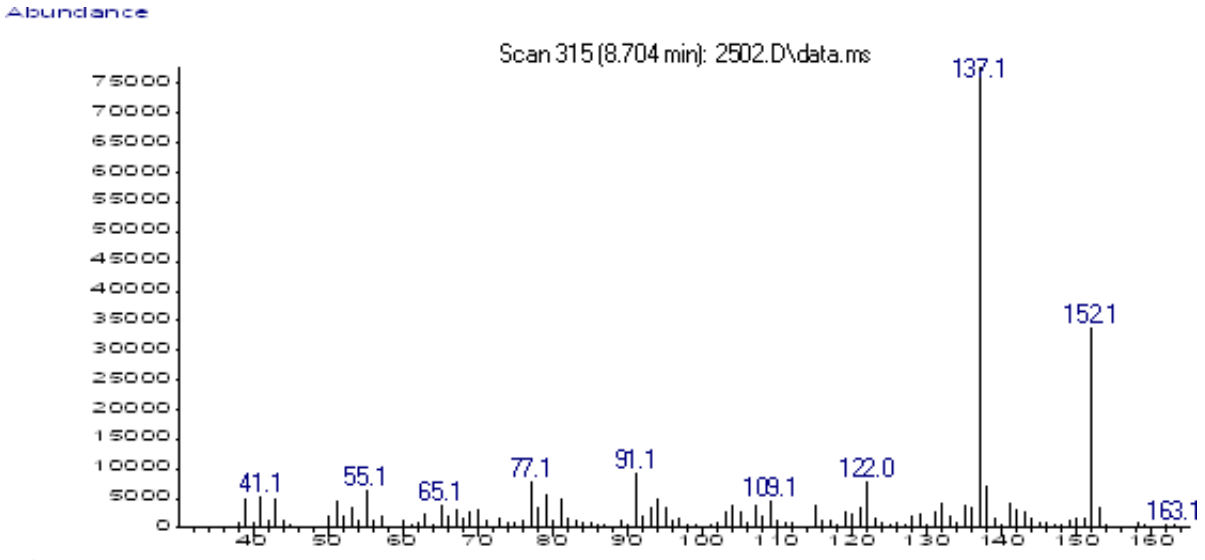
Cinnamaldehyde



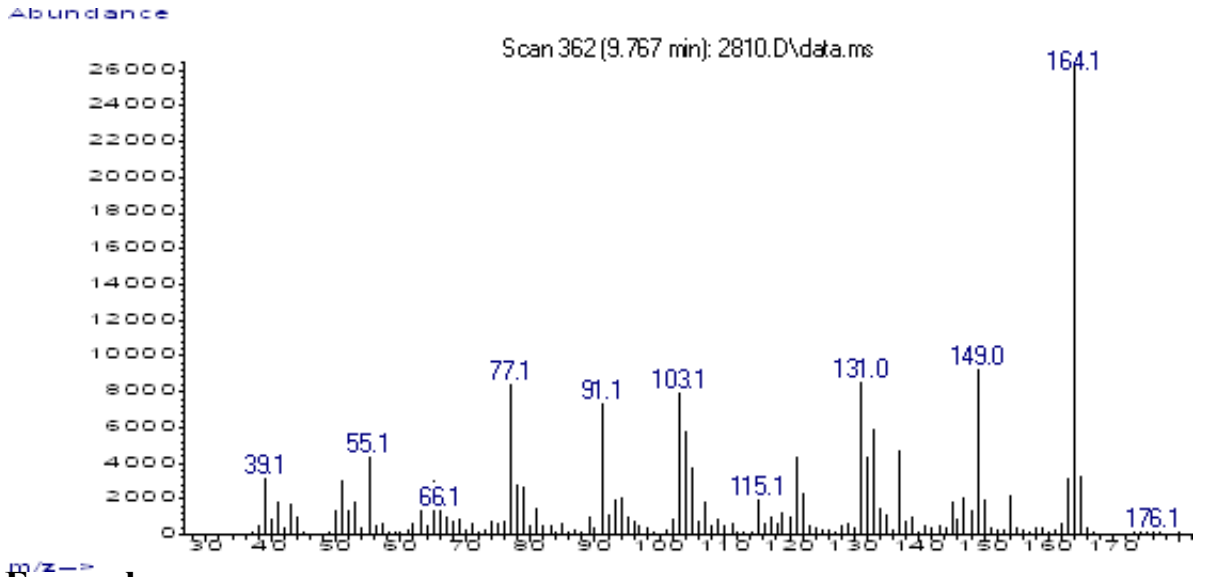
Diethyltoluamid



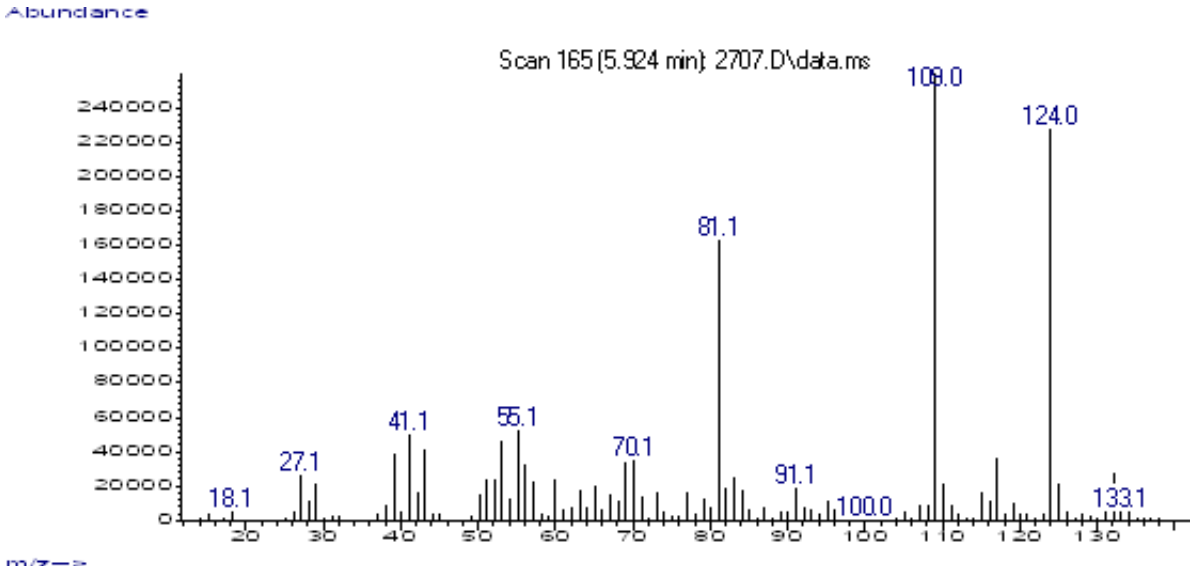
Dodecene



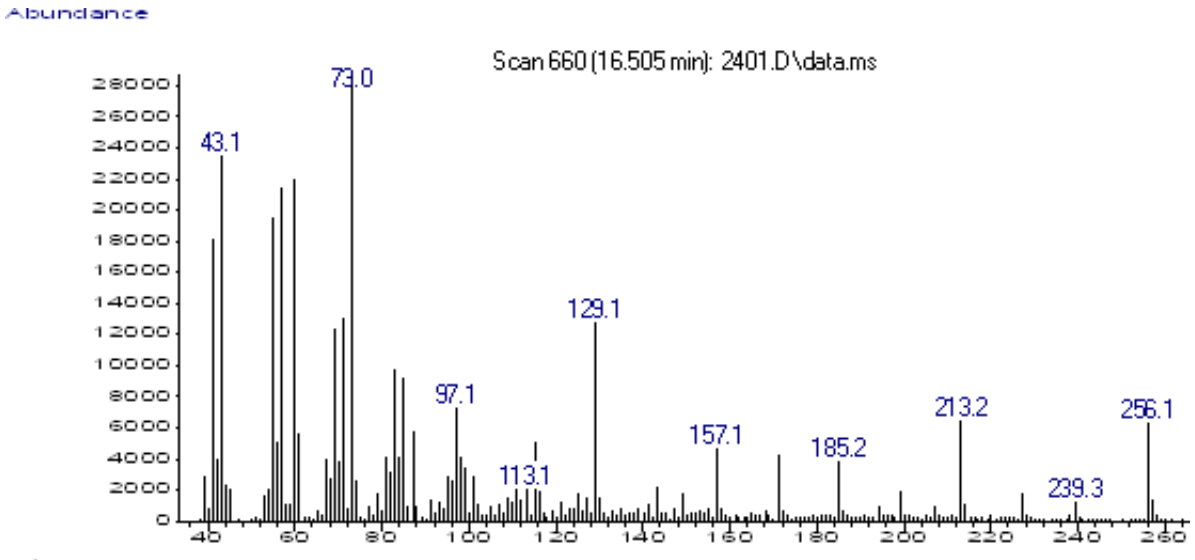
Ethylguaiacol



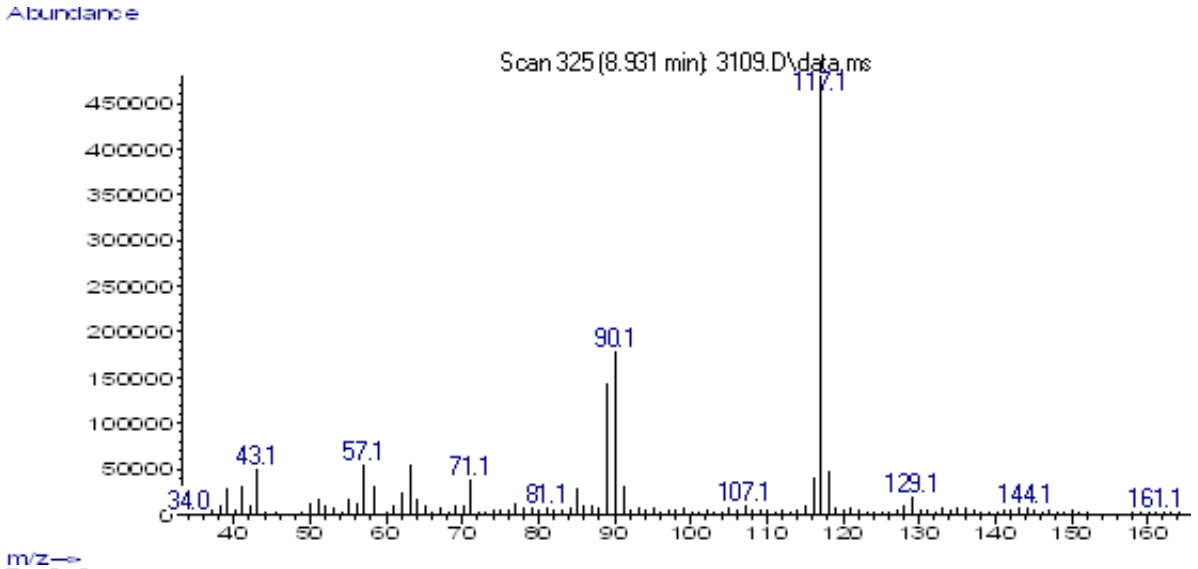
Eugenol



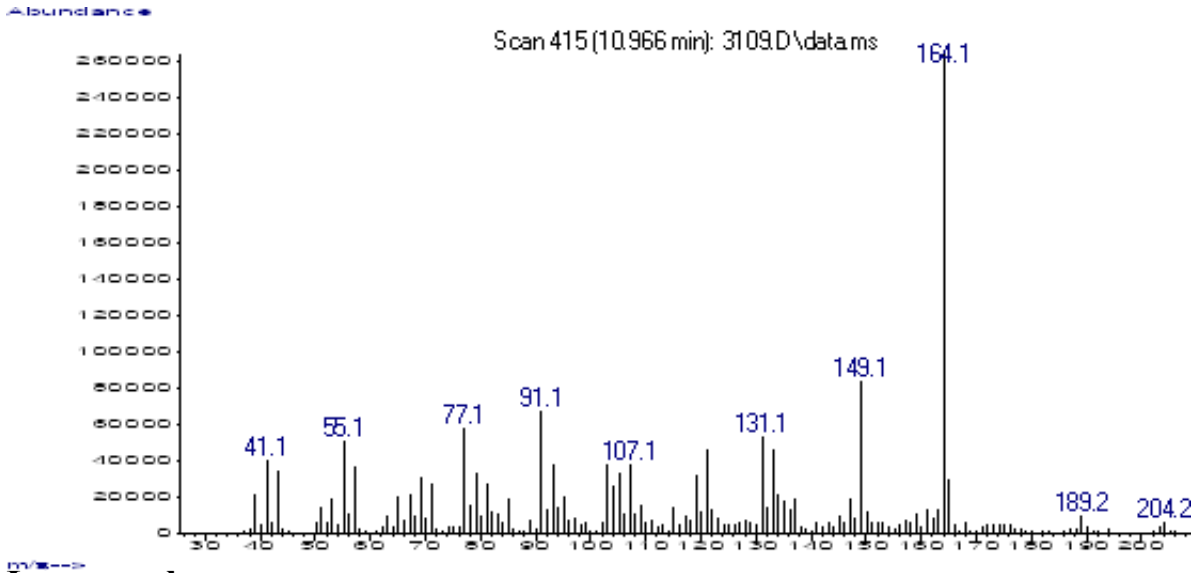
Guaiacol



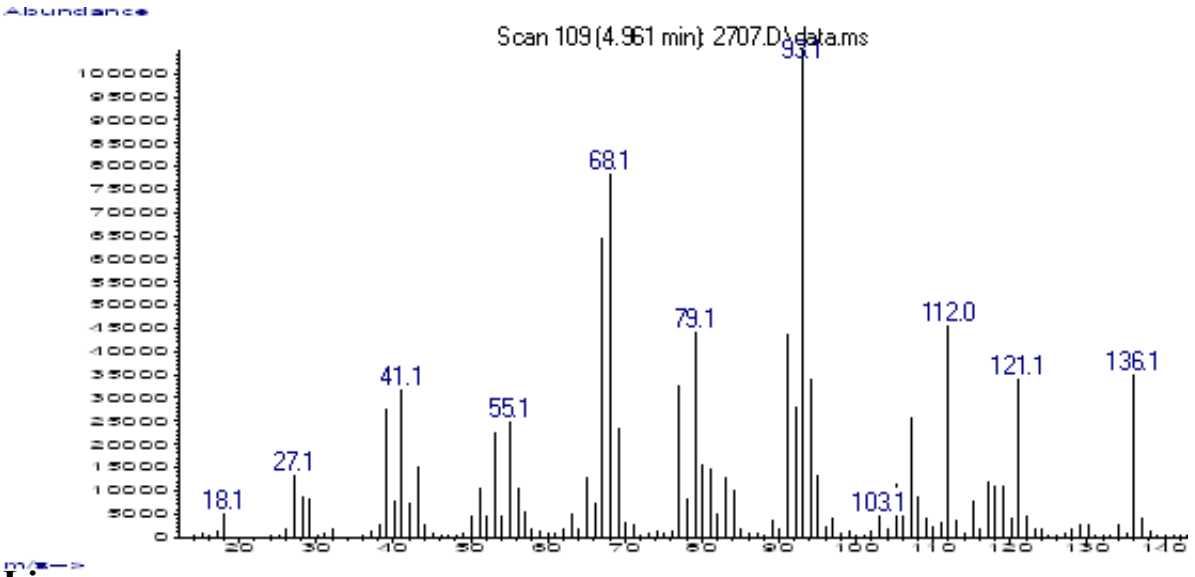
Hexadecanoic acid



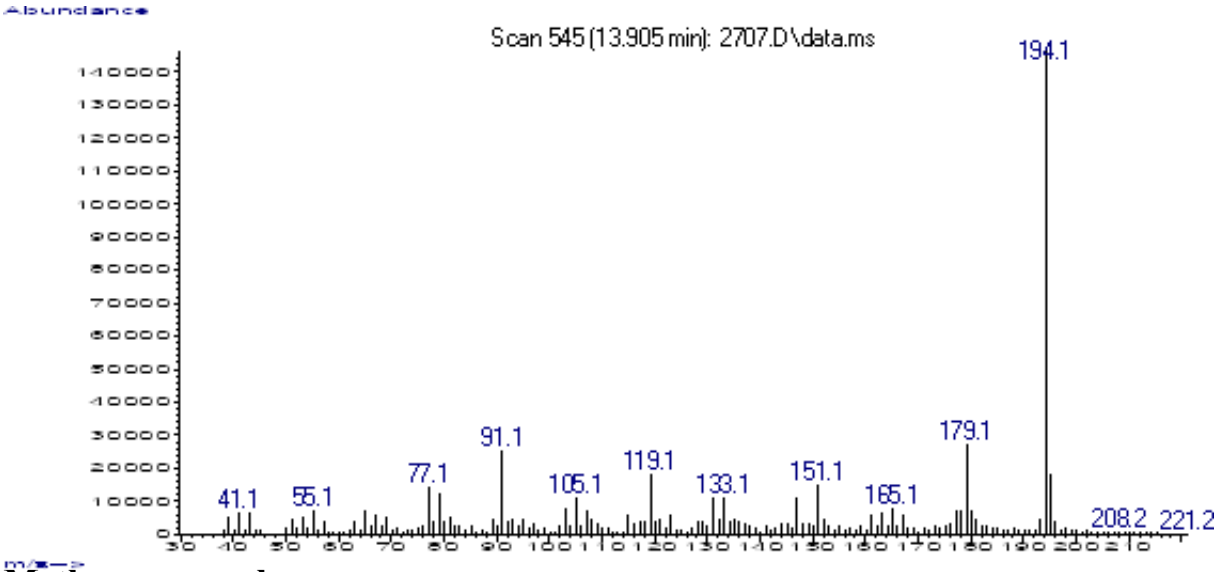
Indole



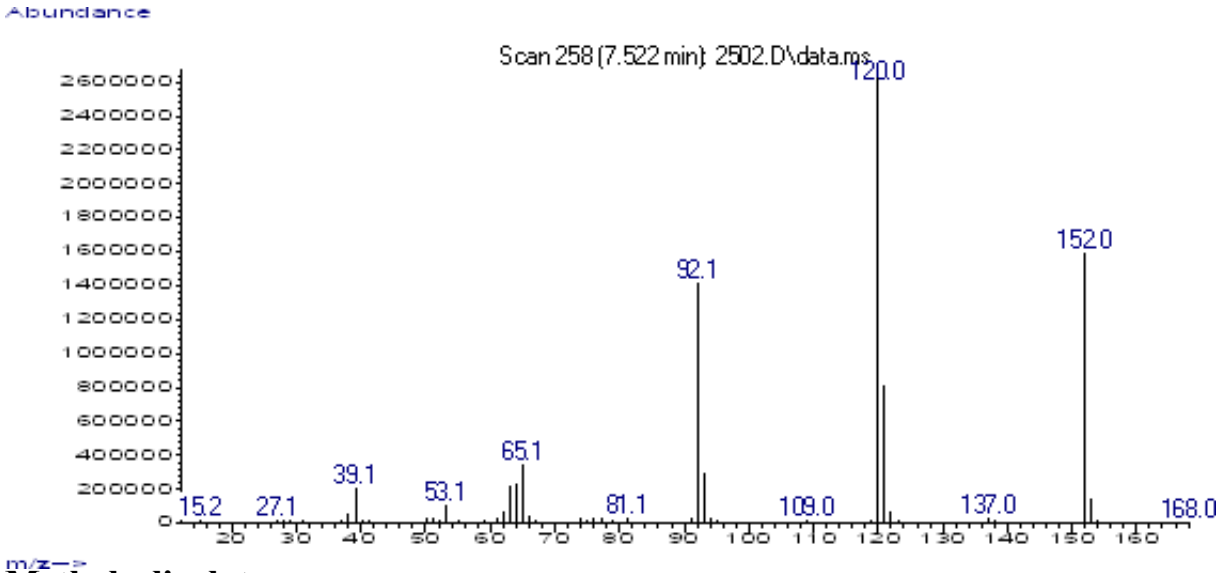
Isoeugenol



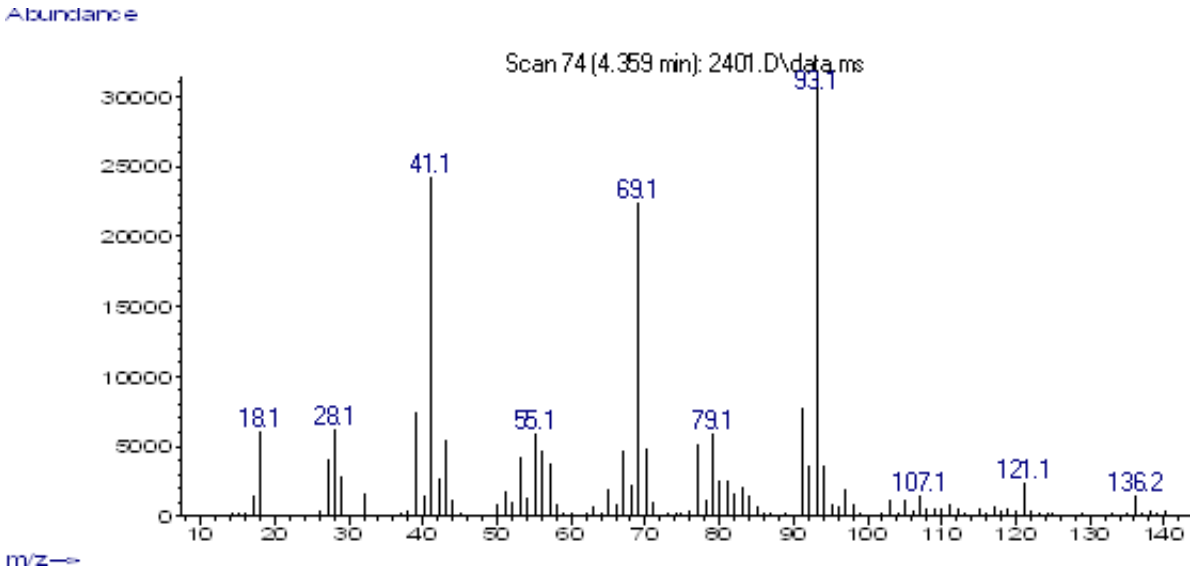
Limonene



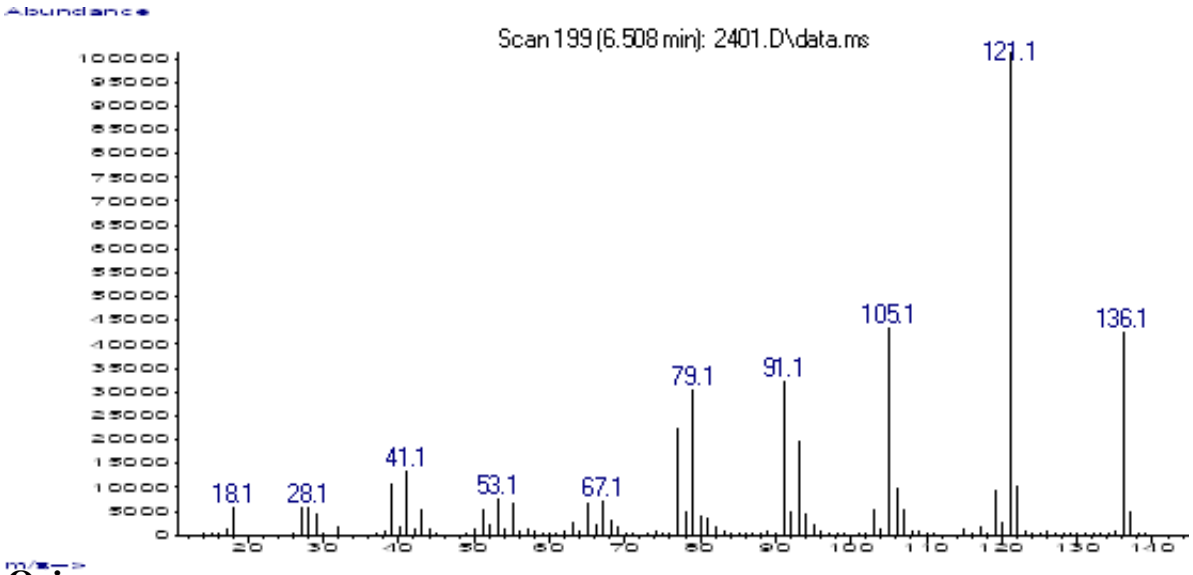
Methoxyeugenol



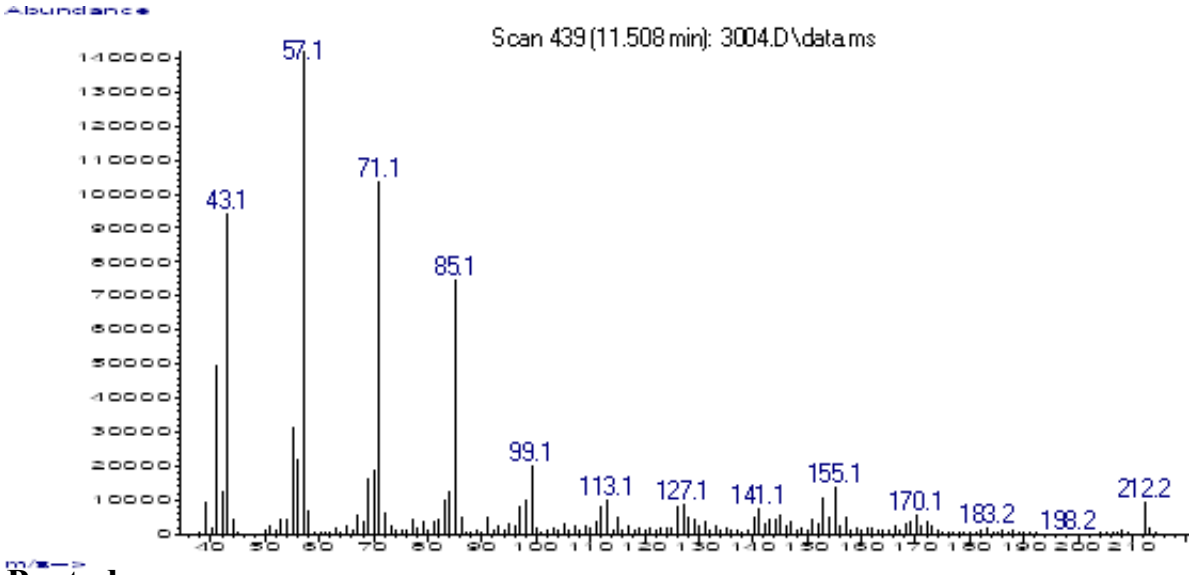
Methylsalicylate



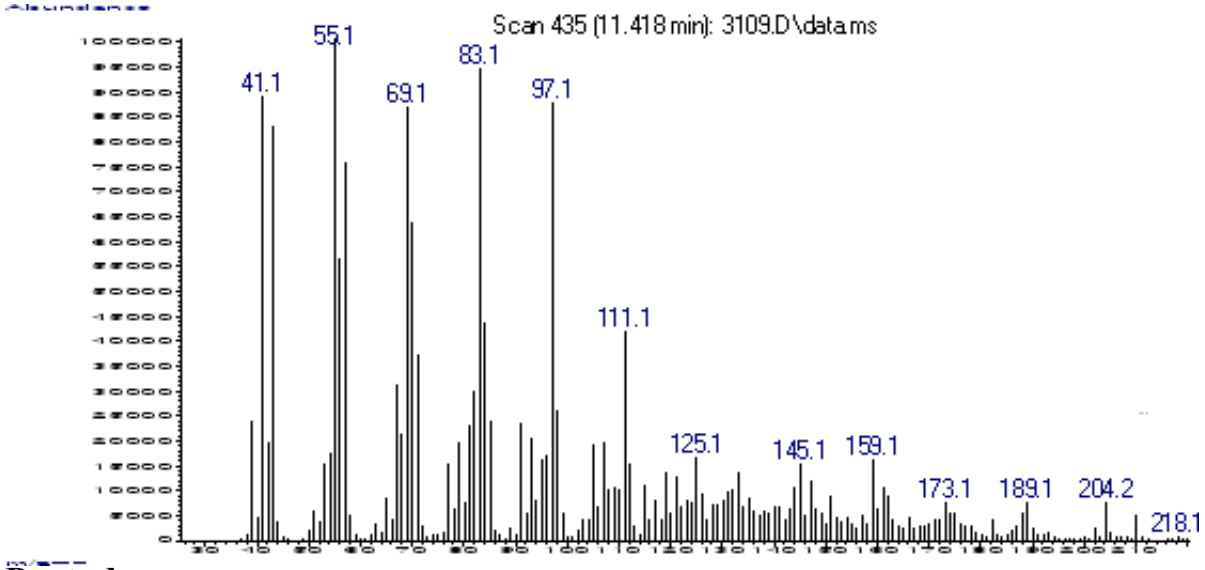
β-Myrcene



Ocimene



Pentadecane



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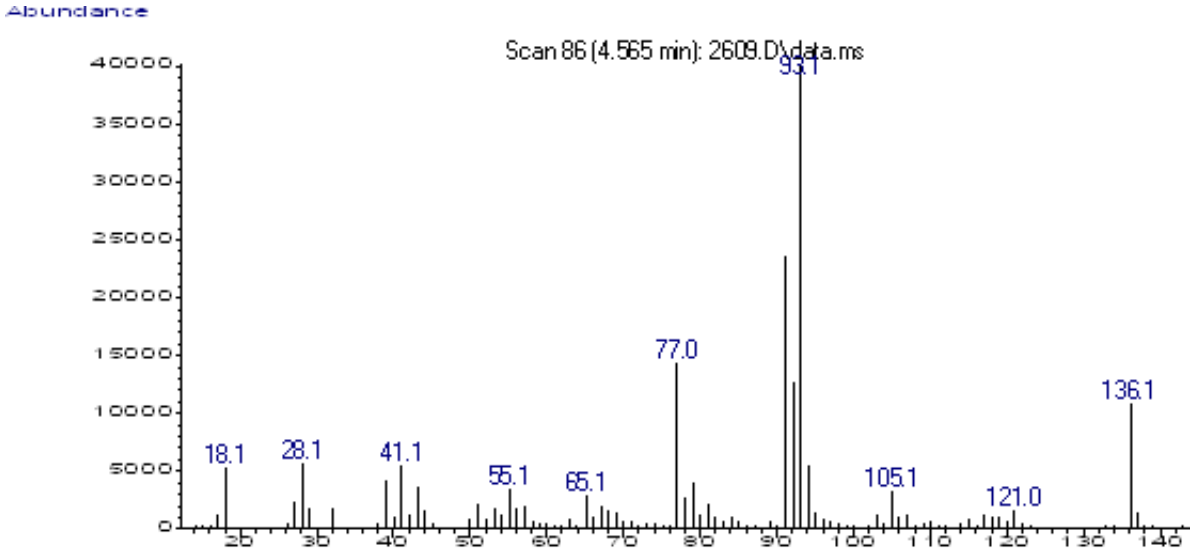
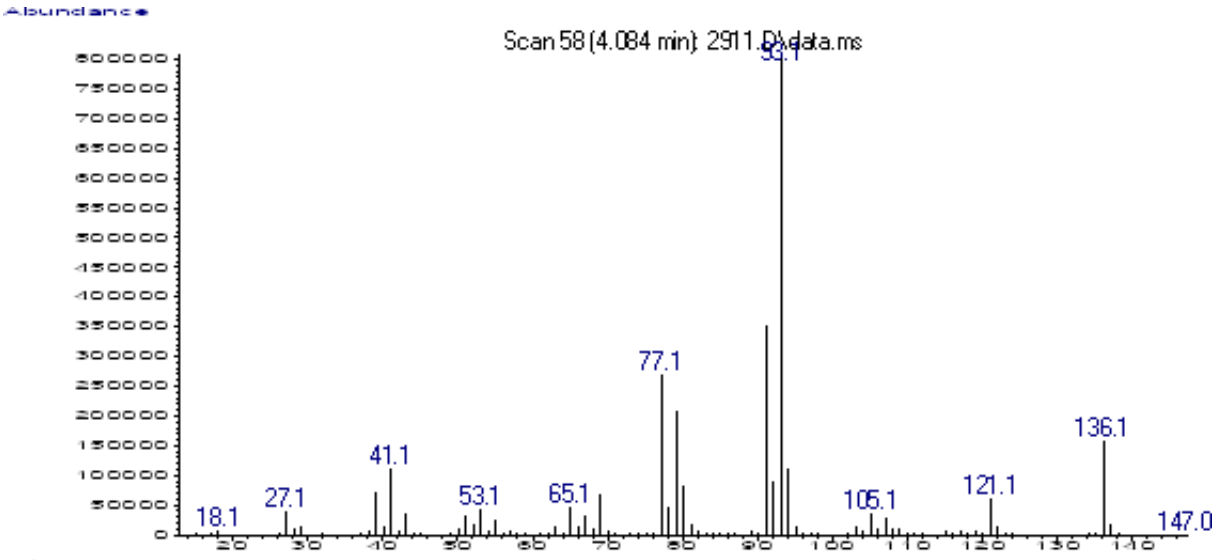
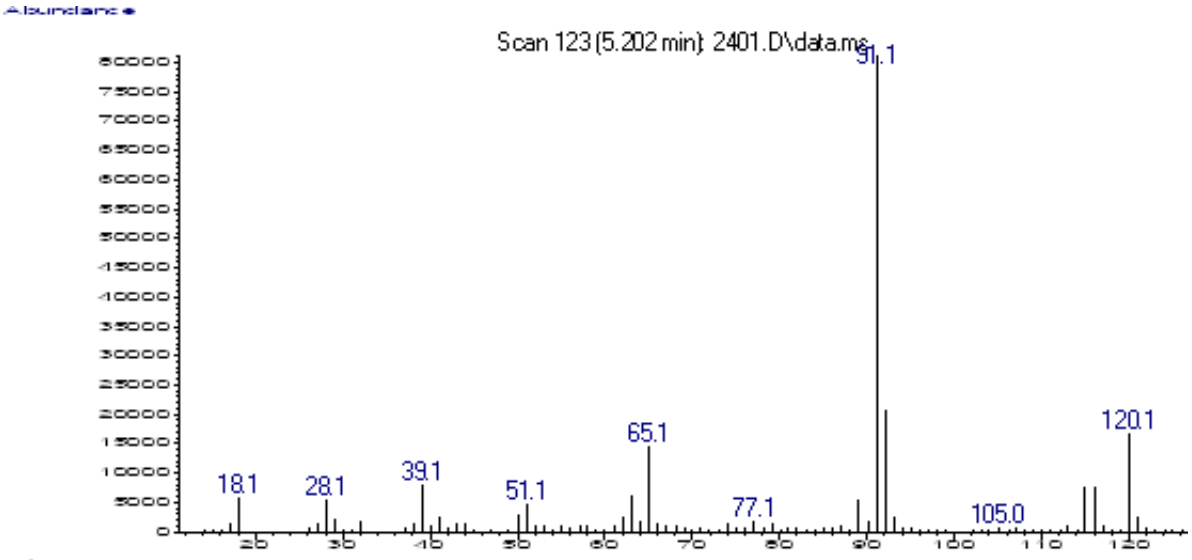


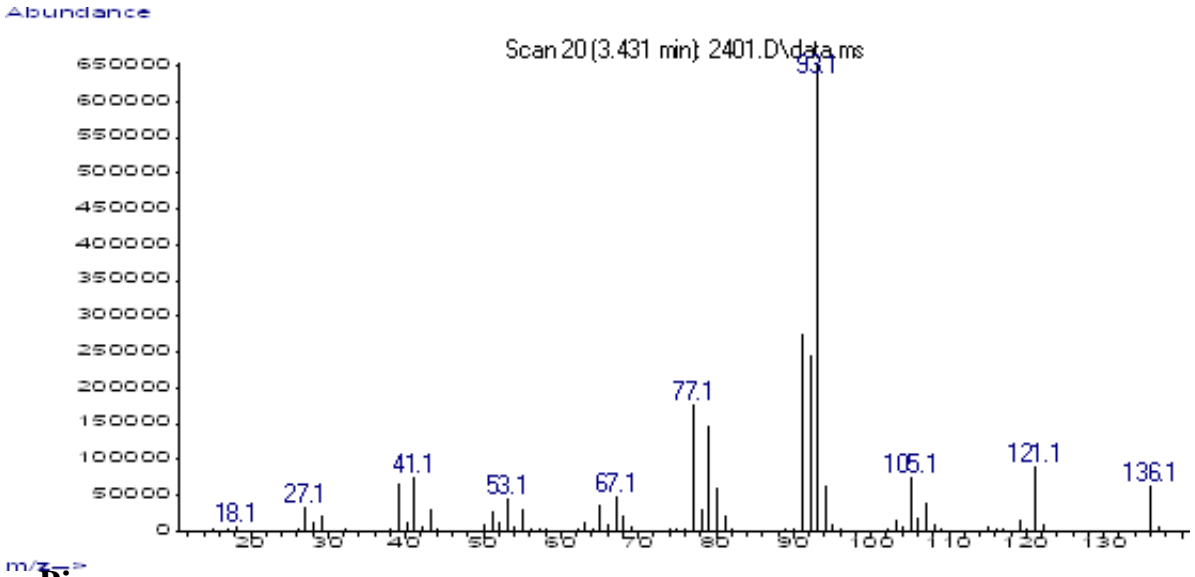
α-Phellandrene



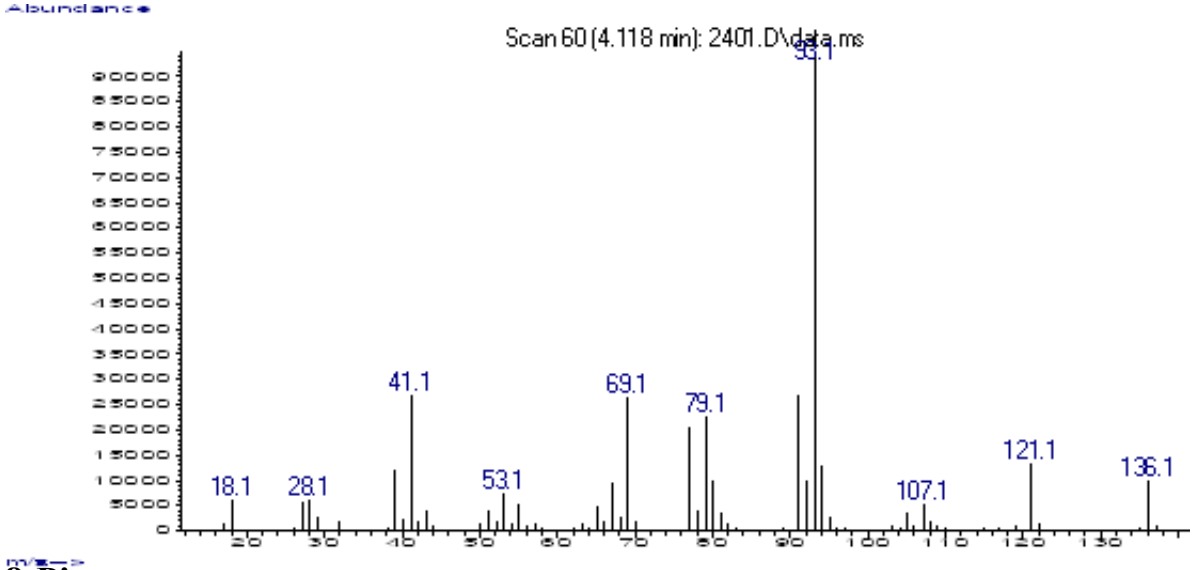
β-Phellandrene



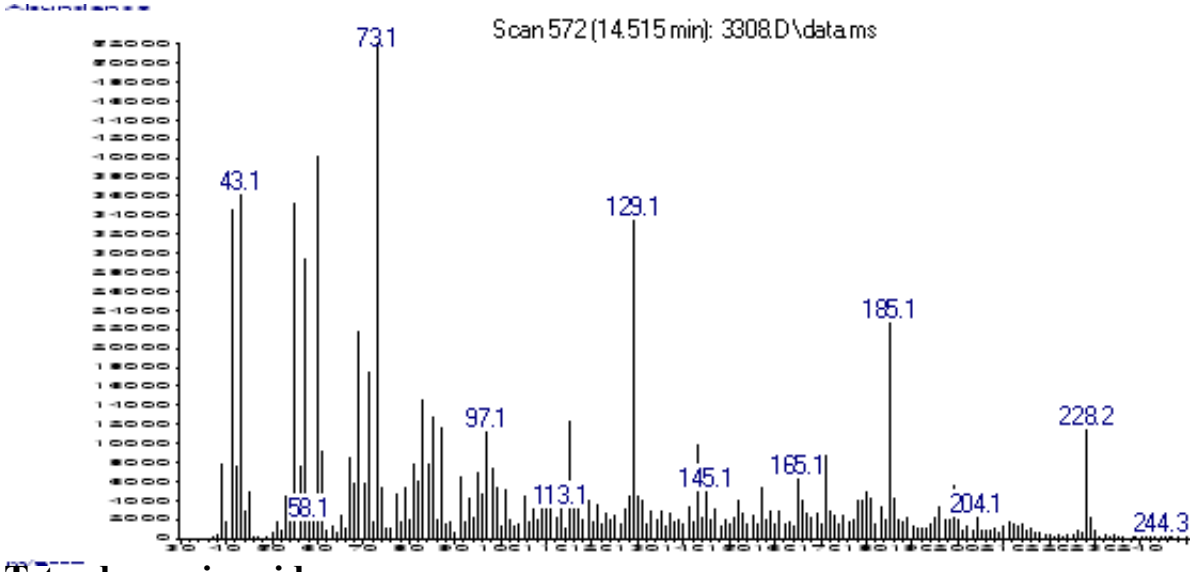
Phenylacetaldehyde



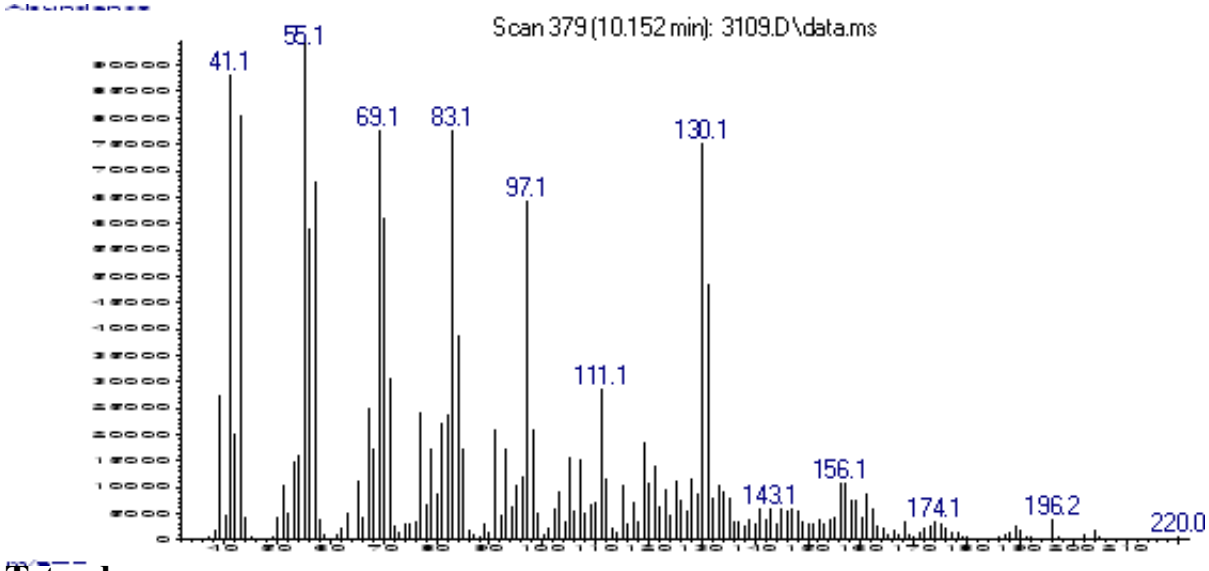
α-Pinene



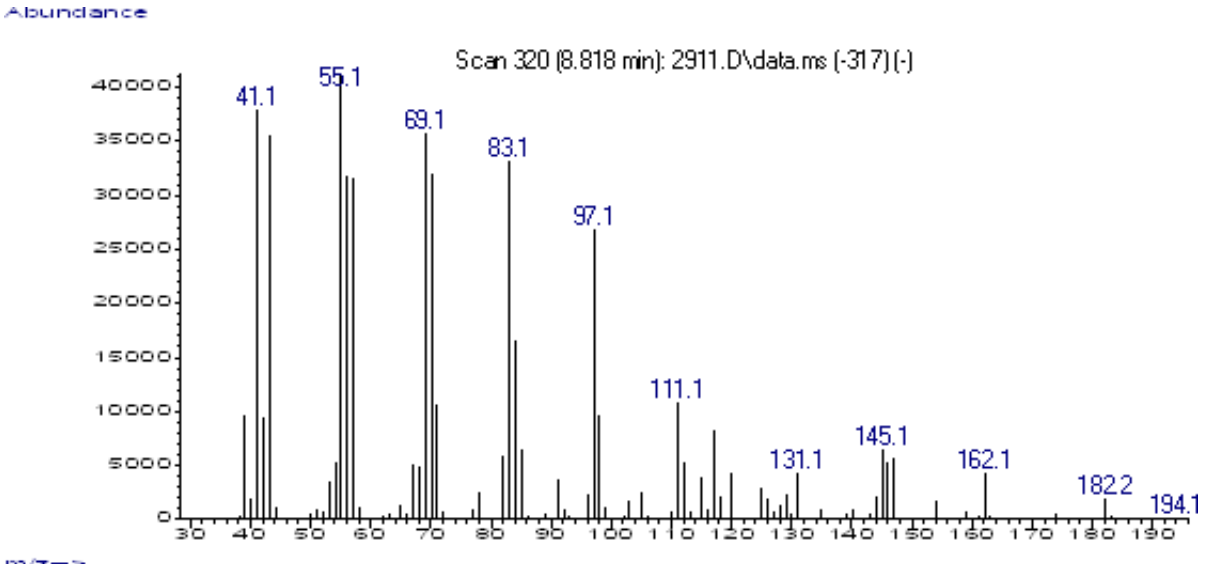
β-Pinene



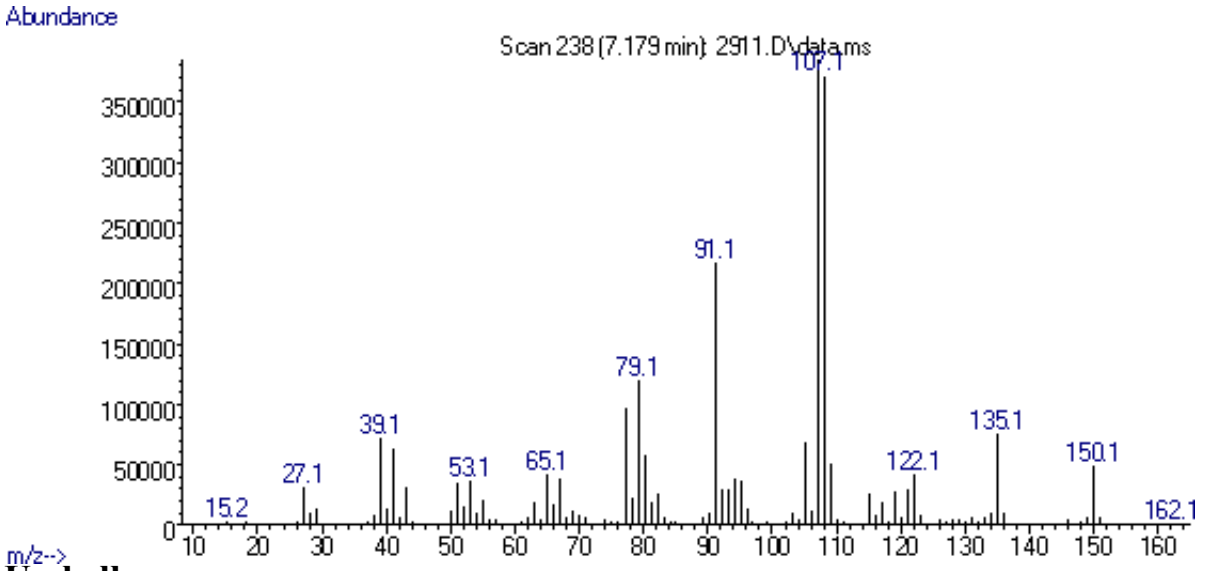
Tetradecanoic acid



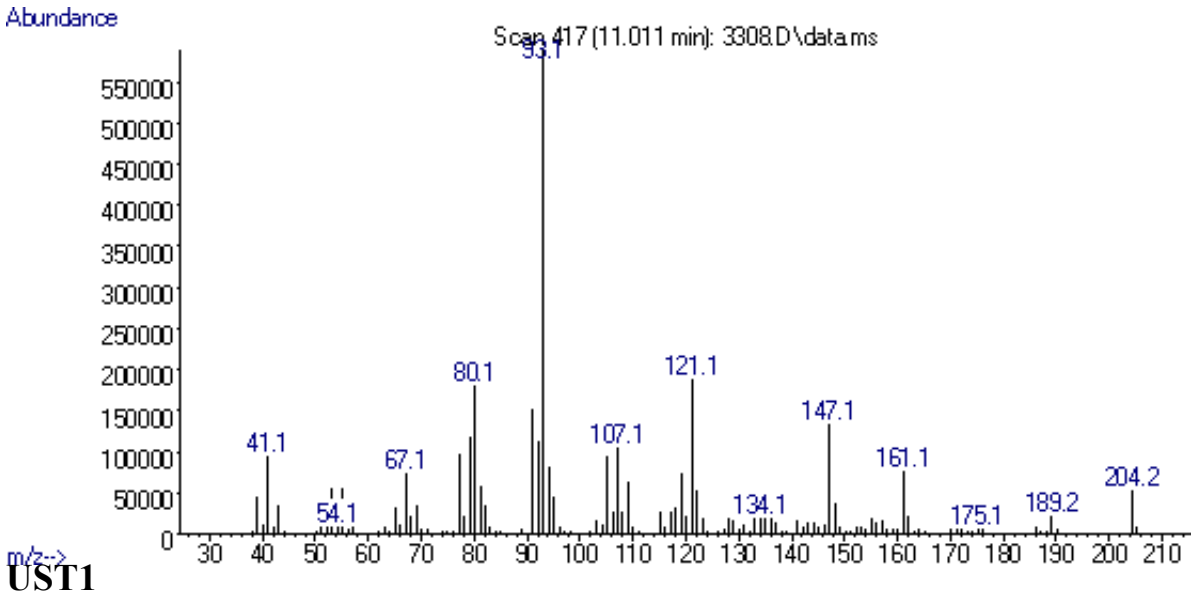
Tetradecene



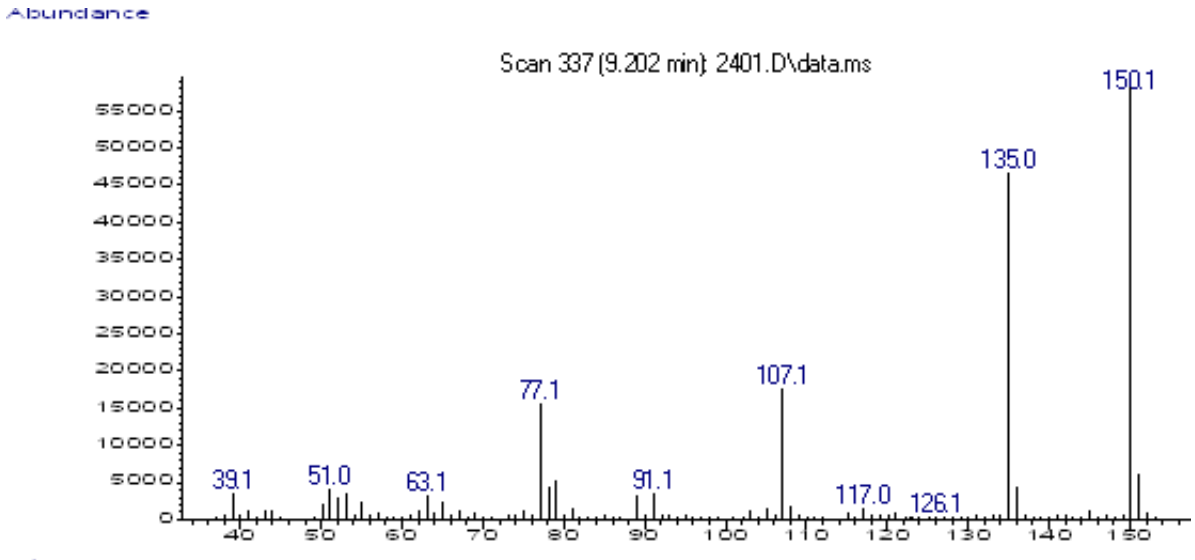
Tridecene



Umbellunone



UST1



Vinylguaiacol