Module-26: Ginger Essential Oil and Oleoresins

26.1. Ginger Essential Oil and Oleoresins:

Essential oils are characterized by their overall capacity to generate aroma and flavour. Therefore, they are widely used as flavouring additives in food production, fragrances in cosmetics, and components of soaps, air fresheners, and detergents. Essential oils extracted from plants also contain the biologically active fraction of chemicals that are biosynthesized in natureand very oftenpossess pesticides, insecticidal, and antibacterial properties. An important field of application is also clinical aromatherapy in which oils are heated and volatilized. Chemically the term essential oil refers to any class of volatile oils containing a multipart mixture of monoterpenoids,smaller amounts of sesquiterpenoids, and other volatile aromatic compounds steam-distilled from different parts of plants. Up to now most reports of the compositional variation of essential oils deal with plant extracts obtained directly by steam distillation.

Ginger oil can be produced from fresh or dried rhizomes. Oil from the dried rhizomes will contain fewer of the low boiling point volatile compounds (the compounds that give ginger its flavour and aroma) as these will have evaporated during the drying process. The best ginger oil is obtained from whole rhizomes that are unpeeled. Ginger oil is obtained using a process of steam distillation. The dried rhizomes are ground to a coarse powder and loaded into a still. Steam is passed through the powder, which extracts the volatile oil components. The steam is then condensed with cold water. As the steam condenses, the oils separate out of the steam water and can be collected. In India the material is re-distilled to get the maximum yield of oil. The yield of oil from dried ginger rhizomes is between 1.5 to 3.0%. The remaining rhizome powder contains about 50% starch and can be used for animal feed. It is sometimes dried and ground to make an inferior spice.

Steam distillation is most used to produce many types of essential oil such as from ginger. The process is cheaper than other extraction processes. It will not use any solvent and can make it safer than other processes. Ginger essential oil consists of 10 compounds, where three are identified as monoterpens and four compounds as sesquiterpens. The dominant components of this oil are zingiberene (35.89±0.30%), β -bisabolene (16.27±0.95%), β-sesquiphellandrene (11.56±0.33%), and <AR> curcumene (12.18± 1.58%), geranial (9.9%), geraniol (9.4%), nerol (7.1%), 1,8-cineol (6.2%), alpha-terpineol (5.6%), borneol (5.4%), beta-phellandrene (3.1%), linalool (1.7%), methyl nonyl ketone (1.6%) and camphene (1.4%). To get the approximately pure essential oil from raw material, conventional extraction technique like steam distillation is used. Steam distillation is unlikely solvent extraction. This is because steam distillation is to produce essential oils but solvent extraction will produce oleoresin. Pure essential oil can be derived from a part of ginger plant that is the ginger rhizome by using steam distillation method. The extraction of the ginger essential oils begins when steam contact to the ginger in the extraction tank. The steam carried out the essential oils from the ginger out of the rhizome and go through the condenser. Then, the steam with the essential oils will be

condensed into liquid phase and will be collected in the beaker. Lastly, the two liquids will be separated. To get high quality and quality of essential oils, the fire from burner that burns the tank and produces steam in the tank must be well controlled. The extractor for this process will have three main parts. First, the steam will be supplied into the vessel. The steam will contact to the raw material and force the essential oils out of its raw material. Second, a condenser will be used to change the mixture of vapours to be two separated layer of water and essential oil. This two separated mixture occurs because of the different in density. Lastly, the mixture of water and essential oil will be collected in a vessel.

26.2. Supercritical CO_2 Extraction:

Ginger root is first charged to T-101, the extraction vessel. Supercritical CO2 is then fed from the holding tank, TK-101, to the extractor. The supercritical CO_2 is then passed through the extraction vessel for a total of six hours. At this point, 95% of the 6-gingerol, which is assumed to make up 30% of the ginger oleoresin, has been removed from the ginger root. The CO_2 and extracted ginger oleoresin leave the extractor and enter E-101, the pre-heater, where the mixture is heated using low-pressure steam. The pressure of the mixture is then throttled to 65 bar, causing the supercritical CO_2 to become a gas. The two-phase mixture then enters the flash vessel, V-101, where essentially all of the liquid oleoresin exits from the bottom of the flash vessel. Essentially all of the CO_2 exits the top of the flash vessel and then enters C-101 and E-102, where it is compressed and cooled back to supercritical pressure and temperature. The recycled CO_2 is then sent back to TK-101.After extraction, CO_2 and extracted ginger oleoresin enter a pre-heater and then a throttling valve. It is necessary to heat the mixture before entering the valve to keep the oleoresin above its freezing point of 31°C upon the reduction in pressure. The process is operated such that the entire amount of CO_2 in the holding tank is circulated through the process only once over the six-hour extraction period. Once a given amount of CO_2 has passed through all the pieces of equipment, it is sent back to the storage tank where it is accumulated for extraction of the next batch of ginger root. The process is then shut down for two hours while the spent ginger is removed from the extractor and a new batch of ginger root is charged to the extractor.

26.2.1. Benefits of CO_2 extraction

- CO_2 does not extract any heavy metals like lead, mercury etc. These heavy metals are found in most plants as they are taken in to the plant from the soil.
- Since high pressure is used the microbial content is destroyed giving a microbial free material. This increases the shelf life of CO_2 extracts and thereby the shelf life of the food item it is added to. Shelf life is typically 2-5 years for CO_2 extracts.
- CO_2 extracts do not require any special storage condition and can be kept in normal room temperature around 30^oC.

- CO_2 extracts are typically only 5% of the raw spice and therefore the transportation cost and storage costs are lower. Added to this is the lower space required for the extract versus the raw spice.
- Most of our customers have found the per kg usage cost of CO_2 extract versus solvent extract is not higher, it would be same if not lower than solvent extracts as the product is purer and better.
- Extracts also give a more consistent quality from lot to lot.

26.3. Oil properties

Ginger oil can vary in colour from pale yellow to a darker amber color and the viscosity also ranges from medium to watery. It is strong smelling oil - spicy, sharp, and warmwith a tint of lemon and pepper, which smells of actual ginger.

26.4. Therapeutic properties

The therapeutic properties of Ginger oil are analgesic, anti-emetic, antiseptic, antispasmodic, bactericidal, carminative, cephalic, expectorant, febrifuge, laxative, rubefacient, stimulant, stomachic, sudorific and tonic.

Summary

Essential oils are characterised by their overall capability to get aroma and flavour. Therefore, they are widely used as flavourer additives in food production, fragrances incosmetics, and elements of soaps, air fresheners, and detergents. There are different methods of extraction of essential oils and oleoresins like steam distillation and Supercritical CO2 Extraction. Steam distillation is most used to produce many types of essential oil such as from ginger. The process is cheaper than other extraction processes. It will not use any solvent and can make it safer than other processes.

SUGGESTED READINGS

- Adams, R.P., Identification of Essential Oil Components by Gas Chromatography Quadrupole Mass Spectroscopy, Allured Publishing Corp., (2001) *Carol Stream.*
- Anne Plotto. GINGER: Post-Production Management for Improved Market Access. Hand book of herbs and spices (2002), vol: 1019, P 9.
- Hector Valenzuela. Farm and forestry production and marketing profile for ginger (Zingiber officinale). *Specialty Crops for Pacific Island Agroforestry* 2010. (http://agroforestry.net/scps).
- Khairu Aizam Bin Ibrahim. Extraction of essential oils from ginger rhizome using steam distillation method. Faculty of Chemical & Natural Resources, University College of Engineering & Technology Malaysia. (2006) November.
- Marek Golebiowski, Bogdan Ostrowski, Monika Paszkiewicz,Malgorzata Czerwicka, Jolanta Kumirska, Lukasz Halinski, Edmund Malinski, and Piotr Stepnowski.Chemical composition of commercially available Essential oils from blackcurrant, Ginger, and peppermint.*Chemistry of Natural Compounds*, 2008. Vol. 44, No. 6.

- Niken Harimurti, Nhadira Nhestricia, Sri Yuliani Subardjo, and Sri Yuliani.Effect of oleoresin concentration and composition of encapsulating materials on properties of the microencapsulated ginger oleoresin using spray drying method. *Indonesian journal of agriculture* 2011. 4(1): 33-39.
- Pino, J.A., Marbot, R., Rosado, A., Batista, A., *J. Essent. Oil* Res. (2004) 16 (3), 186-188