Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Spl Issue [1] January 2023: 37-41.

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
REVIEW ARTICLE **OPEN ACCESS**

A short review: Production of microbial Aroma and flavours

Dixit Ankita M.[1*] and R.D Joshi [1]
[1]Research Scholar, Department of Microbiology Yogeshwari Mahavidyalaya ,Ambejogai , Beed, Maharashtra-431517,
[1]Principal, Head of the Department of Microbiology, Yogeshwari Mahavidyalaya ,Ambejogai , Beed, Maharashtra-431517
Corresponding Author: ankitadixit2020@gmail.com

ABSTRACT:
For the food, feed, cosmetic, chemical, and pharmaceutical sectors, flavours and aromas are crucial. Nowadays, chemical synthesis and extraction are used to create the majority of flavour molecules. Flavour is often caused by a vast variety of volatile and non-volatile components existing in a complex matrix, each of which exhibits a unique mix of chemical and physical characteristics. The creation of unwanted racemic combinations as a result of such chemical processes is a drawback, as is the rising consumer resistance to chemicals used in food, cosmetics, and other home items. This has driven flavour producers to focus on flavour ingredients with biological origins, sometimes known as natural or bio-flavours. Most of the fragrance elements are now made using conventional techniques such as synthetic production through natural sources or extraction.Until recently, plants were a significant source of essential oils and flavours; however, since active ingredients are frequently present in trace amounts, are bound, or are only found in exotic species, isolation is challenging and flavour products are pricey. Besides plant cell and tissue culture methods, relevant precursor chemicals can also be bio-converted. With a focus on recently commercialised technologies, this study discusses the state of the art in the field of bio flavour synthesis, which is based on microorganisms and their enzymes. Another approach to accomplishing this spontaneous synthesis is based on microbial biosynthesis or bioconversion. Additionally, it makes regulatory observations about the biotechnological synthesis of fragrance chemicals. This analysis is concluded with a thorough reference literature scan on fermentation and bioconversion techniques for flavour component production.
Key Words*: Biotechnological approach, Microbial Based Perfumes and flavours, Bioconversion, Microorganisms, enzymes, and cultured cells.*

Received 28.10.2022 Revised 30.11.2022 Accepted 20.12.2022

INTRODUCTION
Aromatic compounds and fragrances are used in almost every business nowadays because of the importance they have on the finished quality of items like foods and drinks. The principal source of these components is the monoterpene molecules found in essential oils. However, these chemicals are found only in minute quantities, and their yield or extraction process can be hampered by a number of variables like seasonal fluctuations in concentration, plant disease, extract of Vegetable intricacy, as well as economic and environmental constraints. A chemical synthesis is a typical approach for the manufacture of aroma compounds; in this process, molecules plentiful in nature, such as terpenic hydrocarbons, are used as starting materials[1].
Flavour is often caused by a vast variety of volatile and non-volatile components existing in a complex matrix, each of which exhibits a unique mix of chemical and physical characteristics. Volatile substances affect not just the flavour but also the aroma, whereas non-volatile molecules are largely responsible for the taste. Some of the components that might contribute to the scent of the meal include alcohols, aldehydes, esters, dicharbonyls, short- and medium-chain free fatty acids, methyl ketones, lactones, phenolic compounds, and sulphur compounds. Sulphur chemicals and phenolic compounds are two more probable causes[2,3].

Single molecules to complex combinations of flavours have been extracted from plants using different methods since ancient times. One day, once the structure of these flavours had been decoded, chemical synthesis was used to create synthetic flavours. More than a fourth part of the worldwide industry for food additives is now dedicated to flavours, and the vast majority of compounds used for flavouring are manufactured by chemical synthesis of components or the removal of substances from natural sources. In contrast, recent consumer surveys have shown that customers favour natural food items. Because of regulatory constraints, flours created by chemically altering naturally occurring components are not authorised to be labelled as natural. Chemical synthesis is often followed by ecologically damaging manufacturing procedures, and it often has less selectivity substrate, which can produce in the generation of unwanted racemic mixtures and, in turn, impair the efficiency and increase downstream costs. However, there are a number of obstacles inherent in the process of creating natural flavours by the direct extraction of plants. The high expense of extracting these compounds from these raw materials is due to their normally low concentrations. Furthermore, its implementation is sensitive to uncontrollable factors like weather and the presence of plant diseases. Both of these processes have their limitations, and with people's interest in natural products on the rise, scientists have been looking for other ways to create natural flavours[4].

Flavour synthesis can also be accomplished by bacterial bioconversion or biosynthesis. One of the most typical perspectivesis the use of suspensions of microbe or preparations of the enzyme,otherwise, cell suspension of plant has also been described as a viable manufacturing method. Microbial fermentation utilises primary nutrients like sugars and amino acids to generate secondary metabolites that provide flavour. Humans will be able to utilise these flavours. For two unique purposes, this capability can be utilised as follows:

- The organoleptic properties of many foods and drinks (such as cheese, yoghurt, beer, and wine) are determined during the production process through in-situ flavour creation.
- cultures of microorganisms bred for the sole aim of extracting aroma molecules for use as flavourings in food processing. The tastes achieved in this way are all-natural flavours.

Intermediates or Precursors can be introduced to the suspension in either case to stimulate the growth of a particular flavour molecule. Furthermore, the information gleaned from studyingthe metabolism of microbes during the fermentation processes of food might be used to create systems of production optimised for certain flavour enhancements. However, enzymology offers a fascinating and favourable selection for creating natural flavours. Lipases, proteases, and glucosidases, among others, are enzymes involved in the synthesis of substances with aromas derived from precursor chemicals. Enzyme-catalysed processes give superior stereoselectivity compared to conventional chemical techniques. Obviously, this is a huge perk. In addition, the items obtained in this manner might be legally categorised as natural substances[4].

Possible substitutes to produce aromatic chemicals include biotechnological techniques, such as the use of called "biocatalysts" in the synthesis of flavouring compounds. Microorganisms, enzymes, and cultured cells or tissues from plants all fall under this category. Pure flavour molecules or complex mixtures of those compounds appear to offer the most potential for production by microbial processes at the present moment. Flavours may be made from scratch by a wide range of microorganisms using a fermentation process that uses simple compounds like sugars and amino acids as substrates. Long-term, learning about the metabolic pathways utilised by bacteria might help with improving the essential oil output of plants. Bioconversion refers to the process by which microorganisms catalyse the targeted transformation of one precursor or intermediate into another. Whether or if region- and stereospecific bioconversions are supplementary to chemical synthesis, they are nevertheless required for the resolution of optical isomers[5].

It wasn't until 2010 that the first reports of using genetically altered strains became prominent in response to a serious shortage of fragrance oil, which is generally obtained from pogostemoncablin. As it so happened, this transpired back when (Patchouli). The essential oil extracted from the patchouli plant is often used in incense as a fragrance. and other aromatic products. Some products of health care use patchouli as an ingredient. It has been reported that bad weather in Indonesia killed medicinal shrubs, leading to a dismal aromatic oil harvest. Earthquakes and volcanic eruptions only exacerbated the already poor supply situation (Chemical & Engineering News). The demand for fragrance oil continues to rise, so scientists have engineered bacteria and yeast to produce scents from the patchouli plant more efficiently and cheaply. The use of genetically engineered microbial strains also allowed for the recreation of the bitter, sandalwood, grapefruit, orange, rose and aromas that are notoriously difficult to get in their natural forms. Several biotech firms employ sugar fermentation to create fragrances and flavours using microorganisms, and these firms include Allylix, Isobionics, Givaudan, Firmenich, Evolva, and International Flavours& Fragrances. International Flavours& Fragrances and Allylix are the names of these businesses[1]. This microbe's first by-product is a citrus chemical called valencene, which is commonly found in the rind of Valencia oranges. The second substance is called "nootkatone," and it may be found in the rind of grapefruits. It's common practice to use these compounds while making fruit-flavoured drinks or scented products. Vanillin, which is generally produced by chemical processes, may now also be produced through microbial fermentation. Perfumes made from microorganisms are eco-friendlier and more authentic since they use a more sustainable manufacturing process. As a rule, plant-based sources are unreliable due to the prevalence of threats such as natural catastrophes and plant diseases. The changed bacteria can produce the scent in far bigger quantities than before, negating the need to harvest the rare plant (Wired Science). The promise of a steady supply of flavour and aroma molecules unaffected by climate change or natural disasters while maintaining a high standard of product quality throughout microbial fermentation is an alluring one. 4 Perfumes are made with 95% petroleum-based chemicals, and the $20 billion artificial flavouring market is estimated to be worth billions more. Molecular compounds belonging to the ester family are responsible for the smells found in nature. When an alcohol and an organic acid react, esters are produced. The ester isoamyl acetate smells like bananas, while the ester methyl salicylate smells like wintergreen. Esters are a vital component of the flavour of beer and wine since they are created naturally by yeasts and other living cells. Bacteria also create esters, the flavouring component of cheese. The researchers explored the effects of transferring the yeast genes responsible for olfactory selectivity into *Escherichia coli*. The enzymes have to be tweaked to alter cellular metabolic pathways and so allow for manipulation of the resulting ester. Researchers employed engineering of metabolism to induce E. coli to create a fake banana odour; they named the final product "Eaud'coli." This ground-breaking technique is protected by a patent[6].

MATERIAL AND METHODS

Reviewers searched nine databases for systematically reviewed articles published between and in English-language peer-reviewed journals 2005 and 2019. Relevant articles were identified by search engines; PubMed, Medline, SCOPUS, CINAHL, PsycINFO, Embase, Elsevier, EBSCOHost, and Google Scholar with the following key words: "Biotechnological approach, Microbial Based Perfumes and flavours, Bioconversion, Microorganisms, enzymes, and cultured cells.

DISCUSSION

Scientific research has demonstrated that the microbial populations present in and around the plant's roots determine the aroma oil that may be extractedfrom a vetiver-like tropical grass. The sort of bacteria that may be discovered dwelling inside the plant determines the makeup of vetiver root oil, which is frequently utilisedas a perfume. Thus, the composition of oil may be changed by changing the makeup of bacterial populations. The scientists also looked at the involvement of microbesin the production of oil and the capacity of various strains of microorganisms discovered in the roots of a plant to thrive when given Vetiver oil as their only source of carbon and energy.They discovered that certain strains of the Enterobacteriaceae family had great success. The researchers also looked at how these bacteria changed the structure of the oil.The raw vetiver oil was found to be digested by each bacterium, producing several novel chemicals that were absent from the oil which is raw but present in oils that are accessible for purchase.A relatively limited amount of aroma-producing molecules (sesquiterpenoids) are created by axenic vetiver, or vetiver that has no other organisms or microbes present, according to research done by experts. However, additional chemicals that create aromas were also formed when the primary sesquiterpenoid (beta-caryophyllene) was superficially supplied to the microorganism.As a result, the bacterial populations found directly in the root influence the oil's content and the molecules that give off aromas when present[6].

The cosmetic and fragrance industries both utilize vetiver essential oil. A type of bacteria is found in the roots of the tropical grass vetiver, according to recent investigations. Few oil precursors are produced by the Vetiver root cells, and these precursors are then processed by the root bacteria to make Vetiver oil more complex. Both the cells that produce oil and the root regions that are intimately linked to the essential oil include bacteria. The oil's chemical composition is altered by these bacteria, giving it new flavours and qualities including germicidal, insecticidal, antibacterial, and antioxidant. These bacteria also encourage the creation of essential oils. Alpha-, beta-, and gamma-proteobacteria and High G+C Gram-positive bacteria, and bacteria from the Fibrobacteres/Acidobacteria group are the microorganisms in charge of this change.The only grass that is grown exclusively for its sesquiterpene-based essential oil from the root is vetiver grass. These serve as pheromones and adolescent hormones in plants. Along with sesquiterpenes, alcohols and hydrocarbons are the content of essential oils, which are largely utilized in cosmetics and fragrances. The additional variation that these microorganisms add to the flavour and aroma of these oils may be advantageous to the perfumery and flavouring industries.The pharmaceutical, cosmetics, and flavouring sectors may make use of the chosen suspension of microbes and expand their libraries of metabolism ofstudy results, which invites new opportunities in the biotech sector for naturally bioactive substances.A plant (with a few simple chemicals) interacts with microorganism present on a root, which in turn bio-transforms them into a range of compounds which are bioactive. This is an excellent illustration of the ecological importance of plant-microbial relationships[7].

Additionally, the amount of oil produced is also influenced by geographical factors. Studies revealed that the environment in which vetiver oil was cultivated has a major impact on its qualities.This creates the opportunity to directly alter the composition of the oil utilizing these bacterial colonies. Either an in vitro approach employing certain strains of bacteria to transform transforming the raw material into the ideal product, or an in vivo way by modifying the bacterial colonization of the plant root, can be used to accomplish this.It is commonly known that chemicals released by a plant's roots enrich the soil around it. For instance, the roots of young maize plants release huge amounts of compounds called benzoxazinoids (BXs), which are crucial for the plant's defence against pests in its stem and leaves above ground.Researchers have discovered that many bacterial genes are in charge of this relationship with BX compounds, which motivates *Pseudomonas putida* to move closer to the plant.*Pseudomonas putida* has capacity to purify the root environment by utilizing BX moieties as an energy source, according to studies that demonstrate its presence speeds up the breakdown of BX molecules.This work has provided fresh directions for further investigation. Analysis of the bacterial genes that had activated in the presence of BX compounds generated by the roots provided one intriguing lead. According to this investigation, the BX compounds not only draw microbe to the surface of the roots but additionally activate mechanisms in the bacteria that can assist to prevent soil-oriented illnesses. This is significant because the plant controls the behaviour of advantageous microorganisms in addition to attracting them.The next step in the study process would be to map out the molecular architecture of the communities of microorganismsthat are influenced by these root compounds &to look into the positive effects of these bacteria on soil quality, plant development, and health[8].

According to different research, maize plants release unique chemical signals that entice bacteria that promote growth to dwell near their roots. This is the initial chemical signal that hadbeen demonstrated to draw advantageous bacteria to the environment around maize roots.This study might be especially helpful in defending our crops from soil-borne pests and illnesses. Plants that can suppress illness and encourage the growth of rhizobacteria can be bred to produce disease-resistant kinds of plants (PGPR). Scientists want to reduce the usage of pesticides and fertilizers in agriculture by doing this. 13 Some plants are thought to release extracellular compounds from their roots that draw other species close to the surface of the root.Up to 100 times more microbes may be present near a plant's roots than elsewhere in the soil. Simple soluble substances like sugars and organic acids that are secreted by plant roots attract these microbes because they are an excellent source of energy.Complex compounds, on the other hand, are not often used as attractants since they are thought to be hazardous. These chemical poisons are used by soil bacteria, such *Pseudomonas putida*, to identify a plant's roots. Because these bacteria boost the presence of ordinarily not soluble plant minerals such as phosphorus and iron and make them accessible, the plant benefits from their presence.Additionally, they assist in protecting the root system from soil-borne infections by competing with dangerous bacteria in the area.

As the biomass previously produced foresees the presence of the biotransformation products, the bioconversions are unrelated to the presence of the substrate during the early phases of microbial action, it is likely that the enzymes involved in the biotransformation that creates the metabolites present in every reaction product carried out a similar study to that carried out by H.F. In general, oxidised metabolites are created when oxygen is incorporated into the substrate molecule during the biotransformation of beta-pinene, alpha-pinene, and camphor. Each monoterpene utilised in this study underwent biotransformation by likely a number of processes, which points to the involvement of several enzymes. Alpha- and beta-respective pinene's biotransformation products, verbenone and alpha-terpineol, were discovered. These goods provide a significant amount of value to the substrates utilised and are employed in the synthesis of medicines as well as the perfume and fragrance industries[9].

CONCLUSION

The purpose of the review was to give a brief summary of what is understood about natural organoleptic chemicals, with a particular emphasis on the most recent developments in their manufacture and application in the food sector. Most of the fragrance elementsare now made using conventional techniques such as synthetic production through natural sources or extraction. The scent business has recently been driven by rising demand for natural products to look for innovative ways to obtain aroma molecules naturally. Based on microbial biosynthesis or bioconversion, there is another method for achieving this natural synthesis. The creation of related aroma compounds for the processing of the food sector using microbial cultures or enzyme preparations has significant benefits over conventional techniques, according to a critical examination of the literature.Additionally, it is widely known that solid-state fermentation can result in larger gives or good product qualities than submerged fermentation at relatively cheap costs.

ACKNOWLADGMENT :I thankful to the Dr.R.D Joshi sir for his valuable guidance and support to conduct the study in Department of Microbiology , Yogeshwari Mahavidlaya , Ambejogai. I also thankful to the technical and non technical staff of the Yogeshwari Mahavidlaya for their support.

CONFLICT OF INTEREST: None

AUTHORS CONTRIBUTION: Ms.Ankita Dixit conceived the Present the idea and wrote the manuscript with the guidance of Dr.R.D Joshi sir and he helps to shape the article.

FUNDING: Self Funded

REFERENCES

1. Rozenbaum HF, Patitucci ML, Antunes OAC, et al. (2006). Production of aromas and fragrances through microbial oxidation of monoterpenes. Brazilian Journal of Chemical Engineering.23(3):273–279
2. G. Urbach, (1997). The flavour of milk and dairy products: II. Cheese: Contribution of volatile compounds, Int. J. Dairy Technol. 50; 79–89.
3. I.L. Gatfield, (1980). Production of flavour and aroma compounds by biotechnology, Food Technol. 10 110–122.
4. Longo MA, Sanromán MA. Production of food aroma compounds: microbial and enzymatic methodologies. Food Technology and Biotechnology. 2006 Jul 1;44(3):335-53.
5. Janssens L, De Pooter HL, Schamp NM, Vandamme EJ. (1992). Production of flavours by microorganisms. Process Biochemistry.;27(4):195-215.
6. Gupta C, Prakash D, Gupta S. (2015). A biotechnological approach to microbial based perfumes and flavours. J. Microbiol. Exp.;2.9-13
7. Wiley B.(2008). Bacteria Manage Perfume Oil Production From Grass. Science Daily.90
8. Neal AL, Ahmad S, Gordon-Weeks R, et al. (2012). Benzoxazinoids in root exudates of maize attract Pseudomonas putida to the rhizosphere. PLoS One. 7(4):e35498.
9. Rozenbaum HF, Patitucci ML, Antunes OAC, et al. (2006). Production of aromas and fragrances through microbial oxidation of monoterpenes. Brazilian Journal of Chemical Engineering. 23(3):273–279

CITATION OF THIS ARTICLE

A.M. Dixit and R.D Joshi: "A short review: Production of microbial Aroma and flavours" , Bull. Env.Pharmacol. Life Sci., Spl Issue [1]: 2023:37-41.