

The Sacred Incense: The Ketoret – קֶטֶרֶת

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Abstract: Jewish religious traditions are detailed in Exodus 30:34-38. Comprising rare spices like stacte, onycha, galbanum, and frankincense, the Ketoret (קֶטֶרֶת) was historically burned in the Tabernacle, symbolizing a direct connection to the divine. Despite ongoing debates on ingredient identification, the ritualistic importance of the Ketoret remains deeply rooted in Judaism, prompting continued exploration in religious scholarship, despite its absence in modern Jewish tradition. Our research conducts a thorough bibliographic review, integrating biblical data to scrutinize the complex phenomena surrounding the Ketoret. Seeking to provide innovative frameworks, our study aims to illuminate the ritual's intricacies, fostering paradigm shifts in interdisciplinary discourse and advancing scientific understanding. The burning of the sacred Ketoret, composed of Commiphora myrrha, Onycha, Ferula galbaniflua, and Boswellia sacra, transcends mere fragrance, symbolizing a transformative process. The rising smoke becomes a spiritual offering, creating a bridge between the terrestrial and celestial realms and mirroring the worshipper's ascent toward the divine. This study underscores the Ketoret's theological significance as a spiritual elevation and connection conduit, where the burning ritual signifies a fragrant communion with the divine. Each ingredient's meticulous selection imparts layers of symbolic significance, representing unity and diversity within the divine fabric. The research also traces the historical evolution of aromatic practices, from traditional fumigation to contemporary extraction methods, highlighting enduring global traditions and diverse applications in various temples and Israel's Ministry of Health-approved kits.

Keywords: ketoret, sweet spices, stacte, onycha, galbanum, pure frankincense

I. Introduction

The "Ketoret" is a sacred incense blend that holds significance in Jewish religious traditions. It is specifically mentioned in the Bible, in the book of Exodus (Exodus 30:34-38), where detailed instructions are given for its preparation and use in the Tabernacle, a portable sanctuary used by the Israelites during their wanderings in the wilderness.

According to the biblical description, the Ketoret consisted of a specific combination of rare and fragrant spices, including stacte, onycha, galbanum, and frankincense. The exact identification of some of these ingredients has been debated over time, and interpretations may vary. The incense was burned on the Golden Altar within the Tabernacle, and the smoke was considered a symbolic element in worship.

The use of the Ketoret is deeply rooted in the religious practices of Judaism, and discussions about its precise composition and preparation have been part of scholarly and religious discourse. The significance of the incense is not only ritualistic but is also tied to symbolic meanings and connections to the divine.

It should be highlighted that the preparation and use of the Ketoret are specific to the historical practices described in the Bible and are not a current tradition in modern Judaism. However, the historical and symbolic importance of the Ketoret continues to be studied and discussed within the context of Jewish religious scholarship.

Incorporating biblical data, a vital bibliographic review demands meticulous scholarly scrutiny. Our research synthesizes innovative frameworks, illuminates complex ketoret phenomena, fosters paradigmatic shifts in interdisciplinary discourse, and advances scientific understanding

II. Research Methods

2.1 The Constituents of Ketoret as Described in Exodus 30:34-38

The exact formulation of the ketoret, the sacred incense used in Jewish rituals, is specified in the Bible, particularly in Exodus 30:34-38. The ingredients are as follows:

Stacte (שֹׁטֶטֶת - na•taf):

This Greek term signifies the fluid essence exuding from the myrrh-producing tree.

Claude Saumaise, also known as Salmasius, discerns stacté from plasté, designating stacté as the liquid component of myrrh obtained through contusion, deemed its most prized element.

It was alternatively recognized as perfume or myrrh in its purest form. (Calmet, 1720)

Onycha (שֶׁחַלִּית - shekh•e•let):

Onycha is a substance historically associated with a mollusk or the operculum (a protective lid) of a shellfish. Its precise identity remains uncertain, and interpretations vary.

Historically, it has been associated with a mollusk called a "stinkhorn" or the operculum (a protective lid) of a shellfish. However, the exact botanical or zoological identification has not been definitively discovered. (Nongmaithem et al., 2017)

Galbanum (חֶלְבָּנָה - khe•lev•nah):

Galbanum is a resin obtained from certain plants, particularly the *Ferula galbaniflua* (synonym of *Ferula gummosa*) plant. It has a strong and distinctive fragrance, contributing to the overall aroma of the incense. It has a strong and distinctive odor. In the context of the incense recipe, galbanum likely contributed to the overall fragrance and symbolism of the incense. (Mahboubi, 2016)

Pure frankincense (לְבוֹנָה - le•vo•nah):

Frankincense, or olibanum (ō-'lib-ə-nəm), represents an aromatic resin integral to incense and perfumery. Derived from *Boswellia* trees within the Burseraceae family, the term originates from the Old French "franc encens," signifying 'high-quality incense.' This resin holds historical significance for its olfactory and ritualistic applications. (Merriam-Webster, 2023, The Oxford English dictionary, 1933)

These fragrant spices were combined to create a unique and sacred incense blend. These specific ingredients were considered a divine instruction, and the resulting incense was reserved for use in the Tabernacle as part of the worship rituals of the Israelites. The unique combination of these elements was considered holy. The mixture was to be "salted and pure and sacred" (Exodus 30:35), emphasizing its consecrated nature and separation for sacred purposes. The burning of this incense was seen as a symbolic act, creating a fragrant offering as part of the religious ceremonies in the Tabernacle.

2.2 Preparing Ketoret: A Biblical Process (Exodus 30:34-38)

a. Exodus 30:34 (NIV): The Lord's Instruction on Fragrant Spices for Incense

In the biblical context of Exodus 30:34, where it is specified to take "fragrant spices—gum resin, onycha and galbanum—and pure frankincense, all in equal amounts," the exact measurement method is not explicitly provided. The Bible doesn't specify particular units of measurement like pounds, kilograms, or any other modern metric.

Ancient measurement systems were diverse and could include the use of volumes, weights, or proportions based on specific containers or utensils. This context emphasises the equality of proportions rather than a precise measurement using a standardized unit.

In the absence of specific details, the instruction suggests that each of the mentioned

ingredients was to be taken in the same proportion or ratio, highlighting the importance of balance and equality in preparing the sacred incense. The focus is on the symbolic and ritual significance of the ingredients rather than on precise scientific measurements.

b. Exodus 30:35 (NIV): Crafting a Sacred and Pure Incense Blend

The instruction in Exodus 30:35 to "make a fragrant blend of incense" indicates that the various aromatic components mentioned in the previous verses (gum resin, onycha, galbanum, and pure frankincense) are to be skillfully combined to create a harmonious and pleasing mixture. Here are some key points to consider:

Artistry and expertise:

The phrase "make a fragrant blend" suggests a process that involves skill and artistry. Crafting incense is a challenging task but requires knowledge and expertise, akin to the work of a perfumer. In ancient times, perfumers were skilled artisans who understood how to balance different scents to create a pleasing fragrance.

Symbolism of fragrance:

Fragrance often carries symbolic significance in religious and spiritual contexts. A pleasing aroma is associated with offerings and prayers, symbolizing the acceptance and favor of the divine. The fragrant blend of incense, when burned, was intended to produce a sweet and symbolic aroma that signified the devotion and worship of the Israelites.

Ritual and worship:

The act of making a fragrant blend of incense is tied to the ritualistic practices of the Tabernacle. The specific combination of ingredients and the careful preparation of the incense were integral to the religious ceremonies conducted by the priests in the worship of God.

Purification and sanctification:

Incense was often associated with purification and sanctification. The aromatic smoke was believed to have a purifying effect, symbolizing the consecration of the sacred space and the people. The fragrant blend, when properly prepared and used, contributed to the ritual purity of the Tabernacle.

Covenant and symbolism:

The making of incense and its use in worship were part of the covenantal relationship between God and the Israelites. The careful preparation of the fragrant blend was a tangible expression of obedience to God's instructions and a recognition of the sacred nature of the Tabernacle.

The directive to "make a fragrant blend of incense" encompasses not only the physical act of combining aromatic substances but also carries deep symbolic and ritualistic significance within the religious practices of the Israelites as outlined in the Book of Exodus.

c. Exodus 30:36 (NIV): Grinding and Placement of the Sacred Incense

This verse provides additional details on how the fragrant blend of incense is to be used and where it should be placed. Here are primary points for consideration:

Grinding to powder:

The instruction to "grind some of it to powder" suggests a specific preparation method. Grinding the ingredients into a fine powder would likely enhance the burning properties of the incense, allowing for a more controlled release of fragrance when it is burned. This meticulous preparation emphasizes the importance of attention to detail in the worship rituals.

Placement in front of the Ark of the Covenant:

The powdered incense will be placed "in front of the ark of the covenant law." The Ark of the Covenant was a sacred chest containing the tablets of the Ten Commandments and

was considered the symbol of God's presence among the Israelites. Placing the incense in front of the ark signifies its role in the worship rituals and symbolizes the offering of the fragrant blend to God.

In the Tent of Meeting:

The Tent of Meeting refers to the sacred space where Moses would meet with God. This was a designated area within the Tabernacle for communication with the divine. Placing the incense in this holy space reinforces its sacred and symbolic significance in the context of divine encounter and worship.

Meeting place with God:

The verse states, "Where I will meet with you." This emphasizes the connection between the act of worship, symbolized by the incense, and the divine encounter. The fragrant offering becomes a means through which the Israelites approach and communicate with God.

Most Holy:

The incense, once prepared and placed in the designated location, is declared to be "most holy." This designation sets it apart as a sacred and consecrated element of worship. It highlights the purity and sanctity associated with the fragrant blend, reinforcing its significance in the religious practices of the Israelites.

Exodus 30:36 outlines the specific steps for preparing and placing the incense in the sacred space of the Tent of Meeting. The attention to detail, the symbolic placement in front of the Ark of the Covenant, and the declaration of its holiness underscore the ritualistic and spiritual importance of the incense in the worship practices of the Israelites.

d. Exodus 30:37 (NIV): The Holiness of the Incense Formula

This verse emphasizes an explicit prohibition against using the formula for the sacred incense blend for personal or unauthorized purposes. Here are pivotal points for understanding:

Exclusive use for sacred purposes:

The instruction is straightforward: the formula for the incense blend is not to be used for personal or common purposes. It is reserved exclusively for the Tabernacle's sacred rituals and worship practices. This underscores the sanctity and specificity of the incense for religious ceremonies.

Consider it Holy to the Lord:

The incense is designated as holy, set apart for the Lord. This reinforces the sacred nature of the formula and the resulting incense. Holiness in this context signifies separation from common or secular use and consecration for divine and worshipful purposes.

Respect for the sacred formula;

The Israelites are instructed not to replicate the incense formula for themselves. This instruction ensures that the sacred nature of the incense is preserved and not diluted by casual or unauthorized use. It underscores the importance of respecting and following divine instructions in matters of worship.

Symbolic and ritual significance:

The incense, with its specific formula, represents a symbolic connection between the worshipers and the divine. By limiting its use to the designated sacred context, the Israelites acknowledge the incense's unique role in their religious practices and its significance in facilitating their approach to God.

Consequences of disobedience:

While the specific consequences are not outlined in this verse, the broader context of the Bible often includes warnings about the seriousness of disobedience to divine commands. Disregarding these instructions could carry spiritual consequences or disrupt the sacred nature of the rituals.

Exodus 30:37 reinforces the exclusivity and sacredness of the incense formula. It serves as a reminder to the Israelites to approach their worship with reverence and obedience, recognizing the unique role of the incense in their religious practices and its specific connection to the divine

e. Exodus 30:38 (NIV): Consequences for Replicating the Holy Incense

This verse underscores the seriousness of replicating the sacred incense formula for personal enjoyment or any purpose other than the designated religious rituals. Here are central points for understanding:

Prohibition and consequence:

The verse issues a stern prohibition against making incense like the sacred formula "to enjoy its fragrance." The consequence for such an action is severe: the person who engages in this unauthorized use of the formula "must be cut off from their people." The phrase "cut off" often carries a sense of being excluded or separated from the community.

Preservation of sanctity:

The severe consequence highlights the importance of preserving the sanctity and exclusivity of the incense for its intended purpose in worship. The formula, being designated as holy to the Lord, is not to be trivialized or used for personal pleasure.

Respect for divine instructions:

This verse reinforces the principle of obedience to divine instructions. The Israelites are expected to follow God's commands regarding the use of incense and to approach their worship with reverence and respect for the sacredness of the rituals.

Symbolic significance:

The act of enjoying the fragrance of the replicated incense can be seen as a symbol of treating sacred elements casually or attempting to derive personal pleasure from something consecrated to the divine. The severity of the consequence emphasizes the importance of maintaining the symbolic and ritual significance of the incense.

Community consequences:

The phrase "cut off from their people" suggests a communal consequence. This could mean exclusion from the religious community or, in some interpretations, separation from the covenant community. The severity of this consequence underscores the gravity of the violation.

Exodus 30:38 serves as a strong warning against unauthorized use or replication of the sacred incense formula. It emphasizes the need for the Israelites to approach their religious practices with the utmost respect, following divine instructions and recognizing the sanctity of the rituals prescribed for worship.

III. Result and Discussion

A comprehensive bibliographical inquiry was undertaken in pursuit of an elucidated understanding of ketoret, a sacred formulation within the Jewish tradition. This systematic investigation delved into the constituent elements of each ingredient, meticulously examining their chemical compositions, biological properties, and nuances within the realm of perfumery.

3.1 Results

a. Analogies between Biblical and Scientific Data

Biblical data

Exodus 30:35 (NIV): "And make a fragrant blend of incense, the work of a perfumer. It is to be salted and pure and sacred."

This verse follows the instructions given to Moses on the specific components of the incense, and it provides additional guidance on how the incense blend is to be prepared:

Fragrant blend of incense: The ingredients mentioned in the previous verse—gum resin, onycha, galbanum, and pure frankincense—are to be skillfully combined to create a fragrant blend. This implies a meticulous and intentional mixing of the elements to achieve a specific aroma. It is a *perfume exhaled by fire*. (*KJV dictionary, n.d.a*)

Work of a perfumer: The crafting of the incense is described as the work of a perfumer. This emphasizes the artistry and expertise required in preparing the incense. Perfumers in ancient times were skilled artisans who understood how to blend various scents to create harmonious and pleasing fragrances. (*KJV dictionary, n.d.b*)

Salted: The term "salted" is symbolic and carries several potential meanings. It could represent purity and preservation. In ancient contexts, salt was often used as a preservative, preventing decay. Symbolically, the salt may signify the enduring nature of the covenant and the offering. (*KJV dictionary, n.d.d*)

Pure: The emphasis on purity underscores the importance of using untainted and unadulterated ingredients. The incense was to be free from impurities or contaminants, reflecting the sacredness of the offering. (*KJV dictionary, n.d.c*)

Sacred: The final product, the fragrant incense blend, is designated as sacred. This means it is set apart for holy and religious use. The incense is not to be casually or indiscriminately used but is reserved for specific ritual purposes within the Tabernacle. (*KJV dictionary, n.d.e*)

This verse outlines the qualities and characteristics of the incense that Moses is instructed to prepare. The process involves the skillful artistry of a perfumer, ensuring a harmonious blend of fragrances. The use of terms like "salted," "pure," and "sacred" conveys the sacredness and consecration associated with the incense, making it suitable for use in the worship of God in the Tabernacle.

b. Scientific Data from the Literature

Resins and gums are natural substances obtained from various plants, trees, and shrubs. They often have distinctive properties, including aromatic qualities, and have been used for various purposes throughout history.

In the pursuit of discerning the precise enumeration of the constituents comprising the sacred Ketoret, an exhaustive inquiry was undertaken. Delving into the profound realm of theological exploration, this endeavour involved meticulously examining definitions gleaned from the venerable biblical dictionary, the King James Version (KJV), renowned for its linguistic richness and historical significance. Additionally, a discerning analysis of stylistic nuances in various biblical versions was undertaken, each serving as a unique lens through which the sacred text is perceived.

Within the theological mosaic, the quest for clarity on the number of Ketoret ingredients necessitated a scholarly engagement with the intricacies of linguistic interpretations embedded in the KJV. This venerable repository of biblical wisdom, known for its archaic eloquence, offers a foundational understanding of the linguistic landscape underpinning the sacred verses.

Moreover, exploring stylistic variations across diverse biblical versions was deemed indispensable. These nuanced variations, reflective of interpretive choices and linguistic subtleties, were scrutinized to distil insights that might illuminate the elusive enumeration of the sacred components of Ketoret.

In pursuing theological precision, this multifaceted approach, embracing both lexicographical insights and stylistic nuances, aspires to contribute to the scholarly discourse surrounding the profound ritual of Ketoret within the broader context of sacred texts and their interpretative traditions.

sweet spices	stacte	onycha	galbanum	pure	frankincense
an aroma	an aromatic gum	a scale or shell	an odorous gum	clear	frankincense (from its whiteness)
סם	נָטָף	שִׁחֻלָּת	חֶלְבָּנָה	זָךְ	לְבוֹנָה

Definitions are taken from Strong's Exhaustive Concordance by James Strong (S.T.D.) (LL.D.) 1890.

Across various biblical translations such as King James Version (KJV), New King James Version (NKJV), New Living Translation (NLT), Literal Standard Version (LSV), Darby Bible Translation (DBT), Holman Christian Standard Bible (HCSB) and God's Word® Translation (GWT), it becomes evident that the sweet spices (fragrances) comprise "gum resin, onycha, and galbanum." It is precisely to these aromatic elements that pure frankincense is seamlessly incorporated. In essence, four distinct components emerge: stacte, onycha, ferula, and boswellia. This nuanced exploration underscores the theological significance of these elements, offering a profound understanding of the symbolic and spiritual dimensions inherent in the biblical narrative.

Henceforth, the composition of the sacred ketoret entails integrating four distinct elements.

This formulation, deeply rooted in religious tradition, invites theological inquiry into the symbolic resonance and spiritual significance embedded within each constituent, elucidating the profound connection between material elements and divine reverence.

The essential oil derived from the frankincense species manifests diverse biological activities intricately associated with the chemical composition inherent to these essential oils. The observed bioactivities can be attributed to a singular compound or a specific group of chemical compounds inherent in the essential oil. The nuanced relationship between the distinctive chemical entities within the essential oils and their corresponding biological effects underscores the complexity of the bioactive properties exhibited by the *Ferula* species, thereby necessitating further elucidation and exploration for a comprehensive understanding of their pharmacological potential.

c. Chemical Components and Biological Activity of *Commiphora Myrrha*

The *Commiphora* genus is derived from the *Commiphora myrrh* tree, a flowering plant categorized within the Burseraceae family (Alyafei, 2020). The Burseraceae family, comprising approximately 150 species, is indigenous to arid, tropical, subtropical, and arid regions (Gadir & Ahmed, 2014). The nomenclature "Myrrh" originates from the Arabic term "murr," signifying bitterness. Traditionally referred to as *C. myrrh*, *Commiphora molmol*, or *Balsamodendron myrrha* in Greek and Chinese literature, this plant holds botanical significance within the context of its taxonomic classification and historical linguistic roots (Germano et al., 2017).

Commiphora myrrha, *Commiphora molmol*, and *Balsamodendron myrrha* are considered synonyms. They all refer to the same resin-producing tree species commonly known as myrrh.

The tree belongs to the genus *Commiphora* and is native to regions in the Middle East and Africa.

The essential oil of *Commiphora myrrha*, commonly known as myrrh essential oil, is prized for its distinctive aroma and potential therapeutic properties. Extracted from the resin of the myrrh tree, this essential oil boasts a complex chemical composition that contributes to its unique fragrance and potential health benefits.

One of the primary constituents of myrrh essential oil is sesquiterpenes, which include compounds like curzerene, furanoeudesma-1,3-diene, lindrestrene, and germacrone. These

sesquiterpenes contribute to the deep, warm, and resinous scent that characterizes myrrh oil. Curzerene, in particular, is recognized for its anti-inflammatory properties, adding to the potential therapeutic benefits of myrrh essential oil in addressing various inflammatory conditions.

Another important component is monoterpenes, with compounds such as α -pinene and limonene. These monoterpenes contribute to the overall aromatic profile of myrrh essential oil, providing bright and uplifting notes to the complex fragrance. α -Pinene, in addition to its aromatic qualities, is known for its potential antimicrobial and anti-inflammatory properties, adding a layer of therapeutic significance to myrrh oil.

Sesquiterpenoids, including β -elemene, also play a pivotal role in the chemical makeup of myrrh essential oil. β -Elemene contributes to the oil's aromatic complexity, providing a slightly spicy and woody undertone. Moreover, β -elemene has been studied for its potential anticancer properties, adding to the diverse range of health-related compounds found in myrrh oil. Furthermore, myrrh essential oil contains compounds like eugenol and methyleugenol, which contribute to its aromatic depth and may possess antimicrobial and antioxidant properties. These phenolic compounds enhance the overall complexity of the fragrance while potentially providing additional health benefits.

In addition to its aromatic qualities, myrrh essential oil has been traditionally used for various therapeutic purposes. It is often associated with anti-inflammatory, antifungal, and wound-healing properties. Myrrh oil is valued in aromatherapy for its grounding and calming effects, making it a popular choice for promoting emotional well-being.

The historical significance of myrrh in cultural, religious, and medicinal contexts further underscores its importance. From ancient times to the present, myrrh has been utilized for its aromatic and therapeutic properties, making myrrh essential oil a subject of ongoing interest in both traditional and modern approaches to holistic health.

The fundamental chemical composition of myrrh essential oil from *Commiphora myrrha* includes sesquiterpenes like curzerene, monoterpenes such as α -pinene and limonene, sesquiterpenoids like β -elemene, and phenolic compounds like eugenol and methyleugenol. This diverse blend of compounds contributes to the unique and complex fragrance of myrrh oil and may offer a range of potential health benefits. Whether used in perfumery, aromatherapy, or traditional medicine, myrrh essential oil continues to captivate with its aromatic richness and historical significance.

d. Chemical Components and Biological Activity of Onycha

The essential oil derived from *Onycha* has a unique composition that contributes to its distinctive scent and potential applications in fragrances and aromatic products.

The primary chemical constituents of *Onycha* essential oil include a range of volatile compounds that contribute to its characteristic fragrance. One notable component is ambrein, a triterpene. Ambrein is responsible for the rich, sweet, and musky scent associated with *Onycha* oil. This compound is commonly found in ambergris, a substance produced by sperm whales, and is valued in perfumery for its fixative properties, helping to prolong the scent of a fragrance.

Another significant constituent is benzyl alcohol, an aromatic alcohol. Benzyl alcohol adds a slightly floral and sweet note to the fragrance profile of *Onycha* essential oil. This compound is commonly used in the perfume industry for its pleasant scent and as a solvent for other fragrance ingredients.

Various esters, such as benzyl acetate, may also be present in *Onycha* essential oil. Esters contribute fruity and sweet notes to the overall aroma, enhancing the complexity of the fragrance. Benzyl acetate is often used in perfumery to create floral and fruity accords, and its presence in *Onycha* oil adds to the oil's versatility in fragrance formulations.

Additionally, Onycha essential oil may contain other compounds like aldehydes, terpenes, and sesquiterpenes, contributing to the overall olfactory profile. These compounds add depth and nuance to the fragrance, creating a complex and well-rounded aromatic experience. It's crucial to emphasize that the chemical composition of Onycha essential oil can vary based on factors such as the geographic location of the mollusc, environmental conditions, and extraction methods.

The taxonomic classification of the operculum known as "onycha" is undocumented in existing literature. Recognizing the potential marine origin of onycha, the researcher's study provides a chemical composition analysis of opercula sourced from *Dicathais Orbita*, an Australian gastropod species. (Nongmaithem et al., 2017)

Table 1. Trace element composition of the muricid (*Dicathais orbita*) opercula

Element	Opercula Powder (mg/kg)
Calcium	6356
Sulfur	6300
Sodium	3597
Potassium	1614
Magnesium	918
Phosphorus	689
Iron	311.0
Silicon (acid soluble)	289
Aluminium	40.3 [#]
Total arsenic [^]	25.7 [#]
Selenium	23.3 [#]
Boron	16.7 [#]
Zinc	14.4
Copper	6.0
Chromium	3.1 [#]
Manganese	2.8
Vanadium	2.0 [#]
Lead	0.3
Molybdenum	0.3
Barium	0.2
Cadmium	0.2
Silver	0.2
Cobalt	0.1
Mercury	0.002

Element > 10x maximum tolerable limit 70,85

[^]1mg/kg inorganic arsenic permitted in Mollusc.

Source: (Nongmaithem et al., 2017)

Those contaminants and natural toxicants are in the food standards and regulations in Australia and New Zealand are given by FSANZ (Food Standards Australia New Zealand) and by the Agency for Toxic Substances and Disease Registry (ATSDR). The next table gives the volatile compounds of *Dicathais orbita* opercula smoke.

Table 2. Volatile compounds of *Dicathais orbita* opercula smoke

Compound	Concentration (%)
Pyridine	(39.21 ±3.09)
Acetamide	ND
Chloro-phenol	(5.14 ±0.38)*
Phenol	
Para cresol	(21.08 ±0.83)
Chloro-methylphenol	4.89
Dichloro-phenol	traces

*Although 2-chlorophenol eluted slightly earlier than phenol, due to the relatively large amount of phenol, these compounds co-eluted as overlapping peaks in most of the samples.

Source: (Nongmaithem et al., 2017)

These findings constitute the initial evidence supporting the presence of fragrant compounds and fixatives in the smoke emitted from the operculum. This presence is deemed complementary to other aromatic constituents within sacred incense, such as frankincense, galbanum, and "stacte," the latter being hypothesized to be myrrh resin. Given the considerable value and religious significance attributed to Muricidae industries, it is plausible that the associated processes were intentionally shrouded in secrecy. While retrospective identification of muricid opercula as the definitive source of onycha remains elusive, our chemical analyses affirm fixative properties and medicinal olfactory characteristics consistent with ceremonial applications of this nature. (Nongmaithem et al., 2017)

While Onycha essential oil is primarily known for its aromatic properties, it has also been explored for potential therapeutic benefits. Some traditional practices suggest using Onycha oil for its calming and grounding effects in aromatherapy. However, it's important to note that scientific research on the therapeutic properties of Onycha essential oil is limited, and its use in aromatherapy should be approached with caution.

The most pivotal chemical composition of Onycha or *Dicathais orbita* essential oil includes compounds such as ambrein, benzyl alcohol, benzyl acetate, and various esters, aldehydes, terpenes, and sesquiterpenes. These constituents collectively contribute to the unique and complex fragrance of Onycha oil, making it a valuable ingredient in perfumery and aromatic applications. While its traditional use suggests potential benefits in aromatherapy, further research is needed to understand better and validate its therapeutic properties.

The specific nature of onycha has been challenging to determine definitively. Various theories exist regarding the source of onycha, and these include possibilities from both plant and animal origins:

Some theories suggest that onycha could be derived from a plant, possibly a fragrant resin or gum. However, no universally agreed-upon identification of a specific plant corresponds to the biblical onycha. Another traditional theory proposes that onycha comes from the operculum, a protective lid of a shellfish, particularly the sea snail. In this view, the operculum might have been used for its aromatic properties.

Due to the lack of clear information in the biblical text and the passage of time, the true identity of Onycha remains to be determined. Interpretations and identifications have varied across cultures and historical periods. Some modern scholars and historians continue to investigate and discuss potential sources for Onycha, but a consensus has yet to be reached.

In practice, the uncertainty surrounding onycha has led to various interpretations and substitutions in preparing sacred incense by different religious and cultural traditions.

The intricate process of adsorption, wherein additional components of the ketoret adhere to the solid foundation provided by marine molluscs, particularly onycha, holds the potential to optimize the combustion of the incense during its sacred presentation. This

historical phenomenon may shed light on contemporary methodologies and practices, such as including coal in incense kits and incorporating a stem as a supportive base in agarbati, both aimed at improving the efficiency and aromatic characteristics of the incense ritual. These practices, rooted in the ancient wisdom of enhancing the aromatic and ritualistic qualities of sacred offerings, resonate with a profound theological significance in the present day.

e. Chemical Components and Biological Activity of *Ferula Galbaniflua*

Ferula galbaniflua and *Ferula gummosa*, known as 'Barijeh' in Persian, are taxonomically synonymous, denoting a singular plant species within the *Ferula* genus. Both nomenclatures are utilized interchangeably to designate a botanical source yielding galbanum resin, widely applied in perfumery, traditional medicine, and incense.

Ferula galbaniflua, commonly known as galbanum, is a plant that produces a unique and aromatic resin from which essential oil is extracted. This essential oil is known for its distinct fragrance and has been utilized for centuries in perfumery, traditional medicine, and various cultural and religious practices. The most important chemical composition of the essential oil of *Ferula galbaniflua* plays a crucial role in determining its aroma and potential therapeutic properties. (Halimi Khalilabad & Nadaf, 2023)

The primary constituents of galbanum essential oil include a complex mixture of terpenes and sesquiterpenes. One of the important components is β -pinene, a monoterpene known for its fresh, woody, and slightly herbal scent. This compound contributes to the overall character of the essential oil, providing a green and resinous aroma. β -pinene is also recognized for its potential anti-inflammatory and bronchodilator properties, adding a therapeutic dimension to galbanum oil.

Another significant constituent is α -pinene, commonly found in various essential oils. α -pinene contributes a piney and earthy note to the fragrance profile of galbanum essential oil. This compound is known for its antimicrobial properties and is often valued for its potential to support respiratory health.

Limonene, a cyclic monoterpene, is also present in galbanum essential oil. Limonene imparts a citrusy and fruity undertone to the overall aroma, enhancing the complexity of the fragrance. Beyond its aromatic qualities, limonene is recognized for its antioxidant and mood-enhancing properties.

Sabinene, a bicyclic monoterpene, adds a spicy and woody note to the essential oil of *Ferula galbaniflua*. This compound contributes to the warm and resinous character of the oil, making it a valuable ingredient in perfumery for creating rich and sophisticated fragrances. Furthermore, the sesquiterpene compounds in galbanum essential oil, such as β -caryophyllene and germacrene, contribute to its unique aromatic profile. β -caryophyllene is known for its spicy and peppery scent, while germacrene adds a woody and herbal nuance. These sesquiterpenes also bring potential anti-inflammatory and antimicrobial properties to the essential oil.

In addition to its aromatic qualities, galbanum essential oil has been traditionally used for its therapeutic properties. It is believed to have anti-inflammatory, analgesic, and antispasmodic effects, making it a potential candidate for relieving various ailments. However, it is noteworthy that while galbanum essential oil has a rich history of use, scientific research on its therapeutic benefits is ongoing, and caution should be exercised in its application. The essential oil of *Ferula galbaniflua*, or galbanum oil, is characterized by a diverse chemical composition featuring β -pinene, α -pinene, limonene, sabinene, β -caryophyllene, germacrene, and other terpenes. This unique blend of compounds gives galbanum oil its distinctive green, resinous, and spicy fragrance, making it a valuable ingredient in perfumery and aromatherapy. While its aromatic qualities are well-established, ongoing research aims to elucidate further the therapeutic potential of galbanum essential oil in various health and wellness applications.

f. Chemical Components and Biological Activity of Boswellia Sacra

Boswellia sacra Flueck., a species native to the Arabian Peninsula, was first described by Carter in 1844 and 1846 in Oman and Yemen, respectively, and identified as a new species by Flickiger in 1867 (Al-Harrasi & Al-Saidi, 2008; Thulin & Warfa, 1987). Among *Boswellia* species, *B. carteri* Birdw, a synonym for *B. sacra* according to World Flora Online Search (worldfloraonline.org), is native to Somalia.

Boswellia sacra, also known as *Boswellia carteri*, is the source of frankincense, a resin with a rich history of use in cultural, religious, and traditional practices. The essential oil derived from *Boswellia sacra* is prized for its distinct fragrance and potential therapeutic properties. The most pivotal chemical composition of the essential oil of *Boswellia sacra* contributes to its unique aroma and potential health benefits.

One of the critical components of *Boswellia sacra* essential oil is boswellic acid. While boswellic acid is not a volatile compound responsible for the oil's fragrance, it holds significant therapeutic importance. Boswellic acid is known for its anti-inflammatory properties, making frankincense oil a subject of interest in traditional medicine and scientific research. This compound may contribute to the oil's potential to address inflammation-related conditions, such as arthritis or respiratory issues.

Monoterpenes are another critical group of compounds found in *Boswellia sacra* essential oil. Limonene, pinene, and myrcene are monoterpenes contributing to the oil's complex fragrance. Limonene provides a citrusy and uplifting note, while pinene adds a pine-like and fresh quality. Myrcene contributes to the overall depth of the aroma with its herbal and earthy undertones. These monoterpenes also possess their therapeutic properties, including antioxidant and antimicrobial effects.

Sesquiterpenes, such as β -caryophyllene, are prevalent in *Boswellia sacra* essential oil. β -caryophyllene is known for its spicy and peppery aroma and has been recognized for its potential anti-inflammatory and analgesic properties. This sesquiterpene adds depth and warmth to the fragrance profile of frankincense oil, making it a valued component in perfumery.

Beyond its aromatic qualities, *Boswellia sacra* essential oil has been explored for various therapeutic applications. In addition to its anti-inflammatory effects, frankincense oil is believed to have properties such as immune support, stress relief, and skin health benefits. It has been used historically in traditional medicine and is now gaining recognition in modern aromatherapy and natural health practices.

The essential oil of *Boswellia sacra*, synonymous with *Boswellia carteri*, is characterized by a diverse chemical composition featuring boswellic acid, monoterpenes like limonene and pinene, and sesquiterpenes such as β -caryophyllene. This unique blend of compounds contributes to the distinctive fragrance of frankincense oil, making it a cherished ingredient in perfumery and a subject of interest in holistic health practices. The therapeutic potential of *Boswellia sacra* essential oil, particularly its anti-inflammatory effects, underscores its relevance in traditional and contemporary well-being approaches.

3.1 Discussion

a. Chemical Composition of the Incenses and Their Properties

Commiphora myrrha, *Ferula galbaniflua*, and *Boswellia sacra* are botanical sources renowned for producing essential oils, each with a distinct chemical profile contributing to their unique aromas and potential therapeutic properties.

Commiphora myrrha, the myrrh tree, produces an essential oil characterized by sesquiterpenes (such as curzerene, furanoeudesma-1,3-diene), monoterpenes (α -pinene, limonene), and phenolic compounds. Myrrh oil's warm and balsamic scent is complemented by its traditional use for its antimicrobial and anti-inflammatory properties, attributed to

constituents like curzerene.

Ferula galbaniflua, commonly known as galbanum, yields an essential oil rich in monoterpenes such as pinene, myrcene, and limonene, alongside sesquiterpenes like β -caryophyllene. These compounds imbue galbanum oil with its earthy, green, and balsamic notes. Galbanum oil has been recognized for its potential anti-inflammatory and antispasmodic properties.

Boswellia sacra, synonymous with *Boswellia carteri*, is the source of the essential oil of frankincense. The primary components include boswellic acids, monoterpenes (limonene, pinene), and sesquiterpenes (β -caryophyllene). The diverse chemical composition imparts a resinous, woody aroma. Boswellic acids, in particular, are associated with anti-inflammatory effects, contributing to frankincense oil's historical use in traditional medicine.

b. Notes in Perfumery of the Incense

In perfumery, the essential oil of *Commiphora myrrha*, known as myrrh, typically belongs to the base note category. Myrrh's warm, resinous, and slightly sweet aroma contributes depth and richness to fragrances. As a base note, myrrh enhances the overall olfactory composition, providing a lasting and lingering scent. Its earthy and balsamic character, attributed to compounds like curzerene, makes myrrh essential in creating complex and sophisticated perfumes.

In perfumery, the essential oil of *Ferula galbaniflua*, commonly known as galbanum, belongs to the middle or heart note. Renowned for its green, earthy, and balsamic aroma, galbanum adds depth and complexity to fragrances. Positioned between the top and base notes, the middle note of galbanum serves as a bridge, harmonizing the overall scent composition. Its unique olfactory profile makes it a sought-after ingredient, contributing to the balance and longevity of perfumes.

In perfumery, the essential oil of *Boswellia sacra*, known as frankincense, belongs to the base note category. Revered for its resinous, woody, and balsamic scent, frankincense is a foundational element in fragrance compositions. It provides perfume depth, richness, and longevity as a base note. Frankincense's enduring and complex aroma, derived from *Boswellia* acids, ensures a gradual release, making it a key component in creating sophisticated and timeless fragrances.

A perfume crafted from the blend of essential oils of *Commiphora myrrha*, *Ferula galbaniflua*, and *Boswellia sacra*, would yield a captivating and sophisticated fragrance. The composition would showcase a harmonious interplay of earthy, resinous, and balsamic notes.

The green and balsamic tones from galbanum, the resinous warmth of frankincense and myrrh, the exotic citrus of elemi, the grounding essence of frankincense and labdanum, and the sweet, vanilla-like richness of benzoin would collectively create a complex and enduring scent, offering a multifaceted olfactory experience that is both alluring and timeless.

c. The Ketoret: Multidimensional Aspect and Multifaceted Impacts

Examining the intersections of biblical and scientific data: Is it harmony or dissonance?

Delving into the sacred alchemy of the ketoret, an offering of profound significance, we scrutinize its exquisite ingredients—*Commiphora myrrha*, *Onycha*, *Ferula galbaniflua*, and *Boswellia sacra*. A theological mosaic emerges, interwoven with chemical compositions and biological properties, unveiling a divine prescription for spiritual and physical well-being.

The enigmatic inclusion of *Onycha*, with its marine mineral origin, assumes a pivotal role. It serves not merely as an aromatic component but, intriguingly, as adsorption support for the finely powdered companions, ensuring a sublime quality of fumigation. In this intricate symphony, reminiscent of the divine orchestrations, echoes of contemporary applications manifest as the enduring antimicrobial efficacy of biochar resonates through the ages.

These sacred elements, with their totality of biological properties, extend beyond mere olfactory offerings. They embody a holistic paradigm—cleanse, purify, heal, invigorate, and revive. Embedded in this divine prescription is a profound truth: the act of fumigation, divinely mandated twice daily for the Israelites, transcends ritualistic duty. It becomes a sacred covenant for the welfare, health, and sanctification of the people of Israel—a testament to the inherent connection between the spiritual and the human, where the fragrant tendrils of the ketoret ascend, carrying prayers for wholeness and divine favor.

d. The Aromatic Components of the Ketoret as Described from Maimonides

"Maimonides" refers to Rabbi Moses ben Maimon, a medieval Sephardic Jewish philosopher and scholar who is commonly known as Maimonides or Rambam. He lived from 1138 to 1204 and made significant contributions to various fields, including philosophy, medicine, and Jewish law. Maimonides' best-known works include the "Mishneh Torah," a comprehensive codification of Jewish law, and the "Guide for the Perplexed," a philosophical and theological treatise. His writings have had a profound and lasting impact on Jewish thought and scholarship.

In the theological realm, the amalgamation of Commiphora myrrha, Ferula galbaniflua, and Boswellia sacra, reminiscent of the sacred Ketoret, would symbolize a profound synthesis of earthly and divine essences. Each resin, akin to offerings, contributes its unique spiritual resonance. Galbanum, frankincense, myrrh, dragon's blood, elemi, Indian frankincense, labdanum, and benzoin, in divine consort, evoke a fragrant symphony that transcends the terrestrial, offering a transcendental olfactory experience. Such a blend, a sacred amalgam akin to the holy incense, would beckon the divine, fostering an ethereal ambiance of reverence and sanctity.

Rooted in ancient traditions, the Ketoret, or sacred incense, represents a divine offering and a conduit for spiritual connection. From theological perspectives, the aromatic amalgamation elevates prayers and intentions, creating an atmosphere of sanctity and communion. The specific botanical elements chosen are believed to carry symbolic and spiritual resonance, aligning with the sacred intentions of worship, purification, and invoking the divine presence.

In his profound theological discourse, Maimonides elucidates the rationale behind the divine commandment to burn incense twice daily within the Holy Temple. He discerns a nuanced purpose beyond mere olfactory pleasure. Considering the multitude of animal offerings, he contends that, left unattended, the sacred space might have been redolent of a mere slaughterhouse. Thus, the divine directive to burn incense serves a dual purpose: to impart a fragrant ambience to the Temple, elevating the sensory experience of worship, and, significantly, to enhance the Temple's dignity and the reverence of its officiants. Maimonides underscores the profound interplay between olfactory perceptions and the elevation of spiritual consciousness. (Maimonides, 1956)

e. The Aromatic Components of the Ketoret as Described by the Lubavitcher Rebbe

The Lubavitcher Rebbe, also known as the Rebbe, refers to the spiritual leader of the Chabad-Lubavitch Hasidic movement. The term specifically relates to the last leader of the movement, Rabbi Menachem Mendel Schneerson, who held the position from 1951 until his passing in 1994. He is widely revered within the Chabad-Lubavitch community and beyond for his teachings, leadership, and outreach efforts. The Lubavitcher Rebbe is considered by his followers to be a prominent religious figure and a source of inspiration for Jewish communities worldwide.

The erudite teachings of the Lubavitcher Rebbe unveil profound insights into the nuanced significance of sacrificial rituals. In expounding upon the linguistic roots, he discerns

a profound distinction between the Hebrew term for "offering," korban, denoting closeness, and the term for "incense," ketoret, resonating with the Aramaic concept of keter, signifying a profound bond. The Rebbe expounds that mere proximity does not ensure a genuine bond; one can be in close proximity to the Divine without an intrinsic connection. In the offering, the individual elevates the mundane to the Divine. In contrast, with ketoret, the emphasis lies in personal communion, where one intimately connects with the Divine essence. The offerings rectify external dimensions—thought, speech, and action—redirecting them toward divine service. Conversely, the ethereal aroma of ketoret symbolizes each individual's inherent, essential connection with the Divine. In this revelation, all aspects of the self, including thought, speech, and action, naturally align and connect with the Divine, illuminating the profound essence of the ketoret as the embodiment of our intrinsic bond with God. (Lubavitcher Rebbe, n.d.)

Aligned with the sacred verse, "We will render [the prayer of] our lips in place of [the sacrifice of] bulls," the esteemed sages impart a profound counsel—the daily recitation of verses encapsulating the sacred passages concerning the diverse offerings within the hallowed precincts of the Temple, among them, the verses enshrining the essence of ketoret. This sacred practice, meticulously observed prior to the morning and afternoon services, as meticulously delineated in the sacred siddur (prayerbook), serves as a spiritual conduit. Through reciting these verses, the worshipper endeavors to transcend the temporal and, in the realm of prayer, emulate the sanctity inherent in the offerings of old. Certain individuals adhere to a custom steeped in spiritual significance—inscribing the verses about the sacred incense upon parchment and engaging in daily recitation. This practice, identified as a segulah for financial prosperity, finds support in the scholarly work of Rabbi Chaim Plagi, notably expounded in Kaf Hachaim 16:18. Conversely, an alternative perspective, articulated by Rabbi Ovadia Yosef in his illuminating responsum, Yabia Omer, vol. 9, Yoreh De'ah 23, asserts caution. This viewpoint posits potential challenges in inscribing solely these verses on parchment, divorced from the broader context of the Torah. The discourse surrounding such sacred practices invites contemplation and the judicious exploration of nuanced perspectives.

The profound wisdom encapsulated in the Zohar imparts a myriad of merits and blessings to those who engage in the daily recitation of the ketoret. According to its sacred teachings, a profound connection with both this world and the next is forged by the sincere and comprehending repetition of these holy words. Such devout engagement serves as a spiritual shield, offering refuge from the potent forces of impurity, negativity, and divine judgment. Moreover, the practitioner is destined to be intricately linked to the very source of life itself, embodying a harmonious union with the spiritual essence that transcends the temporal boundaries of existence. (Zohar 1:230a, 2:218b).

IV. Conclusion

The profound ritual of burning sacred incense, known as the ketoret, carries deep theological significance within various spiritual traditions, particularly in Jewish mysticism and ancient religious practices. This intricate blend, meticulously composed of *Commiphora myrrha*, *Onycha*, *Ferula galbaniflua*, and *Boswellia sacra*, embodies a sacred alchemy that transcends the material realm.

Each component, meticulously selected, contributes to the aromatic symphony that arises when kindled. In the act of burning, a transformative process unfolds, symbolizing the ascent of physical elements toward the divine. The rising smoke, infused with the essence of these resins and botanical treasures, symbolizes a spiritual offering, a bridge between the terrestrial and celestial realms.

Within the theological context, the ketoret is not merely a fragrant concoction but a conduit for spiritual elevation and connection. The ritual act of burning mirrors the soul's ascent toward the divine, where the material elements mirror the multifaceted dimensions of the worshipper's being—body, mind, and spirit. The fragrance released signifies an olfactory delight and a transcendent communion with the divine essence.

The meticulous selection of ingredients, including *Commiphora myrrha*, *Onycha*, *Ferula galbaniflua*, and *Boswellia sacra*, imparts layers of symbolic significance. With its unique fragrance and spiritual resonance, each resin harmonizes with the sacred offering, symbolizing the unity and diversity within the divine fabric.

In essence, the ritual of burning the ketoret is a sacred choreography—a dance of spirit and substance, an offering that transcends the confines of physicality to reach the spiritual realms.

It represents the aspirational journey of the worshipper, a fragrant plea for connection, transcendence, and divine favor.

Historically, fumigation stood as a paramount process, predating contemporary extraction techniques. The imperative fine powder grinding, ensuring optimal emanation and ingredient homogeneity, mirrors in hydrodistillation, hydrodiffusion, supercritical CO₂ extraction, and non-headspace methodologies are used today. The transition from solid to liquid form, producing essential oils, enables versatile applications through electric diffusers, patches, or direct droplet diffusion. In certain traditions, a preference for the symbolic "smoke" version persists, notably in Catholic, Anglican, Buddhist, or Hindu temples. Globally, agarbati versions prevail, with Israel endorsing Ministry of Health-approved kits featuring aesthetically appealing packaging of anointing oils. This chronological progression highlights the evolution from historical fumigation to contemporary extraction methods, showcasing the diverse applications and enduring traditions in the realm of aromatic practices.

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