Section TWO

Identification of *Boswellia* trees, resins and essential oils

Having clarified species level taxonomy within the genus *Boswellia*, it is relevant to move on to its practical implications such as the identification of those different species to facilitate conservation and sustainable use.

In the majority of cases, identification can be achieved through examination of morphological characters of the trees themselves. This is useful for field surveys – the cornerstone of effective conservation prioritisation and management – and also for the identification of species in trade where this is required for reporting and for regulating trade in those species. As such, the CITES Secretariat has placed great importance on understanding the taxonomy of species threatened by trade and has also focused on provision of identification guides (see Rutherford, Groves & Sajeva 2018; Rutherford & Groves 2023).

In the case of *Boswellia*, this is slightly more complex as the traded parts are resins and their derivatives. While these resins may differ qualitatively between different species, chemical markers are not used to describe and identify species in the field or on preserved specimens as species are described using morphological characters represented on type specimens collected and annotated alongside the species description. Therefore, to identify species in trade via their resins or essential oils it is imperative that the species themselves can be unambiguously identified at source and that representative specimens are collected alongside resins to enable a direct link between species identity and traded products.

As a result, an interactive identification key to all species of *Boswellia* has been constructed, and a review of identification using resin chemistry undertaken to evaluate its utility in identifying traded products. The collection of resin samples from all species accompanied by voucher specimens has been initiated, and preliminary results from analyses via Direct Analysis in Real Time – Time of Flight Mass Spectrometry (DART-ToFMS) is presented.

Section 2.1

Identification Key

The *Boswellia* monograph by Thulin (2020) provides a key to all 24 species in the genus *Boswellia*. This is an excellent resource but suffers from two slight practical impediments: firstly, it is a taxonomic key that uses technical terminology that trained and experienced taxonomists are familiar with, but which is less easy to use for local teams and communities at source level, and secondly it is a fixed document that cannot be updated directly in the face of taxonomic or nomenclatural change.

To address these issues, the key in Thulin (2020) and a number of other relevant publications was used to construct an interactive key which is presented online in the Frankincense Resource Portal. In addition, each character and character state has been illustrated thus removing some of the issues associated with the use of technical taxonomic terminology (although such text is maintained so that individuals with such experience can use the key as well). This was based upon development of similar keys at CMEP-RBGE that have used functionality in an in-house taxonomic database to provide keys to plants in specific regions. These keys not only use illustrations alongside text but also include detailed images of key characters photographed from plant samples allowing direct reference to experiences in the field. Adding such images to the *Boswellia* key will be the next stage of development followed by testing in the field with a range of partners as well as testing by a number of taxonomists in different institutes. Following feedback, the interactive key can be adjusted and updated as necessary.

In addition, a series of instruction manuals on how to use the key will be developed including information about the key characters of the species involved so that the key can be used as an educational tool in areas where more than one species of *Boswellia* co-exist. These can be translated into different languages and made available online as required. The key could also be relatively easily incorporated into an online survey tool to enable accurate identification in areas where monitoring occurs with more than one species present.

Full details of the development of the identification key are given in Appendix 2.1.

Section 2.2

Resin and essential oil identification

Since the first publication regarding the chemical constituents of frankincense (Stenhouse 1840) there has been a significant amount of interest and subsequent research into the chemical components of frankincense and its derived essential oils. While most of these publications have focused on the constituents directly, more recently interest has increased in the application of resin chemistry to identification. This interest has been driven by the necessity to identify resins in trade to ensure that adulteration and illegal import of both resins, essential oils and other products can be better regulated.

Despite claims that it is possible to identify *Boswellia* resins based upon their chemical constituents and the use of chemistry to inform taxonomic status (eg. Smiech *et al* 2019, 2021; Woolley *et al* 2012) some doubts remain as to the application of resin chemistry in identification. These doubts include whether studies using different methodologies are comparable (if trying to distinguish between species using results across multiple studies), the identity and provenance of the source materials analysed, and whether the source material is representative of the variation within and among species.

To address these concerns, published literature was examined and tabulated to determine whether claims that resin chemistry can be used in species-level determinations are valid. It is also noted that while it is possible to distinguish between some species in specific studies, would such data be valid in a court of law and potentially of use when prosecuting individuals and/or organisations suspected of illegal activity.

Methods

Publications concerned with the resin chemistry of *Boswellia* were identified through online searches and by examining the cited literature in each publication acquired. Review articles were excluded, as were theses that contained the same data that had subsequently been published (except where they contained additional unpublished information). Information summarised from these papers included: species analysed, type of sample analysed (resin, essential oil, etc), provenance of the samples, analytical techniques used, and whether collection and/or export permits were obtained if analysed out with the range State.

Results

A total of 156 studies were examined during this review. Several articles and/or theses were identified but have yet to be acquired as they are either not available electronically or subscriptions were not accessible. Further, a number of articles in languages other than English that could not be easily translated were excluded: these were predominantly published in Chinese language journals. Translation of these will be attempted at a later date; generally, these articles tend to focus on a small number of significantly traded taxa for which much information is already available.

The taxonomic spread of research on the resin and essential oil chemistry is impressive. Only four species have received no attention in the literature and of these three are recently described species endemic to the Soqotra Archipelago in Yemen. The other, *B. microphylla* was previously recognised within *B. neglecta* and as such some of the samples labelled and analysed as *B. neglecta* may contain samples that are in fact *B. microphylla*. Species that are most prevalent in trade have been analysed significantly more often that other species; this includes *B. frereana*, *B. papyrifera*, *B. sacra* (inc. *B. carteri*) and *B. serrata*. A total of 29 samples analysed specimens that were not identified to species, using terms such as "frankincense" or "olibanum" (see Table 2.1).

Species	# studies
Boswellia ameero	4
Boswellia aspleniifolia	0
Boswellia bullata	1
Boswellia dalzielii	6
Boswellia dioscoridis	1
Boswellia elongata	5
Boswellia frereana	22
Boswellia globosa	0
Boswellia "hesperia"	0
Boswellia microphylla	0
Boswellia nana	1
Boswellia neglecta	15
Boswellia occulta	6
Boswellia ogadensis	1
Boswellia ovalifoliolata	2
Boswellia papyrifera	28
Boswellia pirottae	2
Boswellia popoviana	2
Boswellia rivae	12
Boswellia sacra	34
Boswellia "carteri"	57
Boswellia samhaensis	0
Boswellia scopulorum	0
Boswellia serrata	46
Boswellia socotrana	4
Archaeological	10
unknown	29

Table 2.1. Number of studies examining resin chemistry of *Boswellia* arranged by species.

However, given that it is recognised that the use of different distillation, extraction and analytical techniques can alter the chemical constituents detected and their quantity (eg. Ayub *et al* 2018; Ayub *et al* 2023; Marongiu *et al* 2006; Obermann 1978), the summary shows that (a) studies that analysed essential oils are likely incomparable depending on the methods employed with the temperature of extraction and distillation being different across studies and even within studies if oils are sourced from multiple suppliers, and (b) the varied methods and analytical techniques used on resins are also likely to be incomparable across studies due to extensive differentiation among techniques and parameters employed. This is especially true considering that much of the differentiation detected relies on quantitative estimates of similar compounds differing among species, also considering that in many studies examining essential oils these are from mixed batches rather than individual trees and with sample sizes within studies relatively small in terms of comparisons within and among species. Of the 156 studies, 46 studies examine essential oils distilled from collected resins, and 91 studies examine resins directly. In addition to the former, 17 examined oils previously distilled commercially further reducing the comparability of oils as in those cases the methods and temperatures of distillation are unreported.

Only 32 out of 156 studies examine multiple taxa directly, and of those five examine only two taxa. Several studies claimed to be able to distinguish among species, or to exclude certain species from identification due to the absence of specific compounds (often relating to the identification of archaeological resins). However, these studies examined very few species concurrently therefore similarity to species not included in the study is technically plausible. Three studies examining differentiation between nine taxa are discussed in more detail below as are several studies analysed in the same laboratory under comparable methodologies.

Provenance of examined material is important for reasons mentioned above in terms of identification. Firstly, any study that does not collect voucher specimens for verification of identification cannot be assumed to represent a particular species except in certain specific circumstances. Many studies cite that resins or essential oils were obtained as "true" or "verified" or in one case of "certified botanical origin" but this would be impossible to verify without a voucher specimen. As such, it would be difficult to argue accuracy and representativeness in a court of law. In some cases, where analysed specimens are indicated as collected from a locality or State in which only a single species is known to occur, it may be taken that the species is accurately identified. However, as only 48 studies examined species collected in the wild, this is clearly an issue in many studies, and some studies examining multiple species examined samples from both wild and commercial sources.

Secondly, if the sample size per species is low and does not cover a representative sample of variation – in the first instance representing collections from multiple locations across the geographical and ecological range of each species – then it is difficult to draw conclusions about differentiation within and among species.

29 studies cite vouchers but do not state if they are resin or herbarium vouchers. 15 state resin vouchers explicitly and 22 state herbarium vouchers explicitly. Therefore only 22 of 156 studies assessed collected any verifiable voucher specimens that could be used to verify the identity of the samples analysed. Further, several more recent studies have collected vouchers, but only representative vouchers of the population studied. This is a step in the right direction, and likely suitable where it is certain that only a single species is present at the sampling site. Many such samples are in fact from studies where the essential oil is distilled from resins and analysed directly, which requires significantly more resin than is usually available from a single tree resulting in resin samples being analysed from mixed collections. Most commercial oils will also be from mixed collections. This makes it difficult to detect adulteration or mixed species collections if (a) the species used are not easily differentiated, and (b) when the reference compounds for a particular species are based upon mixed collections and do not

represent a single species. It is unclear – but unlikely – whether online or commercial databases of detected compounds are based upon vouchered and verifiable specimens from individual trees or not.

Ten studies examined archaeological resins from various sources and tested them against samples of specific species to try and ascertain where samples were sourced in antiquity. None of these studies used either wild collected or vouchered resin samples.

Discussion

The identification of the species studied is also critical when making claims that a certain species contains certain compounds, and also when claims are made about the different compounds in different species and whether it is possible to differentiate between those species. Species are described using morphological characters and character states, and no resin characters or characteristics are included in the description of any species of *Boswellia*; as such, the only way to verify the species from which a resin sample was procured is to collect both the resin and a representative herbarium voucher specimen of the tree at the same time. This allows identification of the species and the collected resin unambiguously.

There are several examples of this within *Boswellia*. The first is the case of *Boswellia occulta*, a species described as new to science in 2019 (despite the fact it was known to local resin harvesters and communities as different long before anyone described it as such formally). This was largely brought about by detection of methoxydecane in resin samples assumed to be *B. sacra* from Somaliland. Subsequent research has shown that the resin chemistry of *B. occulta* is quite unique compared to other species (Johnson *et al*, 2019). However, the species was described as new to science based upon novel morphological features that had previously been overlooked by taxonomists – an example being a specimen of *B. occulta* collected in 1945 and subsequently re-determined as *B. occulta* following original determination as an unusual specimen of *B. frereana* – and not based upon novel and unique chemical compounds detected.

The second example involves *B. microphylla* and *B. neglecta*. While these species have been independently described, opinion has varied as to whether they were distinct from each other and as a result *B. microphylla* was for a long time treated within the range of variation of *B. neglecta*. Thulin (2020) finally decided that the two were distinct, and this has been backed up by detailed morphological measurements as part of this study (Gibson 2023). However, while assessing resin chemistry literature assumes that *B. microphylla* has never been assessed for the chemical constituents of its resin, it is possible that samples collected and/or analysed as *B. neglecta* in the past may in fact contain samples of *B. microphylla*. Fifteen such studies were examined during this review. However, none of these studies on *B. neglecta* collected any herbarium voucher specimens so it is impossible to know whether any samples analysed were in fact a different species. Therefore, all studies claiming to represent the chemical variation of *B. neglecta* must be treated with caution as there is no evidence that those samples do not contain samples of *B. microphylla*.

A further case involves endemic taxa from the Soqotra Archipelago. One of those taxa *B. socotrana* has been subsequently split into two distinct taxa. Initially this would lead one to assume that the samples of *B. socotrana* in that study may represent both species (*B. aspleniifolia* and *B. socotrana*) but although herbarium vouchers were not collected the authors state that they took detailed photographic images of the plants sampled – photographic vouchers. This is good practice to enable subsequent identification following taxonomic change even though it would mean that images of the requisite distinguishing characters would need to be adequately represented in the images. However, it should be noted that in the case of additional taxonomic change these images could not be used as Type Specimens in the description of new species as herbarium vouchers are still a prerequisite for species description.

Three papers claim to analyse nine species of *Boswellia* concurrently, all of which sampled commercial resins and as such cannot be considered to represent taxonomically accurate samples. In addition to these, several studies were conducted in the same laboratory under identically reported experimental conditions giving a total of seven species that could be compared although no direct attempt at such a meta-analysis has been made by the authors. Other studies conducted in the same laboratory also mean that additional species could be directly compared, however these generally used commercial samples that cannot be verified. Despite this several of these papers make claims about the taxonomy of the species analysed including the species pair *B. sacra* and *B. carteri* which are claimed to have differing chemical signatures and as such must be treated as different species. This argument has been refuted above and by Thulin (2020). Further, in some of these papers the provenance of the samples used cannot be demonstrated to represent the variation within those species, and while samples cluster in different areas of the presented phylogram they do not cluster in two distinct clades that could indicate a clear taxonomic signal.

Given the fact that there are a wide range of methods available to assess resin chemistry as a means to identify resins in trade, and the recognition that many of these methods require equipment and expertise alongside time and resources, alternative methods were sought to establish protocols for resin identification. These “proof of concept” investigations were published in 2024 (see Price *et al*, 2024, Appendix 2.2).

Price *et al* (2024) utilised Direct Analysis in Real Time – Time of Flight Mass Spectrometry (DART-ToFMS). The positive and negative aspects of this methodology are discussed in that paper but are briefly summarized here. DART-ToFMS analyses samples directly without the need for time consuming preparatory phases such as extraction and fractionation (although in Price *et al* 2024 a simple methanol extraction – easily repeatable – was used as this significantly increased the resolving power of the analysis). The analyses are also extremely quick, as following extraction results can be gained in a matter of minutes. Additionally, there are very low consumables costs. In comparison to Gas Chromatography – Mass Spectrometry (GC-MS) which requires time for the extraction and preparatory phases alongside expensive hardware, DART-ToFMS requires only the hardware and minimal subsequent cost, time and expertise once installed. The negative aspect of this is that DART-ToFMS is a relatively new technology that is not found in as many institutes and laboratories as the more conventional and established GC-MS technology but is used in several countries to identify timber samples.

It has recently been recognised by several authors that to verify resin and/or essential oil samples using any methodology a reference set of all species is required. This automatically raises questions about why resin identification is required, by whom, and whether such methods are accessible and affordable for the range of users and stakeholders involved. The cost of putting together a reference set must also be considered.

For identification purposes resin chemistry analyses have potential to be used for routine species-level identification, but this is currently hampered by a lack of specimen vouchers and comparable methodologies in published works. The construction of a database of chemical constituents for this purpose would require a complete reference set and need to be constructed using identical methods which would also place an obligation on all verification tests to be undertaken using those methods. However, an advantage is that such a reference set, once analysed, could be used in perpetuity and updated as necessary whereas less formal approaches such as organoleptics would require routine collection of fresh reference samples at increased cost and may not be of value in legal proceedings. Further, there are indications that some taxa have similar resins in terms of appearance and odour even though they occur in different genera (see Asfaw *et al* 2019).

The collection of a reference set of resins has been initiated under this programme and is described below.

Section 2.3

Reference Set

There are 24 species of *Boswellia* currently recognised, occurring in 23 range States globally. In order to unambiguously identify one species from another, all 24 taxa should be represented in any reference set and should contain significant representation of both geographical and ecological variation (potentially also including seasonal variation) and resins that are co-produced following insect activity in some taxa. Although only a few species are currently recognised as being significant in trade, this picture is changing and as sources become depleted in some taxa harvesting will move to other areas, States and species. Further, rare and threatened species can be marketed as such and rapidly become threatened as has occurred with rare plants in the horticulture trade. Therefore, including all taxa is proof against future taxonomy, trade directions and changes in the geographical origin of samples in trade.

This programme has started the process of collecting samples of all species from all range States from multiple localities. In addition, to ensure that local range State stakeholders are engaged with *Boswellia* conservation and sustainable use, all samples are required to be collected and exported with documented permits from range State authorities. In many institutes that import samples for analyses, this is a requirement under CBD and the Nagoya Protocol even where taxa are not listed in CITES Appendices. In the above review, only two studies mentioned obtaining permission for collection of wild resin samples for export and analyses and in either case no documentary details of permission were provided (either cited or included in Supplementary information).

Collecting multiple samples from multiple locations in up to 23 range States with full permissions is extremely time consuming and bears a heavy administrative burden. Table 2.2 details progress made in this regard, with annotations of future activities already set in motion. Further, the cost of obtaining such samples is significant; few range States have the funds to support such fieldwork *in situ*. In some cases, while permissions are in place and samples collected, ensuring samples are safely delivered has been problematic from some localities due to couriers being unable to deliver large packages due to security concerns. Establishing this reference set is a long-term commitment that has been set in motion to enable accurate resin identification globally.

State	Species	Notes
Benin	*B. dalzielii*	Contacts established; vouchered resin samples acquired
Burkina Faso	*B. dalzielii*	Contacts established; vouchered resin samples acquired and analysed
Cameroun	*B. dalzielii, B. papyrifera*	Contacts established; currently no funds for field work
Central African Republic	*B. papyrifera*	Contacts established; currently no funds for field work
Chad	*B. dalzielii, B. papyrifera*	Contacts established; currently no funds for field work
Djibouti	*B. sacra*	Contacts established;
Eritrea	*B. papyrifera*	Contacts established
Ethiopia	*B. microphylla, B. neglecta, B. ogadensis, B. papyrifera, B. pirottae, B. rivae*	Contacts established; sample collection and permissions in discussion
Ghana	*B. dalzielii*	Contacts established; vouchered resin samples acquired and analysed
India	*B. ovalifoliolata, B. serrata*	MOU signed with Botanical Survey of India; collections and permissions in discussion

Kenya	*B. microphylla, B. neglecta, B. rivae*	Contacts established; samples of normal and insect-induced vouchered resin samples collected from *B. neglecta*; awaiting export permits
Mali	*B. dalzielii*	Contacts established; currently no funds for field work
Niger	*B. dalzielii*	Contacts established; vouchered resin samples acquired
Nigeria	*B. dalzielii*	Contacts established; vouchered resin samples acquired
Oman	*B. sacra*	Contacts established; collection and export discussions ongoing
Senegal	*B. dalzielii*	Contacts established; currently no funds for field work
Somalia	*B. frereana, B. globosa, B. microphylla, B. neglecta, B. occulta, B. rivae, B. sacra*	Multiple contacts established; vouchered resin samples acquired from *B. frereana;* vouchered resin samples acquired from *B. sacra*; vouchered resin samples of *B. rivae* acquired. Further samples of all three taxa being collected.
South Sudan	*B. papyrifera*	Contacts established; currently no funds for field work
Sri Lanka	*B. serrata*	Contacts established; *B. serrata* likely extinct or introduced
Sudan	*B. papyrifera*	Contacts established; access currently problematic due to insecurity
Tanzania	*B. neglecta*	Contacts established; currently no funds for field work
Togo	*B. dalzielii*	Contacts established; currently no funds for fie3ld work
Uganda	*B. neglecta, B. papyrifera*	Contacts established; currently no funds for field work
Yemen	*B. sacra*, 11 endemic species on Soqotra	Contacts established; vouchered resin samples acquired from Yemen (*B. sacra*) and several species from Soqotra.

Table 2.2. Samples collected, received and planned in order to collate a reference set of vouchered *Boswellia* resins to test species identification via DART-ToFMS.

Section 2.4

DART-ToFMS

In order to demonstrate that DART-ToFMS analyses are capable of directly analysing resin chemistry as a potential method for species discrimination in trade, a proof-of-concept study was undertaken using commercially obtained samples. The results from this demonstrated a high level of repeatability and a high degree of accuracy in identification, with the caveat that samples were not taxonomically verified. However, under the assumption that species can be distinguished in this way and that commercial samples may be incorrectly identified or contain mixed samples, the expectation would be that a fully verified and vouchered reference set of resins would demonstrate even greater ability to distinguish among those species. This study was published (Price *et al.*, 2024) and is available in Appendix 2.2.

As samples and vouchers are received from range States with relevant permissions and documentation, they are sent to the collaborating laboratory for analysis. Preliminary results from these analyses are presented graphically in Figure 2.1.

Until additional samples from additional species are included in this analysis, it will not be possible to reverse the protocol so that verified wild collected vouchered resin samples form the basis for testing and that unclassified or commercial samples are compared to wild samples for verification. Table 2.2 indicates that for some species this process is under way and as additional samples are added the results will be published.

Further, 36 commercial samples were purchased and tested against the existing commercial reference set. Of these, five gave unexpected results. These included three cases where duplicate resin tests indicated different identifications potentially indicating mixed batches of resin, and the other examples were samples of black and white resin from apparently the same source which revealed two different but congruent identifications – one as *B. neglecta* (black resin) and the other as *B.* "carteri" (white resin). To confirm such a result, we are waiting on samples of black and white resin collected from the same trees in Kenya to test how such resins differ from each other if at all as the black resin is highly prized and apparently produced following insect activity in the host tree. Additionally, some samples of *B. neglecta* are mixed with *Commiphora confusa* resins by harvesting communities as they have a similar appearance and odour profile albeit a quantitatively different resin chemistry – which has never been tested against *B. sacra* from Somalia or any other taxa.

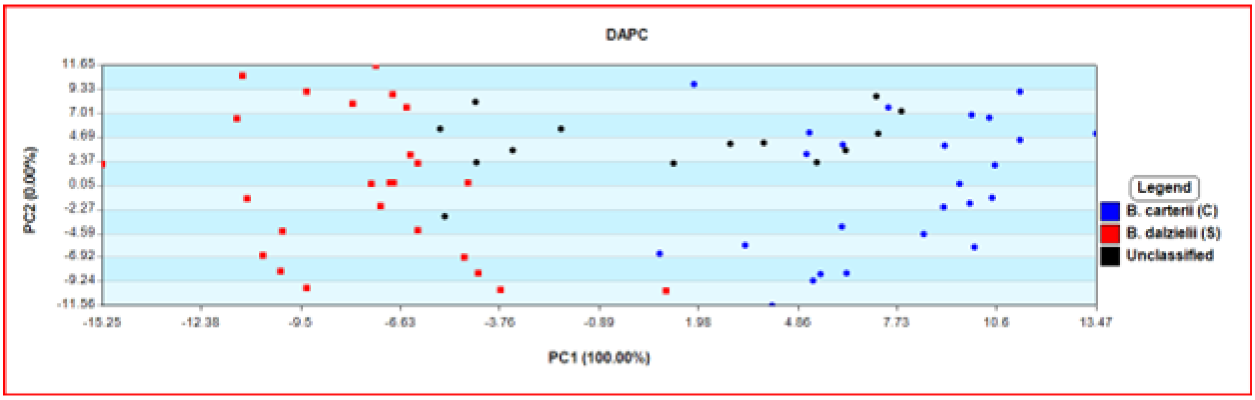

Figure 2.1 DAPC model with samples of *B. dalzielii* collected from the wild (Burkina Faso and Niger) entered as unclassified samples and tested against existing commercial samples labelled as *B. dalzielii*. From initial results, while the majority of samples are accurately classified it is clear that there are similarities between *B. dalzielii* and *B.* "carteri" resins albeit those from commercial samples. Additional samples of *B. dalzielii* from Nigeria are currently being analysed, and the subsequent addition of samples of *B. sacra* from Somalia and Yemen and *B. frereana* from Somalia.

In addition, a single archaeological sample was analysed with permission that was sourced from Qani (ancient Cana, on the south coast of Yemen) and estimated to be approximately 2000 years old. The resin from this sampled identified as *B. carteri* (therefore *B. sacra* from Somalia). This was of interest to archaeologists as previously it had been assumed that many of the south Arabian ports in antiquity were part of the Arabian frankincense trade that shipped supplies along the Arabian coast rather than importing resins from Africa. With a robust species-level identification method and source information about each species it may be possible to trace ancient trade routes to species level and learn more about trade complexities in antiquity: collaborators have informed us that the main impediment to such research is the lack of a reference set of *Boswellia* resins. While this has little bearing on contemporary trade it does put into context comparisons with ancient trade. This result will be further tested with additional archaeological samples.

Of the numerous techniques that could be used to analyse *Boswellia* resin chemistry for identification of products in trade, DART-ToFMS shows promise for several reasons. Preliminary tests (see Price *et al*, 2024) demonstrate the potential resolution of the method which gives an advantage over Thin Layer Chromatography. Both Gas Chromatography-Mass

Spectrometry and DART-ToFMS require initial resources for hardware, but the latter is beneficial due to its quick analysis time and low consumables cost. DART-ToFMS has been successfully used in identification in the illegal timber trade, and it is proposed that as this method becomes more widely available and accessible it demonstrates advantages over other methods currently available.

The current study intended to further analyse essential oil samples from the vouchered resin collections. A preliminary literature review (Roman Clemente 2022) identified that there is potential to distinguish among the essential oils of different species albeit with the caveat that most samples analysed are from commercial sources or differ in their analytical techniques. Acquiring essential oils from field collections would have required multiple visits to individual trees and sites to extract enough resin for single tree distillation which was not possible due to financial and time constraints. It is recommended that a similar proof of concept study using DART-ToFMS with commercial essential oils is undertaken before establishing whether a reference set of essential oils is also required for identification of essential oils in trade.

Section 2.5

Conclusion

Boswellia tree identification in the field has been made accessible to all users by the provision of an identification key available online. This has the potential for future development and also integration with tools that monitor tree health in the field.

Despite the non-comparability of published resin chemistry analyses and the inability to verify species identifications in those studies, resin chemistry clearly holds promise for the identification of resins and essential oils in trade. This requires a botanically vouchered reference set analysed using identical methods and using a system that is accessible and affordable by users. DART-ToFMS – a new technique that is now being used more routinely for timber identification – shows potential for this purpose and has some advantages over traditional and more established techniques. In the future, additional vouchered samples will be collected to complete testing of *Boswellia* resins and essential oils in trade.

Section 2.6

Expected Outputs

Formal publication of the review of chemical profiling of *Boswellia* resins alongside preliminary results from wild sourced DART-ToFMS profiles.

Full reference set compiled and annotated, and exploration of how to share chemical profiles developed.

Section 2.7

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