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KERALA KARSHAKAN

English journal

The First English farm journal from the house of Kerala Karshakan

From Rich Soil to Premium Food

The Plasma Revolution !

INSIDE

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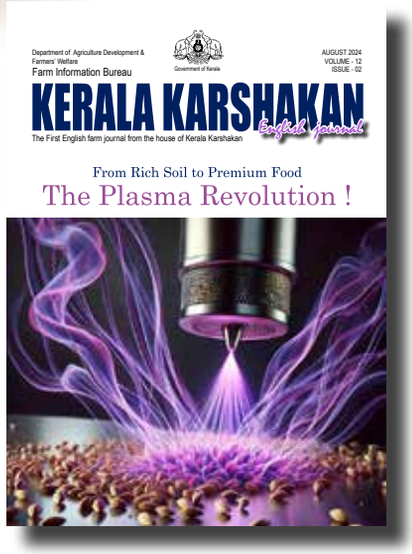

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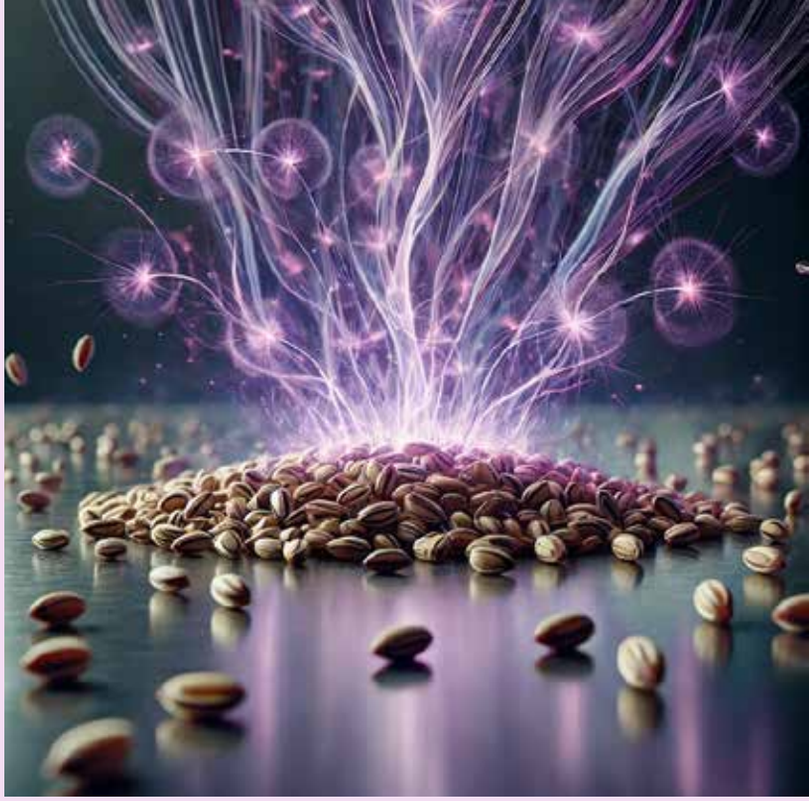

Plasma technology is transforming agriculture by using electrically charged gases for efficient surface sterilization and modification without damaging the product. The main advantage of this "cold plasma" technology is that it operates at room temperature, making it perfect for applications where heat could harm the product. This innovative technology is gaining recognition across nearly all areas of agriculture and holds significant promise for smart farms aiming for efficient and sustainable outcomes.

From Rich Soil to Premium Food

The Plasma Revolution !

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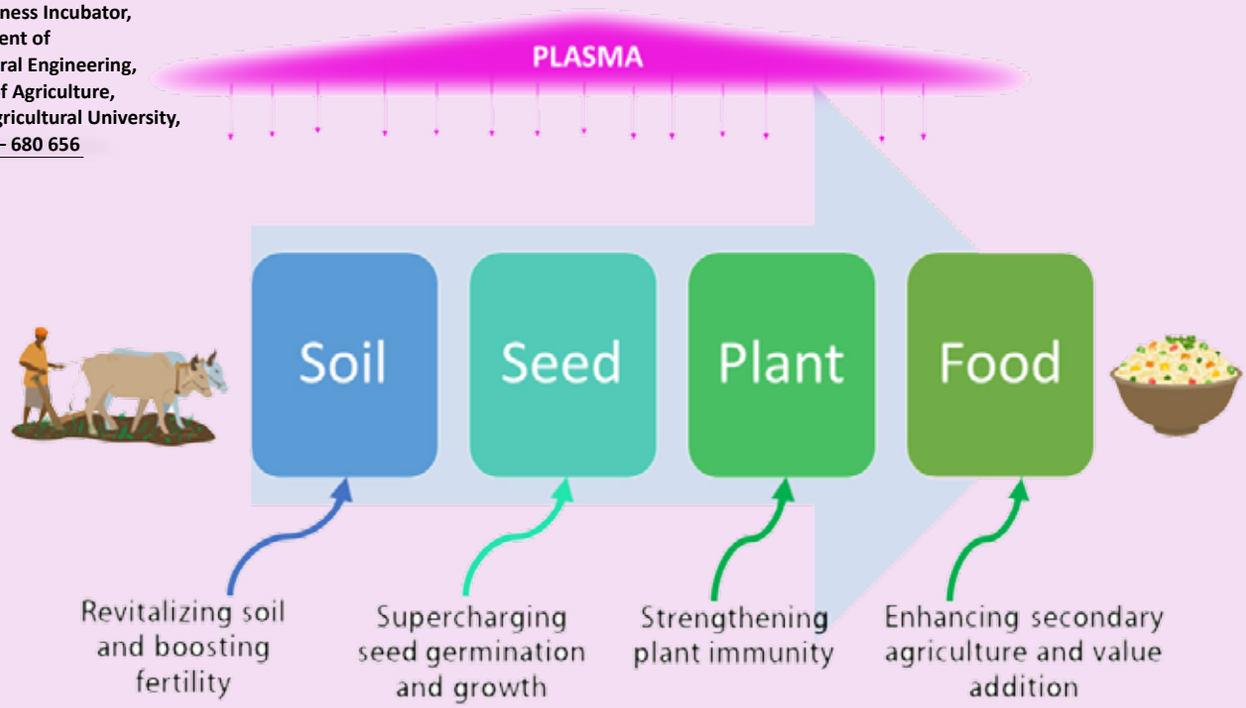


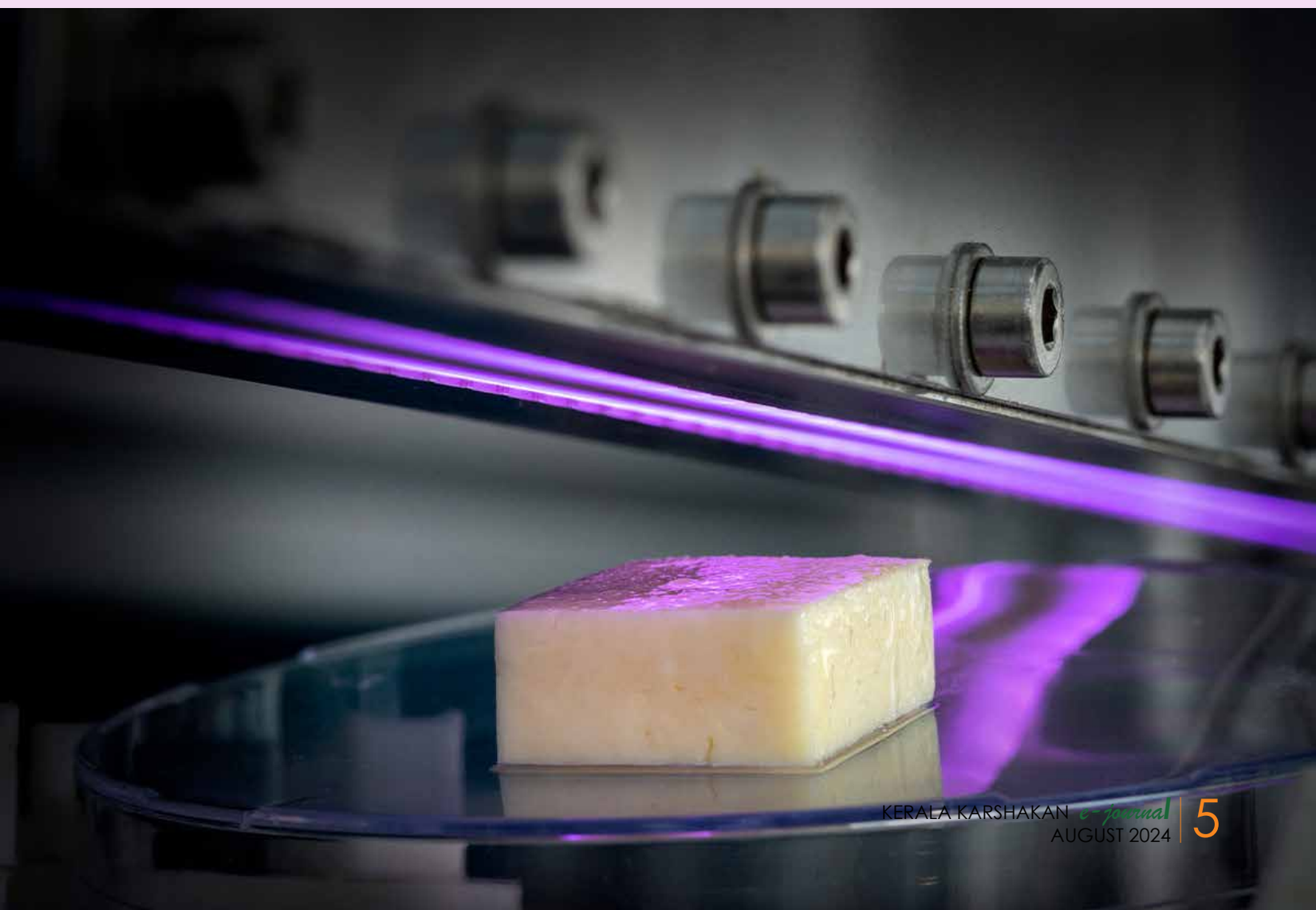
Figure 1. Illustration of the Plasma-integrated Agri-Food chain

What is Plasma Technology?

Plasma technology involves the use and manipulation of plasma, the fourth state of matter, which consists of ionized gas with free electrons and ions. When exposed to a sample, plasma's mechanisms include the production of Active Oxygen Species (AOS) like hydroxyl radicals (OH□) and ozone (O3), which interact with microbial cell membranes and internal structures to neutralize them. Active Nitrogen Species (ANS) such as nitric oxide (NO) and nitrite (NO2-) interact with microbial proteins and nucleic acids to deactivate them. Additionally, plasma-generated electric fields facilitate electroporation, creating temporary pores in microbial cell membranes. This technology can enhance soil health, improve seed germination rates, promote plant growth, and ensure food safety and quality by effectively reducing microbial contamination. The plasma-integrated Agri-Food chain is illustrated in Figure 1. Additionally, the following sections provide an in-depth understanding of how plasma technology is revolutionizing food production and post-harvest phases.

Enhancing soil health

Plasma improves soil structure, aeration, and nutrient availability by breaking down complex organic molecules into simpler forms that plants can readily absorb. Plasma-activated water (PAW), produced by exposing water to plasma, further boosts soil fertility by increasing nutrient availability and promoting the growth of beneficial microorganisms. This process reduces the reliance on chemical fertilizers, thereby mitigating soil degradation and pollution over time. Additionally, plasma facilitates nitrogen





fixation in the soil by using energy to convert atmospheric nitrogen (N2) into reactive nitrogen species, such as nitrates (NO3-) and ammonium (NH4+), which plants can easily assimilate. This method offers a sustainable alternative to traditional nitrogen fertilizers produced through the energy-intensive Haber-Bosch process.

Enhancing seed germination

Plasma technology enhances seed germination by modifying seed coats to improve water absorption and increasing essential antioxidants and hormones. The reactive oxygen and nitrogen species (ROS and RNS) produced by plasma serve as signaling molecules that regulate various physiological pathways in plants. Additionally, the reactive species generated by plasma disrupt the cell walls and membranes of bacteria, fungi, and viruses, effectively inactivating them and providing effective pathogen control for seeds. As a result, plasma-treated seeds germinate quickly, grow robustly, and exhibit enhanced disease resistance, eliminating the need for hazardous chemical treatments such as sulfuric acid and sodium hypochlorite.

Boosting plant immunity and growth

Plasma technology is a powerful tool for promoting root growth and stimulating beneficial soil microbes, leading to enhanced nutrient absorption and increased crop yields. This encourages the production of essential plant hormones such as auxins and cytokinins, which regulate growth and stress responses by modifying gene expression and boosting enzyme activities. Additionally, it enhances the synthesis of secondary metabolites like phenolic compounds and flavonoids, providing plants with natural protection against pathogens and environmental stressors. Unlike traditional methods like fertilizers and genetic modification, plasma offers a sustainable and cost-effective solution, reducing environmental impact. By strengthening plant immunity, plasma technology makes crops more resilient to drought, salinity, and other challenges, paving the way for healthier and more robust agricultural systems.

Enhancing food processing

Plasma technology, as a pretreatment method, significantly enhances various food processing methods, thereby improving the efficiency of the process and product quality. In

drying processes, plasma modifies the surface properties of food materials, facilitating moisture removal and resulting in faster, more uniform drying. Further, in extraction, extrusion, etc., plasma interacts with food components, leading to changes in protein and starch structures. This enhances the functional properties, such as better water absorption, improved texture, and increased nutritional value.

Maintaining food nutrients and removing antinutrients

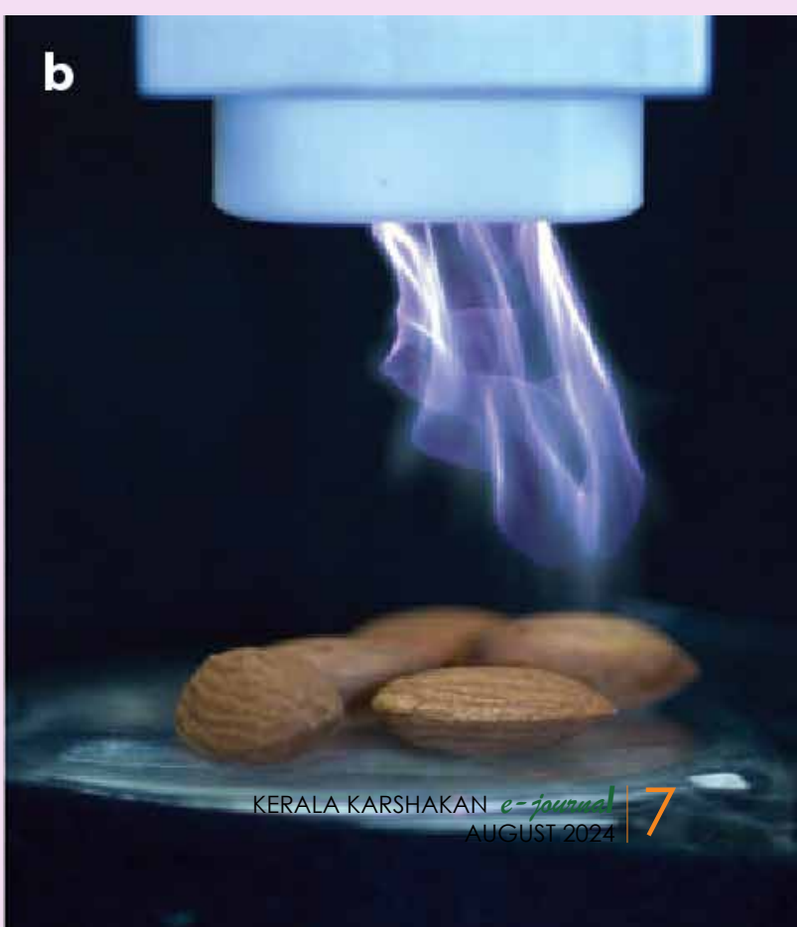
Cold plasma effectively reduces antinutrient factors such as phytic acid and trypsin inhibitors, commonly found in grains, legumes, nuts, seeds, and certain tubers. These antinutrients interfere with nutrient absorption, but cold plasma breaks them down, improving the bioavailability of essential nutrients. Additionally, cold plasma preserves the nutritional quality of food by minimizing nutrient loss during processing. It achieves this by using low-temperature treatments that prevent the degradation of heat-sensitive vitamins and other essential nutrients, ensuring that food remains highly nutritious while removing compounds that hinder nutrient absorption.

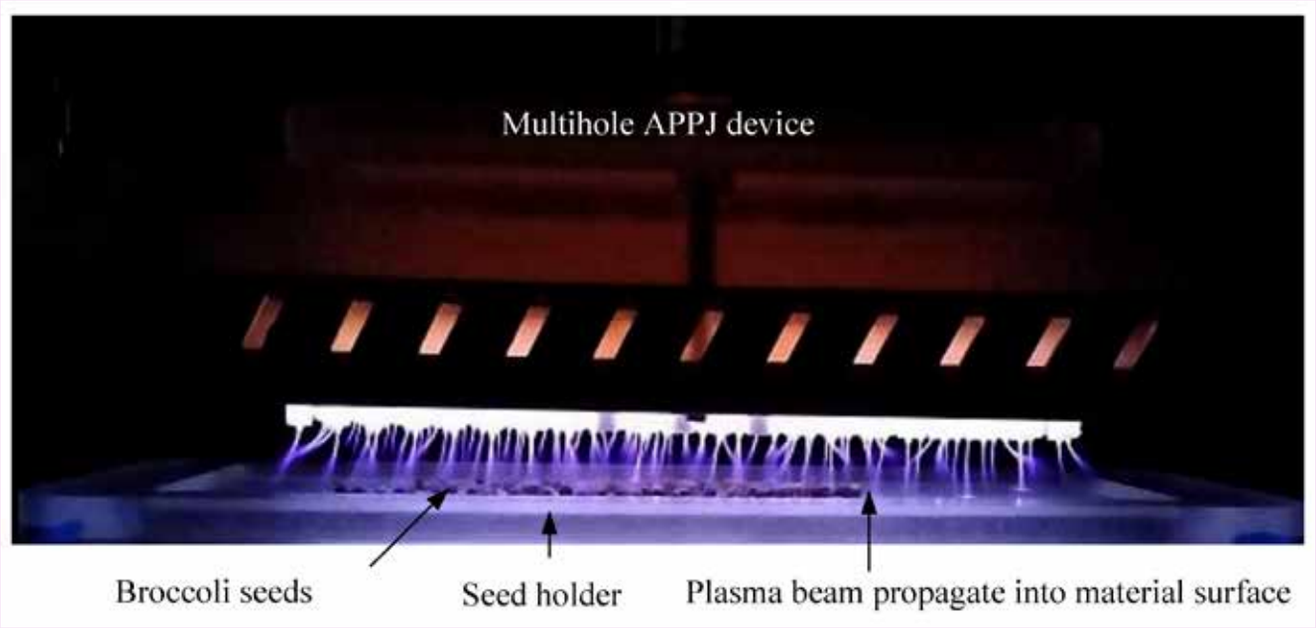
Extending food shelf-life

Plasma technology extends the shelf life of food by reducing microbial load and delaying spoilage. Reactive species generated by plasma, such as ROS and RNS, eliminate bacteria, fungi, and other pathogens on food surfaces by damaging their cellular components. Plasma-activated water (PAW) is also highly effective for food sterilization, as its reactive species, including hydrogen peroxide (H2O2) and nitrate (NO3-), interact with and inactivate microbial cells. Studies indicate that PAW can reduce harmful bacteria like Salmonella, Listeria, and E. coli by 3-4 logs, significantly improving food safety by reducing bacterial counts by up to 99.99%.

Challenges in adopting plasma technology on Indian farms

Plasma technology is gaining traction in smart farms worldwide, but its adoption on Indian farms faces several hurdles. The high initial setup cost for plasma equipment is a major barrier for small and marginal farmers. Additionally, customizing plasma equipment to meet specific needs is challenging. Many farmers are hesitant to switch from traditional practices to novel





technologies, limiting the benefits. Inconsistent electricity and unstable power supply also create technical difficulties in maintaining plasma technology on Indian farms.

Future research should focus on developing cost-effective, portable plasma devices tailored to the needs of Indian farmers. Strengthening extension services and government initiatives to educate and support farmers in adopting this innovative technology is crucial. Collaborative efforts between research institutions, government bodies, and the private sector are essential for successful implementation. Research should also explore the benefits of plasma technology for indigenous crops, problem soils, and potential exotic seeds, ensuring its broad applicability and effectiveness.

Current Research in India

India is at the forefront of exploring plasma technology for agriculture. The Agri-Business Incubator at Vellanikkara under Kerala Agricultural University is a key player, supporting startups and projects that use plasma technology to create innovative agricultural solutions. This cutting-edge center has launched initiatives like seed priming for hybrid melon seeds, small variety coconut, gac fruit, and more to boost seed germination. They are also conducting studies on reducing antinutritional factors in millets.

Other institutions are also diving into plasma research. By adopting this technology, Indian farmers can achieve more sustainable and efficient farming, leading to higher crop yields, healthier plants, and better food quality, all while tackling environmental challenges. Notable institutions in this field include NIFTEM Thanjavur, IIT Kharagpur, ICT Mumbai, and NIT Rourkela.

Conclusion

Plasma technology is revolutionizing agriculture by efficiently sterilizing and modifying surfaces without damaging products. Operating at room temperature, it boosts soil health, seed germination, plant growth, and food shelf-life by reducing microbial contamination. Despite challenges like high setup costs and inconsistent power supply, research in India is focused on creating affordable, portable plasma devices for local farmers. Support from research institutions, government bodies, and the private sector is crucial for successful implementation. Adopting this technology can lead to better crop yields, healthier plants, and improved food quality, fostering sustainable farming practices.

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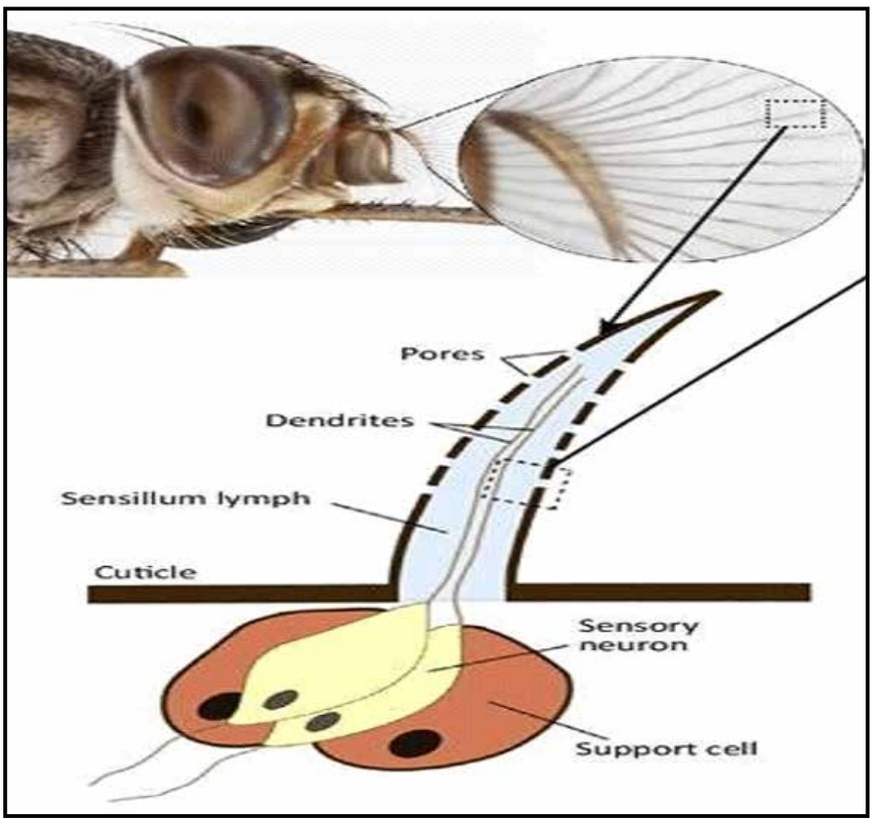

Fig1: Insect olfactory system (Antenna)

Title: electro antennography its tools and techniques

Intrdoduction

Among the animal kingdom's most sensitive and capable chemical sense organs are the antennae of insects. In milliseconds, insects can detect picograms of particular volatile organic compounds per cubic metre of air—far below the detection limits of analytical instruments used today. For a variety of technological uses, it is necessary to investigate the sensitivity and specificity of insect olfactory structures in detecting volatile organic compounds (VOCs). The term "insect olfaction" describes the ability of chemical receptors in insects to recognise and identify volatile substances for oviposition sites, predator avoidance, mating partner detection (through pheromones), and foraging.

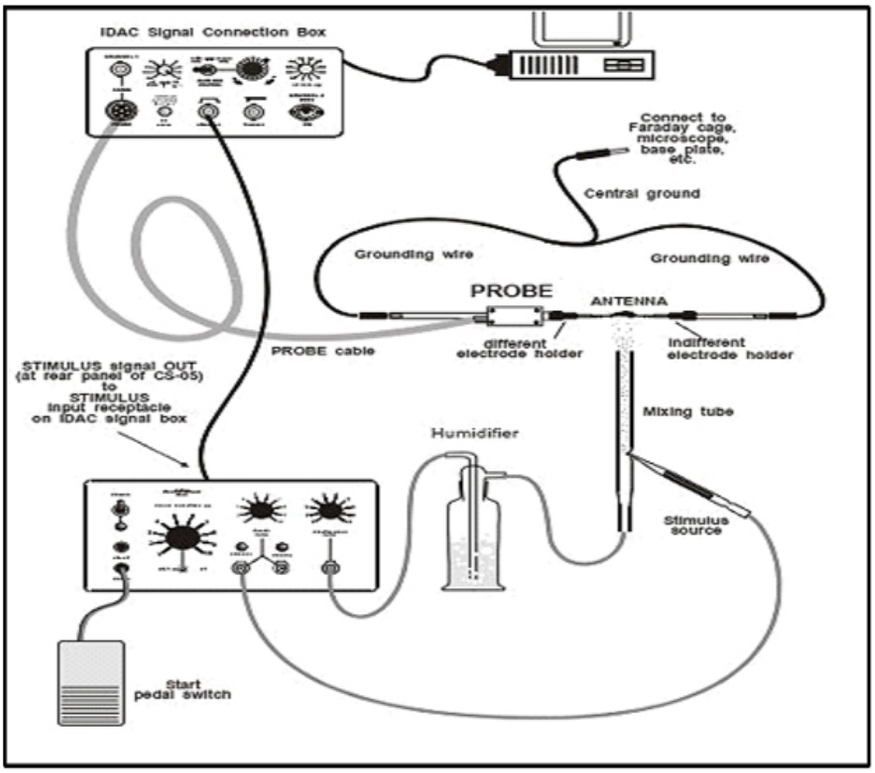

Fig2: Basic Instrumentation of Electroantennogram

For insects, it is therefore the most significant sensation. The two main sense organs used by insects to identify smells are their antennae and specialised oral organs known as maxillary palps. As smells bind to cell surface, proteins like olfactory receptors, sensory neurons in the antenna, maxillary palp, and labella produce electrical signals known as spikes, or action potentials, that are specific to odours (Fig.1).

There are three methods used to record action potentials.

1. Electroantenograms,
2. Electropalpograms and
3. Single sensillum recordings (SSR).

Electroantenograms (EAG) and electropalpograms (EPG) are diagnostic tools used to record action potentials from the maxillary palp or the entire antenna, respectively. An overall picture of smell in each organ is given by EAGs and EPGs. With a single sensillum, an electrode is inserted during an SSR, and only the ORNs contained in that sensillum are recorded, generating more precise data.

A popular bioassay in experimental entomology for identifying volatiles detected by insects' antennal olfactory apparatus is electroantennography (EAG). The technique is based on Schneider's (1957) discovery of tiny voltage variations between an insect antenna's tip and base when it was stimulated with pheromones. The measured voltage fluctuation is thought to be the result of electrical depolarizations of numerous olfactory neurons in the insect antenna, despite the fact the exact mechanism underlying the EAG signal is unknown.

There are numerous uses for the EAG method, including

1. Screening of substances that are biologically active.
2. Purification of extracts
3. identification of active fractions,
4. selection of active synthetic compounds
5. concentration measurements in the field, and

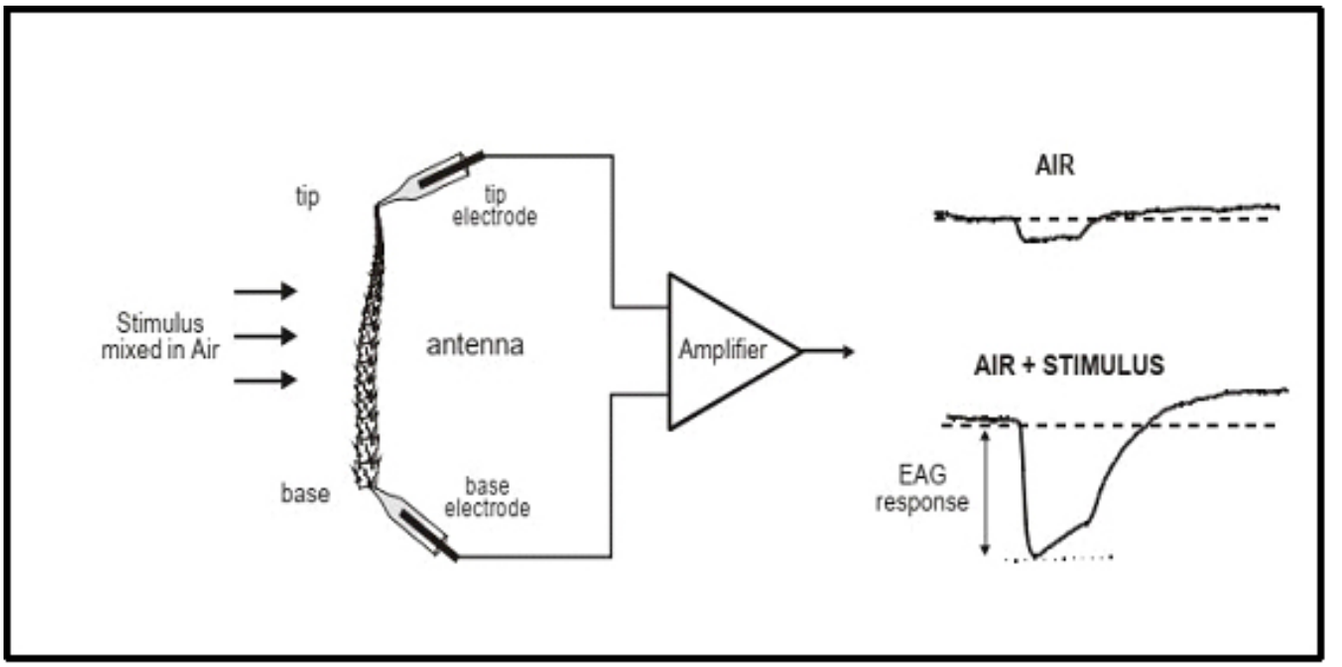

Fig3: Principle of Electroantennogram Recording

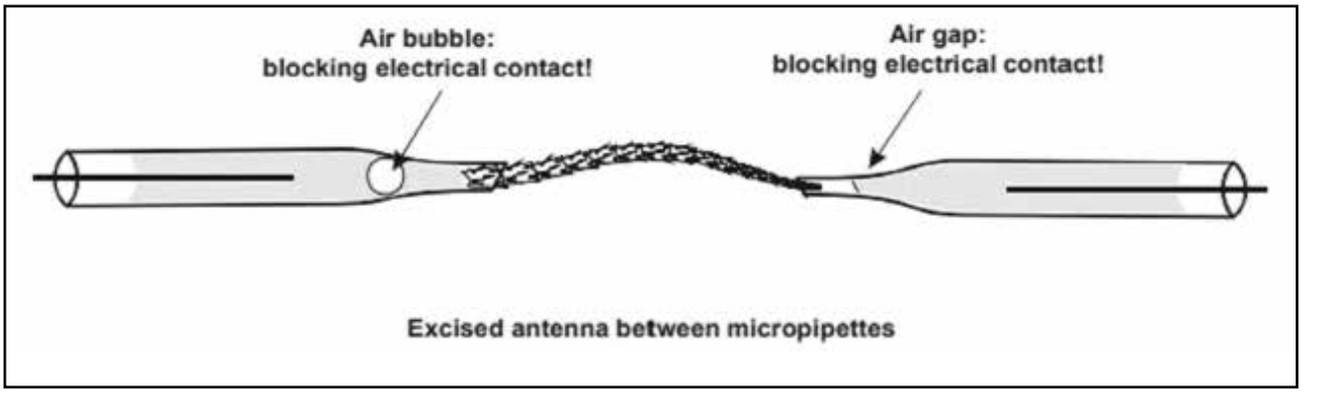

Fig4: Glasspipette electrode

6. Used as a detector in gas chromatography

History

Several groups conducted experiments in France and Germany between 1953 and 1956 to measure any electrical response from a stimulated antenna. They used a variety of insect antennae, different odorants, electrodes, amplifiers (with vacuum tubes) and oscilloscopes. This was done before the EAG became a practical bioassay. They could detect an increase in noise in their very basic setups in reaction to the appearance of an odour. The ElectroAntennoGram, or EAG, was named in 1957 by Schneider and Schneider et al. (1967) in reference to the slow potential recordings that could be made from antennal preparations in the ensuing years. This phenomenon was named after the ElectroOlfactoGram (EOG) and ElectroRetinoGram (ERG), which are recordings of the responses of numerous receptor neurons in the organ to the presentation of a stimulus.

Fig5: Micropipette puller

Basic instrumentation:

The instrument consists of:

1. EAG Probe: This two-electrode device is also referred to as an antenna holder. Magnetic board is used to mount the entire system.

2. Amplifier: An electronic device that can boost a signal's power (a time-varying voltage or current) is called an amplifier, sometimes known as an electronic amplifier or just an amp. This two-port electronic circuit

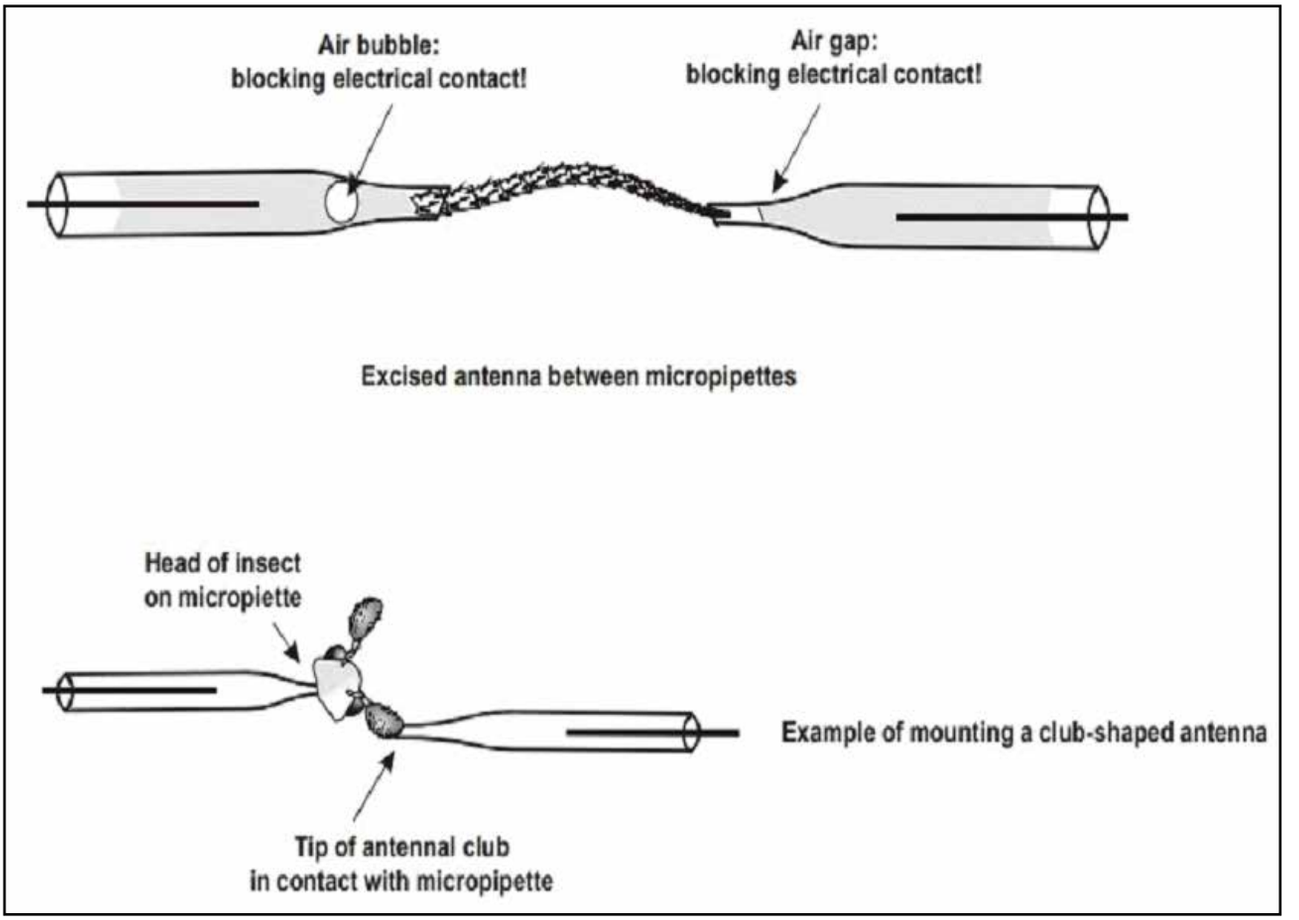

Fig6: Excised Antenna

produces a signal at its output that is proportionately stronger than the signal applied to its input terminals by amplifying the signal with the help of electricity from a power supply.

3.IDAC signal collection box

4. Stimulus controller

5. Stimulus mixing tube:

A tiny aperture in the mixing tube directs airflow towards the antenna while the test stimuli are combined with it.

6.Stimulus Source tube (Fig. 2).

Working principle of electroantennogram

It is generally believed that the observed voltage fluctuation is the result of electrical depolarizations of numerous olfactory neurons in the insect antenna, even though the exact mechanism underlying the EAG signal is unknown. A response's amplitude in an EAG increases until a saturation point is reached at progressively higher stimulus concentrations (Fig.3).

The amplitude is further dependent on: 1) Nature of the stimulus 2) the insect species, 3) its sex, and many less well defined factors

Electrode preparation

A.Glass pipette electrodes

The tip of a micropipette is brought close to the antenna under the microscope to create a fine point with a micropipette puller. Break off the tip of the

micropipette using a micro forceps. While breaking the tip, measure the opening's diameter against the antenna base's diameter and attempt to make the micropipette's inner diameter marginally greater than the antenna base's outer diameter. The saline solution that fills micro-pipettes can be either ringer solution or 0.9% NaCl or 0.1M KCl. The antenna tips are inserted into micro-pipettes that have been assembled on micro-manipulators. After that, the electrode wire can be connected to the amplification system and placed inside the micro-pippete (Fig.4).

B.Metal wire electrodes.

- Using an electrically conductive gel to mount an excised antenna is a very appealing option.
- Applying the gel to a metal electrode surface and inserting the antennal ends into it are two possible uses for it, in addition to replacing the KCL saline solution in micropipettes.
- The gel readily makes contact with the hydrophobic antenna, in contrast to a water-based saline (KCL) solution that repels it.
- Droplets of gel are applied to the metal electrodes (silver or stainless steel), and the

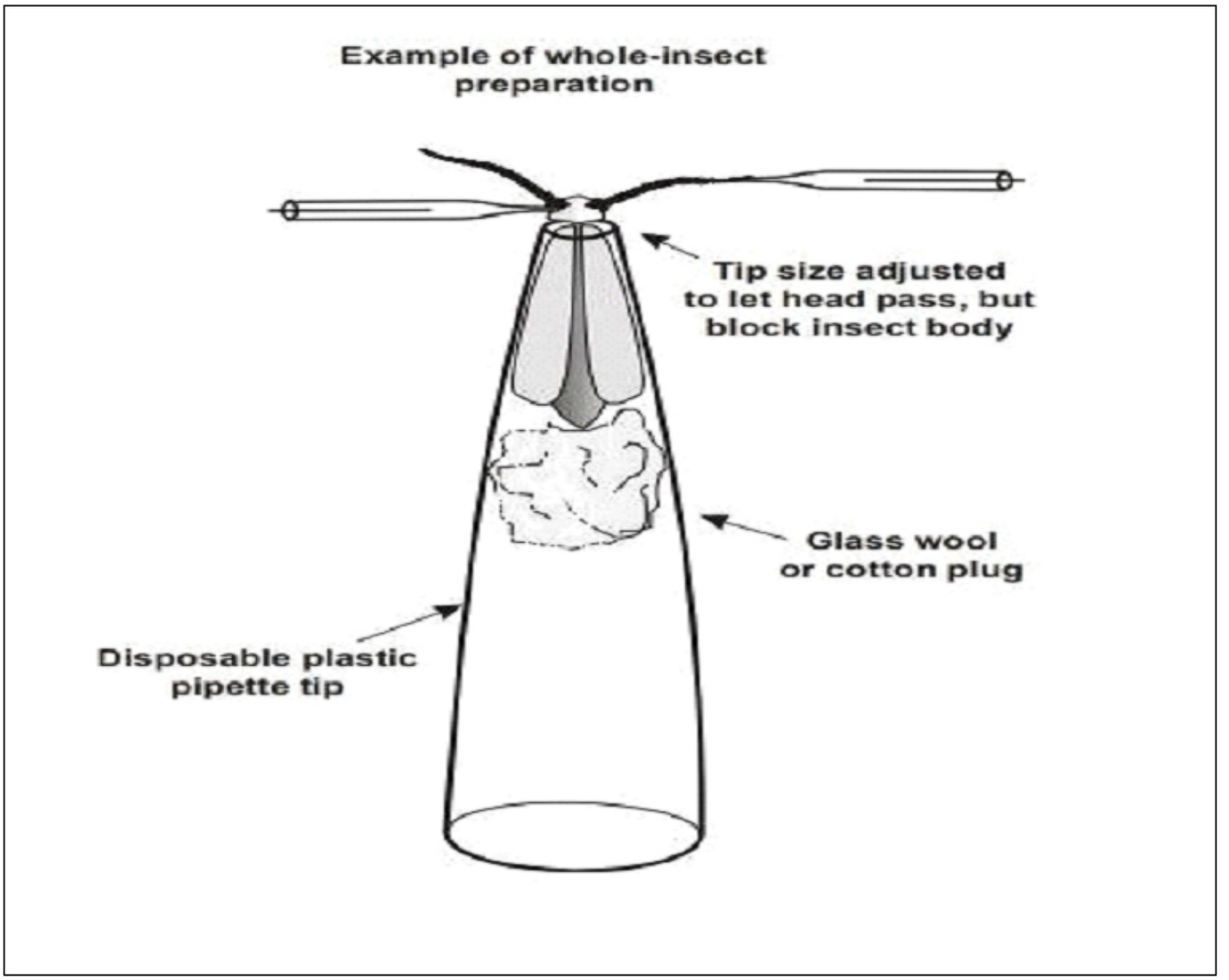

Fig7: Whole Insect Antenna

antenna end is easily pushed into them (Fig.5).

Antennal preparations:

A.Excised Antenna: The morphology of the antenna may require modifications to this procedure. The antenna of flies and beetles, which have extremely short club-shaped antennas, is difficult to remove from the head without seriously damaging the antenna. In these situations, the antenna is left on the head, but the head is removed and mounted on the tip of the micropipette. The antenna's club is pressed up against the end of the recording micropipette without separating any segments from the antenna tip (Fig.6).

Advantage: The EAG's sensitivity may rise as a result of removing the antennae from the insect body, which muffles background noise from other neural activity.

Disadvantage: As the antenna and signal deteriorate over time, the increase in signal to noise ratio is not free; in contrast, a full body preparation can stay stable for up to one working day.

B.Whole Insect Antenna: An excised antenna's lifespan is restricted and can range from a few minutes to one or two hours, depending on a many factors. Therefore in such situations, with limited insects available, or when long-term recordings are required, as in coupled gas chromatography-electroantennagraphic detection (GC-EAD), it may be beneficial to keep the antenna affixed to the insect.

Here, an experimental study will make use of the entire insect.The insect's head can pass through the tip of the disposable plastic pipette, but its body is blocked. The pipette is filled with glass wool or a cotton plug to keep the insect stable. To prevent interference with electrically active structures, such as antennal muscles, it is crucial to position the basal pipette in close proximity to the antennal base (Fig.7).

Stimulus preparation:

Usually, stimuli sources are made with test compound in decreasing amounts. There are three different ways to express the amounts: picogram (1 pg = 10 -12 g), nanogram (1 ng = 10 -9 g), and microgram (1 μg = 10 -6 g). The solutions are prepared to a concentration that ensures the volume (10 or 100 μl) of solvent applied to the filter paper contains the exact amount needed to achieve these exact amounts on the paper. Standard Pasteur pipettes with a strip of filter paper that has been coated with the test compound to create highly useful stimulus sources.

Control sources:

Three types of control sources are used and they are:

1) Pasteur pipettes should be clean. The purpose is to ensure that the pipettes are not contaminated.

2) Only use filter paper with pipettes in order to test for contamination of the filter paper.

3) Pipettes containing solvent and filter paper for testing solvent contamination.

Conclusion

There are already a number of ways to use insect olfactory reception in the field. With the help of an emerging technology called the EAG, we can easily identify the components of a lure that will trap and divert pest species that pose a threat to human safety. It is best to purchase this technology from the lab and use it on land. Robust field systems are still lacking, and methods vary in how they measure sensitivity, speed, and accuracy. A deeper comprehension of the neural networks controlling insect behaviour and learning will enable robust models for pattern recognition that will improve multisensorial devices. Therefore, there is still much to learn in this exciting field.

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Geographical Indication A Mark into History

A geographical indication or GI is awarded to products that corresponds to a particular place of origin which can be a town, region or country with unique qualities which are essentially linked to the location. Since, the quality depends on the geographical region of production there is a clear association between the product and the place of origin. Recently over 60 products were

Central Travancore Jaggery

Kalanamak rice white

Chak - Hao rice

conferred GI tag which makes the final tally of 635 products in India which have been given the GI tag (1). In the beginning, agricultural products that derive their qualities from place of production were considered under the tag. The first GI tag in the country was given two decades ago to the famous Darjeeling tea. However, unique qualities associated with materials, labour skills which is a

Wayanadan Gandhakasala Rice

Kalanamak

Kaipad rice

characteristic of a product were also acknowledged eventually under the category of GI tagged products. Now products like drinks (Banaras Thandai a drink made by blending milk with a nutritious mix of nuts, seeds and spices), cheese (Udhampur's Kalari cheese, Arunachal Pradesh's Yak Churpi), natural products (Mysore sandalwood, Banaras paan, Mangalore cashew nuts, Coorg honey), alcoholic beverages (Judima rice wine by Dimasa people of Assam, Goa's Cashew Feni), traditional handicrafts (Kashmir Shawls, Sonepur pottery, Kutch embroidery) and small-scale artisanal units (Amroha Dholak, Baghpat Home Furnishings,

Tirur betel leaf

Kuttiattor mango

Kalpi Handmade Paper) are protected under the GI tag.As of today, Tamil Nadu (~61) has the highest number of GI tags followed by Uttar Pradesh (~56) and Karnataka (~48). The comprehensive list of GI tagged agricultural products from different states of India are presented in Table. 1.

GI system in India

GI is governed by the World Trade Organization (WTO) agreement. India being an agro-based economy GI protection gains importance and hence the Parliament of India passed the Geographical Indications

The official process of Geographical Indications registration

STEP 1: Filing of application	• Signed application must be made in triplicate and sent to Geographical Indications Registry Intellectual Property Office Building Industrial Estate, G.S.T Road, Guindy, Chennai – 600 032 (E-mail: gir-ipo@nic.in) • The application shall be signed by the applicant or his agent and must be accompanied by a statement of case explaining how the special characteristics and how those standards are maintained. • Three certified copies of the map of the region to which the GI relates.
STEP 2 and 3: Preliminary scrutiny and examination	• The Examiner will scrutinize the application for any deficiencies and applicant should within one month of the communication remedy the same. • The content of statement of case is assessed by a consultative group of experts well versed on the subject and will ascertain the correctness of particulars furnished after which Examination Report would be issued.
STEP 4: Show cause notice	• If the Registrar has any objection to the application, the applicant must respond within two months or apply for a hearing. • If the applicant wishes to appeal, he may within one month make a request. • The Registrar is also empowered to withdraw an application, if it is accepted in error.
STEP 5: Publication in Journal	• Every application, within three months of acceptance shall be published in the Geographical Indications Journal.
STEP 6: Opposition to Registration	• Any person can file a notice of opposition within three months against the GI application published in the Journal and the Registrar shall serve a copy of the notice on the applicant. • Within two months the applicant shall sent a copy of the counter statement. • If he does not do this be shall be deemed to have abandoned his application. Where the counter-statement has been filed, the registrar shall serve a copy on the person giving the notice of opposition. • Thereafter, both sides will lead their respective evidences by way of affidavit and supporting documents. • A date for hearing of the case will be fixed thereafter.
STEP 7: Registration	• Where an application for a GI has been accepted, the registrar shall register the geographical indication. The date of filing of the application shall be deemed to be the date of registration. • The registrar shall issue to the applicant a certificate with the seal of the Geographical Indications registry
STEP 6: Opposition to Registration	• A registered GI shall be valid for 10 years and can be renewed on payment of renewal fee.

Table 1: GI tagged agricultural products from others states of India

Sl. No.	Place of origin	Products
1	West Bengal	Darjeeling tea, GobindaBhog rice, Laxman Bhog Mango, Tulaipanji Rice, Khirsapati (Himsagar) Mango, Fazli Mango grown in the district of Malda
2	Odisha	Ganjam Kewda flower, KandhamalHaldi, Ganjam Kewda Rooh, Nayagarh Kanteimundi Brinjal, Odisha KhajuriGuda (jaggery), Koraput Kalajeera Rice
3	Sikkim	Sikkim Large Cardamom, DalleKhursani (red cherry pepper chilli)
4	Mizoram	Mizo Chilli, Mizo Ginger
5	Assam	Joha Rice, Assam Karbi Anglong Ginger, Tezpur Litchi, KajiNemu (lemon), GongarDunjia, Keradapini (Plant/ Shrub), Boka Chaul rice, Chokuwa Rice
6	Tripura	Tripura Queen Pineapple
7	Meghalaya	Memong Narang, Khasi Mandarin, Meghalaya Chubitchi (Rice Liquor)
8	Manipur	Kachai Lemon, Chak - Hao (fragrant sticky rice), HatheiChilli, Tamenglong Orange
9	Nagaland	Naga Mircha, Naga Tree Tomato, Naga Cucumber
10	Arunachal Pradesh	Arunachal Orange, Arunachal Pradesh Khaw Tai (Khamti Rice), Arunachal Pradesh Adi Kekir (Ginger), Arunachal Pradesh Khelap / Phalap/ Felap Tea (Bamboo Processed Tea), Arunachal Pradesh Angnyat/ Adlay/ Tanyak Millet, Arunachal Pradesh Marua Apo (Marua Millet Beverage)
11	Jammu and Kashmir	Kashmir saffron, Gucci Mushroom, Basmati Rice, Mushqbudji rice, Bhaderwah Rajmash (red beans), Ramban Anardana (wild sour pomegranate)
12	Ladakh (UT)	Ladakh Raktsey Karpo Apricot, Ladakh Seabuckthorn
13	Himachal Pradesh	Himachali Kala Zeera, Basmati
14	Uttarakhand	Red Rice, Almora Lakhori Chilli, Berinag Tea, Burans Sharbat, Ramnagar (Nainital) litchi, Tejpat, Basmati rice, Munsiyari white kidney beans
15	Uttar Pradesh	Mango Malihabadi Dusseheri, Kalanamak Rice, Allahabad Surkha Guava, Rataul Mango, Basmati, Mahoba Desawari Pan (betel), Pratapgarh Aonla, Adamchini Chawal (Rice), Banaras Langda Aam (Mango), Ram Nagar Bhanta Brinjal), Banaras Pan (betel leaf), Muzaffarnagar Gur (Jaggery), Hathras Hing (asafoetida)

Sl. No.	Place of origin	Products
16	Delhi/ Punjab/ Haryana	Basmati
17	Bihar	Shahi Litchi, Katarni Rice, Magahi Paan (Betel), Bhagalpuri Zardalu (mango), Mithila Makhana, Marcha Rice
18	Chhattisgarh	Jeeraphool rice, Nagri Dubraj rice
19	Madhya Pradesh	Balaghat Chinnor rice, Nagpur Orange, MahobaDesawari Pan (betel), Sharbati wheat (Golden grain), RewaSunderja Mango
20	Maharashtra (30)	Alphonso mangoes, Nagpur Orange, Nashik Grapes, Kolhapur Jaggery, Ajara Ghansal Rice, Malgalwedha Jowar, Waigaon Turmeric, Bhiwapur Chilli, Sindhudurg & Ratnagiri Kokum, Waghya Ghevada (beans), Sangli Turmeric, Navapur Tur Dal, Ambemohar Rice, Sangli Raisins, Lasalgaon Onion, Dahanu Gholvad Chikoo, Beed Custard Apple, Jalna Sweet Orange, Jalgaon Banana, Mahabaleshwar Strawberry, Marathwada Kesar Mango, Purandar Fig, Jalgaon Bharit Brinjal, Solapur Pomegranate, Alibag White Onion, Vengurla Cashew, Bhandara Chinnor Rice, Badlapur Jamun, Bahadoli Jamun, Dagdi Jowar of Jalna
21	Gujarat	Gir Kesar Mango, Bhalia Wheat, Kachchhi Kharek (dates)
22	Rajasthan	Sojat Mehndi
23	Goa	Cashew Feni, KholaChilli, HarmalChilli, Myndoli Banana, Goa Mankur Mango (Malcorado or Mankurad), Agsechi Vayingim (Agassaim Brinjal), Sat-Shiro Bheno (Sat-shiranchobhendo-lady's finger), Goa Cashew (KajuOrCaju)
24	Karnataka	Coorg Orange, Gulbarga Tur Dal, Mysore Betel leaf, Nanjanagud Banana, Mysore Malligae, Udupi Malligae, Hadagali Malligae, Indi Lime,Devanahalli Pomello, Appemidi Mango, Kamalapur Red Banana, Bangalore Blue Grapes, Sirsi Supari, Bangalore Rose Onion, BydagiChilli, Udupi MattuGulla Brinjal, Kari Ishad Mango, Indi lime, Malabar pepper
25	Tamil Nadu	Virupakshi Hill Banana, Sirumalai Hill Banana, Erode Turmeric, Eathomozhy Tall Coconut, Nilgiri honey, Coonoor coffee, Madurai Malli, AuthoorVetrilai (betel leaf), Ramnathapuram Mundu Chilli, Cumbum Panneer Thratchai (grapes), Kanyakumari Matti Banana, Vellore Spiny Brinjal, SholavandanVetrilai (betel), Udangudi Panang Karupatti (palm jaggery), Salem Sago (Javvarisi)
26	Telangana	Banganapalle Mangoes, TandurRedgram
27	Andhra Pradesh	Guntur Sannam Chilli, Banganapalle Mangoes

[Source:https://apeda.gov.in/apedawebsite/about_apeda/Food_&_Agri_Products_Registered_as_GI.htm]

Table 2: Agricultural products from Kerala with GI tag, place of originand their unique properties

Sl. No.	Product	Year	Features
1	Alleppey coir	2007	Produced in Ambalapuzha and Cherthala taluks of Alleppey districts since 1859 it is unique for the skills of craftmanship.
2	Navara Rice	2007	An endemic rice from Kerala with short duration and high free amino acids like cysteine and methionine has a high curative property for many ailments.
3	Palakkadan Matta Rice	2007	A red rice variety popular through ages and once considered a royal food is famous for its unique flavour and aroma. It is rich in several minerals like Zn and Mn which renders antioxidant properties rich in vitamin B6 and has a higher fiber content.
4	Alleppey Green Cardamom	2008	An endemic rice from Kerala with short duration and high free amino acids like cysteine and methionine has a high curative property for many ailments.
5	Pokkali rice	2008	An organically grown rice cultivar in salinity prone areas which are below sea level in Kerala. The rice-fish cultivation system improves the soil in each rotation and the rice is said to have many medicinal and health benefits.
6	Vazhakulam pineapple	2009	With its unique aroma and flavour one of the sweetest pineapples with its golden yellow colour, crisp flesh and low acidity Vazhakulam pineapples (locally known as kannara) holds a major share of the country's pineapple market. These features are often attributed to the specific soil and climatic factors of the region.
7	Central Travancore Jaggery	2009	Prepared from sugarcanes cultivated along the banks of Manimala, Pampa, Achenkovil and Meenachil rivers has a deep amber colour and is great in taste.
8	Wayanadan Gandhakasala rice	2010	A short bold aromatic rice with natural sandalwood fragrance. It is easily digestible hence used as gruel for infants and geriatric food.
9	Wayanadan Jeerakashala rice	2010	Also known as, Wayanadan Kaima its lovely aroma and cumin like features it as an excellent choice for Thalassery biriyani and neychoru.
10	Kaipad rice	2014	A single crop rice cultivated in the saline prone areas of northern districts of Kerala. It has a distinctive taste and nutritional values.

Sl. No.	Product	Year	Features
11	Chengalikodan Nendran	2015	A popular traditional banana grown in Thrissur district with unique taste, bunch shape (like elephant trunk) and fruit colour. It has thin skin and offered as kaazhchakula to the diety of Guruvayur temple.
12	Nilambur teak	2017	First forest resource to get GI tag from India. The large size, durability, distinctive colour and high resistance to fungal decay are its unique properties.
13	Marayoor Jaggery	2019	One of the sweetest jaggery produced in Idukki district of the state is made following traditional techniques. It is dark brown in colour and rich in iron, low on sodium and free from impurities.
14	Wayanadan Robusta Coffee	2019	Grown as pure or mixed crop in Wayanad holds major share of coffee produced in the state.
15	Tirur Betel	2019	Grown in Tirur and nearby places of Malappuram district these betel leaves with more pungency and shelf life are reported to be unique for its high protein and chlorophyll content in fresh leaves. Eugenol is the major essential oil in Tirur betel leaf contributing to its pungency
16	Edayur chilli	2021	A unique cultivar of the area with its low pungency is popular used to prepare kondattam, sun dried curd chillies.
17	Kuttiattor mango	2021	Kuttiattor known as the mango village of Kannur has an attractive orange-yellowcolour and no specks or spots on the skin and a remarkable taste.
18	Kodungalloor Pottuvellari	2022	A snap melon largely consumed as a juice is rich in vitamin C and has a higher content of calcium, magnesium, fibre and fat content.
19 2022	Attappady Thuvara		This red gram variety has white seed coat colour and can be used as vegetable and split pulse.
20	Kanthalloor-VattavadaVeluthulli	2022	Rich in essential oil and other components like allicin, sulphides, flavonoids, and proteins.
21	Attapady Attukombu Avara	2022	Curved like a goat's horn this dolichos bean has a higher anthocyanin content which imparts a violet colour for the fruits. It has anti-diabetic properties, reduces cardiovascular risks and rich in protein, calcium and fibre content.
22	Onattukara Ellu	2022	It has a high content of unsaturated fat and antioxidant content.

of Goods (Registration and Protection) Act 1999 and it came into force with effect from September 2003.

The salient features of the act are:

- Goods mean any agricultural, natural or manufactured goods or any goods of handicraft or of industry and includes foodstuff
- Indication includes any name, geographical or figurative representation or any combination of them conveying or suggesting the geographical origin of goods to which it applies

Producer, in relation to goods, means any person who,

- if such goods are agricultural goods, produces the goods and includes the person who processes or packages such goods;
- if such goods are natural goods, exploits the goods;
- if such goods are handicraft or industrial goods, makes or manufactures the goods;
- includes any person who trades or deals in such production, exploitation, making or manufacturing, as the case may be, of the goods.

GI tag can be granted to an individual, a family, partnership,organization or association established by or under the law. The act is regulated by the Controller General of Patents, designs and patents, the Registrar of Geographical Indications with registry located in Chennai. The registration of a geographical indication shall be for a period of ten years but may be renewed from time to time in accordance with the provisions of this section. The application process is explained in Figure 1.

Benefits of GI

The geographical indication tag prevents any third parties or unauthorized users from using the tag on products that don't conform to the instructed standards. But it doesn't prevent one from using the same techniques as set out in the standards i.e. the producer has a right over the sign not on the technique, unlike patent.Hence GI provides legal protection for the local unique product and restricts the use of the name without permission. GI tag offers popularity for the product in domestic and international markets which in turn increases the export potential at the meantime enhancing the market share of the producer as well.

National scenario of GI tagging in agricultural products

Out of all states of India Maharashtra has the largest number of registered agricultural products (30). When we compare the agricultural products, rice with specialty characteristics specific to the place of origin forms the commodity with maximum number of GI tags (~24). Some noteworthy products are Kalanamak from UP, GobindaBhog rice and Tulaipanji Rice from West Bengal, Jeeraphool rice and NagriDubraj rice from Chattisgarh, Basmati from Delhi/UP/Uttarakhand/ Haryana/Punjab/J&K, Chak - Hao (fragrant sticky rice) from Manipur, Boka Chaul, Chokuwa and Joha rice from Assam, Bihar's Katarni Rice, Arunachal Pradesh Khaw Tai, Uttarakhand's red rice and Kerala's very own Palakkadanmatta, Jeerakashala, Gandakashala, Pokkali and Navara rice (Figure 2).Other food grain crops (cereals, pulses & millets) are less represented as compared to specialty rice. In case of other cereals only two products have GI tag viz., Bhalia Wheat of Gujarat and Sharbati wheat of Madhya Pradesh. Among pulses and millets few products like Tandurredgram, Gulbarga tur dal,AttappadyThu vara,Waghyaghevada (beans), Munsiyari white kidney beans, Navapurtur dal, Angnyat millet, Malgalwedha jowar, Dagdi Jowar of Jalna are protected with GI tag.Another category of GI tagged agricultural products are major fruit crops like mango

(Alphonso, Banganapalle, Banaras Langdaaam, Laxman Bhog, Fazli, Marathwada Kesar, Malcorado, Appemidimango), orange (Arunachal orange, Coorg orange, Khasi mandarin, Nagpur orange, Jalna Sweet orange), grapes (Nashik grapes, Bangalore blue grapes, Cumbumpanneerthratchai), banana (Jalgaon banana, Kamalapur red banana, Virupakshi hill banana, Sirumalai hill banana, Nanjanagud banana, Kanyakumari matti banana, Myndoli banana) and minor fruit crops like pomegranate (RambanAnardana, Solapur pomegranate), pineapple (Vazhakkulam and Tripura Queen pineapple), apricot (Ladakh RaktseyKarpo apricot), litchi (Ramnagar and Shahi litchi), guava (Allahabad Surkha Guava), gooseberry (Pratapgarhaonla),dates (Kachchhi Kharek),jamun (Badlapur and Bahadoli Jamun), (Beed) Custard Apple, (Mahabaleshwar) Strawberry, (Purandar) fig and(Dahanu Gholvad) Chikoo. Some vegetables like chillies (Naga mircha, Kholachilli, Harmalchilli, Bydagichilli, Ramnathapurammunduchilli, Edayurchilli, Guntur sannamchilli, DalleKhursani), brinjal (Agassaim brinjal, Ram Nagar Bhanta ,Udupimattugulla brinjal, Vellore Spiny Brinjal, NayagarhKanteimundi Brinjal), cucumber (Naga Cucumber), onion (Lasalgaon onion, Alibag white onion, Bangalore rose onion), lady's finger (Sat-Shiro Bheno) are also GI registered. Among spices and condiments, the GI tagged products are available in crops like cardamon (Alleppey green cardamom, Sikkim large cardamom), ginger (Arunachal Pradesh Adi Kekir, Assam Karbi Anglongginger), turmeric (Waigaonturmeric, Sangliturmeric, Erode turmeric), garlic (Kanthalloor-Vattavadaveluthulli) andasafoetida (Hathrashing).

GI tagged agricultural products of Kerala

As per the report of Directorate of Industries and Commerce, Government of Kerala (2023), the Kerala state with exquisite history of art, heritage and foreign trade holds 31 GI tags, among which most of them are for agricultural goods.Palakkadanmatta rice, Alleppey coir, Malabar pepper, Marayoor jaggery, Wayanadanjeerakashala rice, Pokkali rice, Vazhakulam pineapple are few of the popular GI tagged agricultural commodities from Kerala (Table 2, Figure 3). Aranmulakannadi (mirror), Balaramapuram Sarees and Fine Cotton, Kasaragod sarees, Kuthampuly sarees, KuthampullyDhoties and Set Mundu, Maddalam of Palakkad and its logo, Screw Pine Craft of Kerala and its logo, Brass Broidered Coconut Shell Craft and its logo, Payyannur Pavithra ring, ChendamangalamDhoties and Set Mundu and Cannanore Home Furnishings are other non-agricultural GI tagged products of Kerala. These products, natural or manufactured are intrinsically connected to their geographical origins. The legacy of these goods can be attributed to the local environmental conditions like climate and soil and the strongly guarded traditional artistry of the specific region. The products are usually named after the place of origin and is called geographical indications or appellations of origin.

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Single Flowered Lisianthus

Lisianthus

The Elegant Bloom

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Introduction

The Lisianthus flower, known scientifically as *Eustoma grandiflorum*, is cherished for its delicate, rose-like appearance and a wide range of vibrant colors. Often referred to as the "poor man's rose," this flower is popular in floral arrangements and gardens alike due to its beauty and versatility. It is one of the newer flower species brought to the world market and more recently introduced to the Indian market. In European

Double Flowered Lisianthus

and Asian markets, it is already listed among the top selling cut flowers. It is gaining popularity with the floral industry worldwide due to its rose-like flowers, excellent post-harvest life and blue flowers. It is also widely used as a flowering potted and bedding plant.

History and Origin

Lisianthus is native to North America, particularly in regions stretching from Nebraska to Texas, as well as parts of Mexico and the Caribbean. The name "Lisianthus" comes from the Greek words "lysis," meaning dissolution, and "anthos," meaning flower, referring to the delicate petals

Rosanne Series

ABC series

that appear to dissolve in beauty. It is a beautiful eye soothing cut flower belonging to the family Gentianaceae with diploid chromosome number of 36. Lisianthus also known as Texas bluebell or prairie gentian, is valued in landscaping for several reasons:

1. Aesthetic Appeal

- Vibrant Colors: Lisianthus comes in a variety of colors, including white, pink, blue, purple, and bi-colored varieties. This wide range of colors makes them a versatile choice for adding visual interest to gardens.
- Elegant Flowers: The flowers have a delicate, rose-like appearance with ruffled petals, adding a touch of elegance and sophistication to garden beds and borders.

2. Long Blooming Period

- Extended Blooms: Lisianthus blooms from early summer to fall, providing continuous color and beauty throughout the growing season. This makes them a great choice

for maintaining garden interest over a longer period.

3. Versatility in Use

- Mixed Borders and Flower **Beds:** They can be used in mixed borders, flower beds, and containers. Their upright growth habit and colorful blooms make them suitable for various garden settings.
- **Cut Flowers:** Lisianthus is popular as a cut flower due to its long vase life. This adds another dimension to its usefulness in landscaping, as gardeners can enjoy the flowers both outdoors and indoors.

4. Low Maintenance

- Drought Tolerant: Once established, lisianthus plants are relatively drought-tolerant, making them suitable for xeriscaping and low-water-use gardens.
- Pest and Disease Resistance: They are generally resistant to pests and diseases, reducing the need for chemical interventions and making them an environmentally friendly choice.

5. Adaptability

- Growing Conditions: Lisianthus can adapt to a variety of soil types, though they prefer well-drained soil. They thrive in full sun to partial shade, making them adaptable to different garden conditions.

6. Pollinator Attraction

- Pollinator Friendly: The flowers attract pollinators such as bees and butterflies, contributing to the health and biodiversity of the garden ecosystem.

Characteristics Morphology

- Lisianthus is herbaceous annual, with slightly succulent bluish green leaves and large funnel shaped flowers growing on long straight stems. The flower has a stem 60 to 80 cm long and carries 5 to 7 flowers per stem. Multibranched stems of Lisianthus have several flower buds that open successively.
- **Flowers:** Lisianthus blooms in a variety of colors, including white, pink, purple and blue, often with multiple colors on one flower. The petals are delicate and slightly ruffled, giving the flower a soft,

elegant look.

- **Foliage:** The leaves are lance-shaped and pale green, providing a subtle backdrop that accentuates the vibrant blooms.

Growth Habit

- **Height:** Depending on the variety, Lisianthus plants can grow between 6 inches to 3 feet tall.
- **Blooming Time:** They typically bloom in late spring to mid-summer, with each plant producing multiple blossoms over several weeks.

There are several varieties of Lisianthus, each with its unique characteristics. Here are some of the main types:

1. Double Flowered Lisianthus: These varieties have multiple layers of petals, giving them a full, lush appearance. They are often mistaken for roses or peonies.

2.Single Flowered Lisianthus: These have a simpler, more open appearance with a single row of petals. They are often used for a more minimalist aesthetic.

3.Rosanne Series: Known for their unique colors and strong stems, making them suitable for cutting. They come in various shades, including blue, brown, and green.

4. Echo Series: These are early blooming varieties that produce large flowers on long stems. They are available in many colors, including pink, white, blue, and yellow.

5.Arena Series: Known for their large, double blooms and sturdy stems, making them ideal for floral arrangements. They come in a wide range of colors.

6.Mariachi Series: These feature double flowers with ruffled petals and are available in a variety of colors, including carmine, lime green and blue.

7.Flamenco Series: Characterized by their frilly, double blooms and strong stems, making them excellent for cut flowers. They come in vibrant colors like pink, blue, and yellow.

8. ABC Series: These varieties are prized for their early blooming and large, double flowers. They are available in several colors, including purple, blue, white, and pink.

9.Voyage Series: Known for their long vase life and large, double flowers with fringed petals. They come in various colors, including champagne, pink, and green.

Cultivation

- **Temperature:**Lisianthus can be produced in open fields, naturally ventilated

polyhouses or in low cost polytunnels that simply protect the plants from wind and rain or in climate-controlled greenhouses. It prefers moderate climate and can be grown at an altitude range of 1,000-1,800 meters above mean sea level. For better growth and quality flower production, the optimum day and night temperatures should be maintained between 20-24°C and 16-18°C, respectively

- **Soil:** Lisianthus prefers well-drained, slightly alkaline soil. It's crucial to avoid waterlogged conditions, which can lead to root rot.The soil pH must be maintained from 6.5 to 7.2. A pH below 6.0 is damaging and above 7.5 can reduce the intensity of flower colour.
- **Light:** The optimal light levels for lisianthus flower are 4,000 to 6,000 ft candles. Plants may produce more florets under high light intensities, but higher intensities may result in less intense flower colours.
- **Irrigation:** Regular watering is essential, especially during

dry periods. However, the soil should be allowed to dry out slightly between waterings.

Propagation:

Sexual Propagation

- Lisianthus is mainly propagated through seeds. In hilly areas, the seeds can be sown from mid-December to February under controlled environmental conditions. The Lisianthus seeds are very small (19,000 seeds per gram) and seedling growth is very slow

Asexual Propagation

- Vegetative propagation by means of shoot tip cuttings is an efficient method for producing large numbers of plants in ornamentals. It will ensure true to the type plants with great uniformity
- **Planting:** Generally, 8-12 weeks (65-80 days) are required from seed sowing to final transplanting in the field. The seedlings with four to five pairs of true leaves are generally transplanted

Care and Maintenance

- **Fertilization:** Lisianthus is a heavy feeder and grows best with high fertility levels in the soil. High nitrogen and potassium fertilization are required for good growth. Fertilization using a 15:0:15 N:P:K fertilizer is recommended. A balanced,

slow-release fertilizer applied during planting and again during the growing season can promote healthy growth and abundant blooms.

- **Pruning:** Deadheading spent flowers encourages continuous blooming and prevents the plant from putting energy into seed production.
- **Pest and Disease Control:** Lisianthus is relatively pest-free, but it can occasionally suffer from aphids or spider mites. Regular inspection and appropriate treatments can keep these pests at bay.
- **Harvesting:**The Lisianthus cut flowers are harvested when one or more flowers are open.Flowers should be harvested in the mornings, when flower and plant tissues are cool.
- **Vase Life:**The vase life of cut Lisianthus ranges from 12-15 days depending upon cultivars.

Uses

- **Floral Arrangements:** Lisianthus is a favourite among florists due to its long vase life and striking beauty. It's often used in:
- **Bouquets:** The rose-like appearance makes it a perfect substitute for roses in wedding bouquets and romantic arrangements.
- **Centrepieces:** Its variety of colors and elegant form make it a versatile choice for table centrepieces.
- **Mixed Arrangements:** Lisianthus pairs well with other flowers, adding a touch of sophistication to any bouquet.
- **Landscaping:** In the garden, Lisianthus can be used in:
- **Borders and Edges:** The plant's height and color variety make it ideal for adding interest to garden borders.
- **Container Gardens:** Lisianthus grows well in pots, making it a great choice for patios and balconies

Conclusion

The Lisianthus flower, with its delicate beauty and versatile nature, has captured the hearts of gardeners and florists alike. Whether adorning a bridal bouquet or adding a splash of color to a summer garden, it brings elegance and charm to any setting. With proper care and attention, this stunning flower can thrive, offering its exquisite blooms for weeks on end.Lisianthus is a valuable addition to landscaping due to its aesthetic appeal, extended blooming period, versatility, low maintenance, adaptability and pollinator-friendly nature. Its elegant flowers and vibrant colors can enhance the visual appeal of any garden, making it a popular choice among gardeners and landscapers

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‘Unveiling the glistening beauty of

Bird of Paradise’

The Bird of paradise (*Strelitzia reginae*) belongs to the family Strelitziaceae which earns its name from its distinctive flower, resembling the vibrant head of a tropical bird and is otherwise known as the crane flower. Native to the subtropical coastal regions of southern Africa, this perennial evergreen grows slowly and is popularly cultivated in warm climates.

It is a distinctive flower, resembling a colourful bird in flight, makes it a highly appealing choice for landscaping. The Bird of Paradise flower emerges from a tall stalk, often reaching lengths of 5 feet or more, with its distinctive ‘bird’s head’ shape peeking through the foliage. As

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the flower blossoms, it unfolds to resemble a vibrant crown of orange and blue atop the bird's head. Typically, each stalk supports one to three flowers, each adorned with three orange sepals and three blue petals that enclose the reproductive parts of the flower, including the stamen and style. The Bird of Paradise is an evergreen perennial herbaceous plant suited to moderate subtropical climates. Growing from rhizomes, it typically reaches heights of 1 to 1.5 meters. Its foliage resembles small banana leaves, characterized by their evergreen nature, thickness, long stiff petioles, leathery texture, concave shape, and oblong form, all contributing to its attractiveness as an ornamental plant.

The Bird of Paradise is an easy-to-grow, low-maintenance plant ideal for landscaping. It thrives in full sun to partial shade and blooms multiple times throughout the year. The Bird of Paradise is well-suited for planting near water features such as ponds, lily pools, water tanks and swimming pools, as its leaves do not fall into the water. It creates a charming effect when planted along herbaceous borders or in front of shrubbery. It's unique flower shape makes it an excellent specimen plant. The Bird of Paradise is also becoming popular as a cut flower due to its vibrant colors, distinctive appearance, and long vase life. It is commercially cultivated for cut flower production in regions like California, Florida, Hawaii, Israel, and South Africa, serving both domestic and international markets. Additionally, it can be grown in pots as an indoor plant, provided it has access to ample natural light.

Propagation

Bird of Paradise can be propagated through either seeds or division. Seedlings typically take 3 to 5 years to flower, whereas plants grown from divisions will begin flowering

in 1 to 2 years. When hand pollinated, the flowers will develop seed pods containing 60 to 80 seeds each, maturing in about five months. These seeds are black with orange tufts. It is best to sow the seeds before their coats harden. If seeds become hard and dry from storage, scratch the seed coat with a file before planting. Commercial nurseries often scarify hardened seeds by soaking them in concentrated sulfuric acid for 5 minutes, followed by rinsing with fresh water. Sow the seeds in a loose, clean, organic medium, keeping them moist; they should germinate within 2 to 3 months. Once the seedlings have three or four leaves, they can be transplanted into pots. Fertilize and keep them in partial shade for about 6 months before moving them to their final location.

Propagation by division involves separating the clumps or removing young offshoots. This method is less reliable than seed propagation. Divide the clumps in late spring or early summer, ensuring that each division contains four to five young shoots. When replanting divisions or seedlings, maintain the same soil level as before to avoid burying the stems too deeply. Keep the soil moist until the roots establish, then start applying fertilizer. New roots typically take at least three months to develop.

Cultivation, Care and Maintenance

The Bird-of-Paradise thrives and produces the most blooms when grown in full sunlight, although the foliage becomes a deeper green when grown in partial shade. It is tolerant of salt and adaptable to various soil types but flourishes best in rich, well drained soils.

The plant tends to flower more around the edges of the clump, so spacing plants at least six feet apart is recommended for optimal blooming. In lower elevations of Hawaii, the Bird of Paradise flowers year-round but is particularly prolific in late spring and summer. Generous watering during the winter months promotes vigorous growth and ensures abundant flower production in the summer. Pruning is necessary as dead flowers and leaves remain on the plant indefinitely. Applying a 3-to-4-inch layer of well composted organic mulch around the plants helps conserve moisture, reduces weed growth and provides essential micronutrients. For optimal growth and flowering apply a slow-release complete fertilizer at a rate of one pound every three months to a mature clump.

Harvesting and storage

Flowers should be harvested when the first floret begins to open. To extend their storage life up to one month, cut them at the tight bud stage and place them in pulsing solutions containing 10 % sucrose, 250 ppm citric acid, and 150 ppm hydroxyquinoline citrate (HQC) for two days at 22°C.

For packaging and storage, each Bird of Paradise flower is wrapped in either polyethylene or butter paper. The stems are then packed into cardboard boxes measuring 120 x 30 cm and stored at a temperature of 8°C.

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Peanut butter fruit

a nutty delight from south america

Edible part- Fruit pulp is creamy and sweet, and the flavour resembles peanut butter's.

Botany – Peanut butter fruit plants are hardy tropical,evergreen perennial shrubs or trees, the leaves are simple, opposite

Common name – **Peanut butter fruit**
Scientific name- ***Bunchosia armeniaca, Bunchosia grandulifera (Jacq.) Kunth***
Family – **Malpighiaeace**
Vernacular names -**English- Peanut butter fruit, Monks Plum, False guarana**
Japanese – **Ameishia**
Kannada – **Shengabenne hannu**
Brazil- **Caferana**

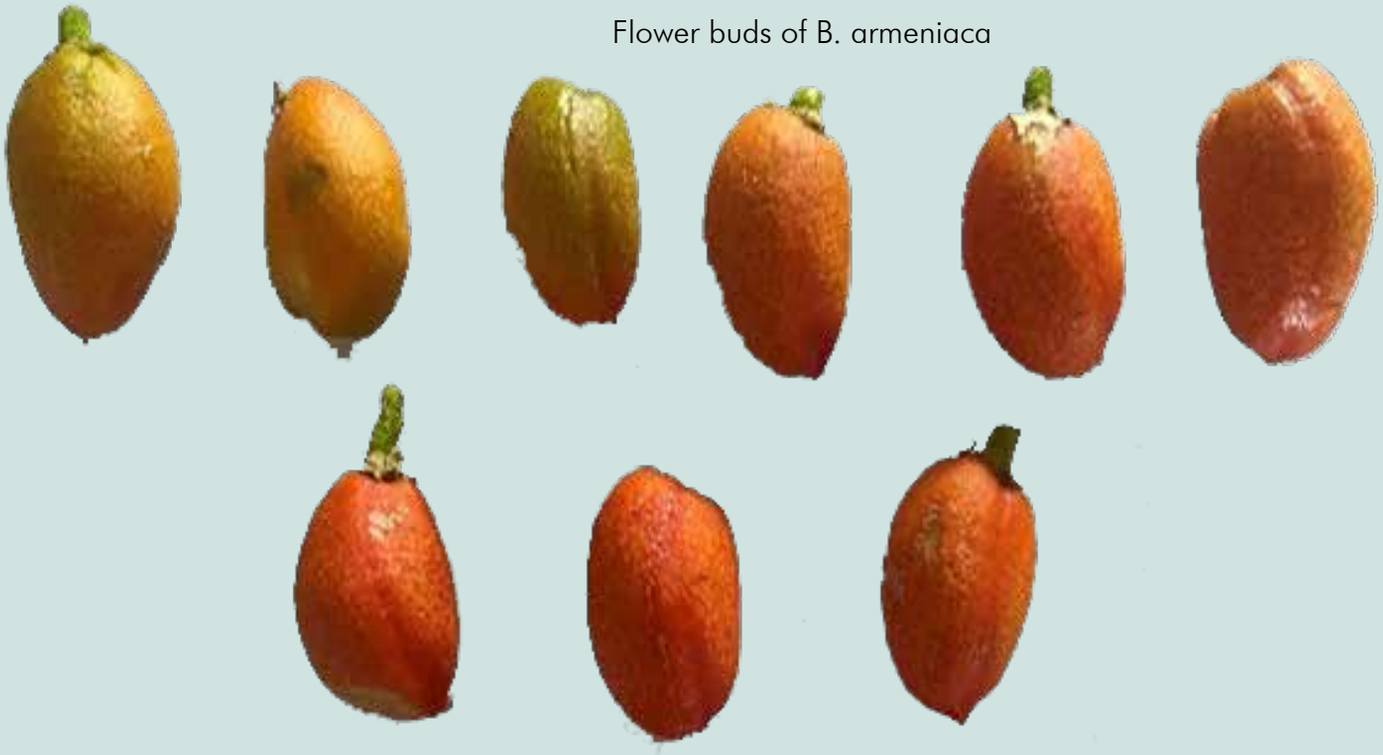
Ripe fruits of B. armeniaca

Nutritional compositions

Fruit analysis showed that the pulp had a high concentration of soluble solids and sugars, whereas the seeds were primarily composed of ash and protein. The minerals K, P, Ca, and Mg were the most prevalent in the fruit according to its elemental composition. The pulp and seed contained seventeen different fatty acids, with palmitic acid being the most concentrated (Blank et al. 2017). (Silva et al. 2016) reported total phenols of 2.245 mg/100g of fruit pulp, total flavonoids of 138 mg/100g

and oblong. The flowers are actinomorphic bisexual with axillary racemose inflorescences. Fruits are indehiscent, obovate berries borne in clusters (Lim 2012).

The peanut butter fruit is native to northern South America. It has a deep red pulp and seed. The people who live in the Brazilian either eat the fruit pulp raw or in juice form. Once roasted and ground, the seeds are used in the same way as the drink known as "guarana." Regular consumption of this fruit pulp is supposed to increase longevity, endurance, and mental clarity (Anderson 2004).



Flower buds of B. armeniaca

of fruit pulp, total anthocyanin of 15.9 mg/100g of fruit pulp, and caffeine of 206.35 mg/100g of fruit pulp.

Karunasena et al., (2018) reported total fat of 3.35g/100g of fruit pulp, crude fibre of 45.29g/100g of fruit pulp and carbhohydrates of 50.16g/100g of fruit pulp.

The probable composition of the peanut butter fruit pulp yielded the following results: 2.83 g/100g of dietary fibre; 29.73 g/100g of carbs; 65 g/100g of moisture; 0.72 g/100g of ash; 0.92 g/100g of protein; 0.78 g/100g of ethereal extract; and 129.62 kcal/100g of pulp. Regarding the sugar content and profile of the pulp, fructose was found to be 19.41 g/100 g and glucose to be 4.01 g/100 g (Fraga et al. 2021; Borguini et al. 2022).

Medicinal uses – In traditional medicine, peanut butter fruit is used for treating endocrine and as an anti-inflammatory (Giraldi and Hanazaki 2010; Karunasena et al. 2018).

The dietary fibres in the fruits are reported to be anti-cholesterol and reduce the risk of heart disease.

A Brazilian study has discovered that peanut butter fruit is an exceptional source of Lycopene, a carotenoid with high quantities in prostate tissue. 40 mg/100g of carotenoids (on a moist basis) were present in the fruit, with lycopene (36 mg/100g), β-carotene (2.5 mg/100g), and lutein (0.3 mg/100g) accounting for 89% of the quantity.

Antibacterial and anti-inflammatory activities of peanut butter fruit- The rutin, isoquercitrin and afzelin extracted from the leaves of Bunchosia exhibited antibacterial activity against *staphylococcus aurens, Escherichia coli and Pseudomonas aeruginosa*. This plant also showed anti-inflammatory activity against leukocyte influx (Queiroz et al.

2015).

The anti-bacterial and anti-fungal activity of Bunchosia was studied (Dassanayake 2019) and it found that ethanolic crude extracts with 100 to 125 microgram/ ml were determined to have antibacterial effects on bacterial pathogens like *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa*, and fungal pathogens like *Candia albicans and Aspergillus fumigates*.

Antidiabetic activity - In rats given streptozotocin (STZ) to induce diabetes, the ethanolic leaf extract of *Bunchosiaglandulifera* was assessed for its potential antidiabetic effects. The rats given STZ had lower blood glucose levels and higher levels of glycogen in their muscles and liver, according to the results. Glycogen content and increased glucose absorption in vitro indicated strong antidiabetic action of leaf extract of Bunchosia (Eshan et al. 2023).

Propagation- generally propagated by seeds.

Soil and Climate- prefers fertile soil with high organic matter, and can tolerate a temperature of 40 □.

Availability of fruits – In the months of Summer

Maturity and Harvest- Fruit ripens in small batches and must be gathered daily. Harvest as soon as the fruit becomes dark orange or red and the flesh remains solid. If a fruit is left on the plant after ripening, its flavour alters the next day. Dried fruits have been compared to dried figs and persimmons.

Close view of B. armeniaca plant

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Enhancing the Nutritional Value of Straw

Strategies for Improved Cattle Feed

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Often regarded as a low-cost agricultural by-product, straw can be transformed into valuable feed for cattle through various methods aimed at enhancing its nutritional value. These strategies not only improve the quality of straw but also contribute to more efficient fodder production systems. Below are some techniques to enhance the nutritional value of straw:

1. Ammoniation

One of the most common methods to increase the protein content of straw is ammoniation. This process involves treating straw with nitrogen containing substances such as urea or ammonium sulphate, ammonium bicarbonate etc as ammonia source. The ammonia released during this treatment reacts with the straw, converting low-quality proteins into more digestible forms. As a result, the protein content of straw increases, making it a better nutritional source for cattle.

2. Fermentation

Another effective technique to improve the quality of straw is fermentation. By inoculating straw with beneficial microorganisms such as bacteria or fungi, fermentation breaks down complex compounds in the straw into simpler, more digestible forms. This process not only increases the availability of nutrients but also enhances the palatability of straw-based feeds,

preserving and improving the nutritional value of straw.

3. Supplementation

Supplementation involves mixing straw with high-nutrient feed additives to enhance its nutritional value. Additives such as molasses, grains, protein concentrates, or mineral supplements can significantly improve the energy, protein, and mineral content of straw-based diets. This approach allows for customized formulations based on the specific nutritional needs and production goals of different cattle breeds.

4. Chemical Treatments

Chemical treatments such as alkaline or acid treatments can alter the structure of straw and increase its digestibility and nutrient availability. For example, treating straw with sodium hydroxide (NaOH) or ammonia breaks down tough fibers and lignin, making the nutrients more accessible to animals during digestion. However, care must be taken to ensure that chemical treatments are applied safely and do not adversely affect animal health.

5. Biological Treatments

Biological treatments involve using enzymes or microbial inoculants to enhance the nutritional value of straw. Enzymes can break down complex carbohydrates and fibers, while microbial inoculants can increase fermentation processes and nutrient utilization. These biological approaches are often more environmentally friendly and can be integrated with sustainable cattle feeding practices.

6. Physical Processing

While not directly increasing nutritional value, physical processing techniques such as chopping, grinding, or pelleting can improve the digestibility of straw by reducing particle size. Smaller particles are easier for animals to chew and digest, leading to better utilization of the nutrients contained in straw.

In conclusion, enhancing the nutritional value of straw involves a combination of techniques ranging from chemical and biological treatments to supplementation and physical processing. By adopting these strategies, farmers can transform straw into a valuable feed resource, promote sustainable agriculture, and improve the overall nutrition and performance of cattle.

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"Papino Fruit

The Unique Melon Pear"

Introduction

Papino fruit is botanically *Solanum muricatum*. It is also referred to as pepino dulce in Spanish, has been described as a succulent, juicy, and sweet fruit that is used mainly in desserts, although some cultivars have been used in salads due to their higher acidity content and grassy flavor notes. It is a diploid (2n = 24) subtropical species and is also known as melon pear, melon shrub, or sweet cucumber. In spite of the name, it's not actually a melon. Pepino translates as "cucumber" in Spanish, but it's not a cucumber either! Rather, it is a member of the

Scientific classification		
Kingdom	:	Plantae
Clade	:	Tracheophytes
Clade	:	Angiosperms
Clade	:	Eudicots
Clade	:	Asterids
Order	:	Solanales
Family	:	Solanaceae
Genus	:	*Solanum*
Species	:	*S. muricatum*

Proximate	Amount
Water	91.45 %
Energy (kcal)	25-35
Protein	0.78 g
Carbohydrate	7-8 g
Fibre	2 g
Ash	0.47%
Vitamin C	20-25 % of RDI
Potassium	5-10 % of RDI

nightshade family that includes eggplant and bell peppers. Native species from South America, more specifically from the Andes area of Peru and Chile, is widely distributed from Colombia to Bolivia.

The fruit belongs member of the Solanaceae family, which includes several important crops, such as tomatoes (*S. lycopersicum*), potatoes (*S. tuberosum*), and eggplants (*S. melongena*) among others. Of the 1500 species described in the Solanum genus. pepino is one of the few that is domesticated and cultivated for food purposes. The main reasons for this limited use of pepinos include high sensitivity of fruit set to environmental conditions, especially to high temperatures, which affects its pollen viability; poor fruit quality (ripening is highly affected by temperature); the time required for fruit ripening; plant propagation; and a lack of exploration of its high degree of genetic diversity. The first documented use of *S. muricatum* is cited on pre-Inca ceramics displaying images of the fruit that date to at least 2000 years ago. Pepinos have been commercially and experimentally grown in several countries, including Australia, Chile, Colombia Peru, Ecuador, Israel, New Zealand, Turkey, United States and Spain, where cultivars have been developed for a Mediterranean climate (Mahato e al., 2016).

Nutrition and health benefits

Pepino is described as a highly nutritious superfruit, is packed with health benefits with high water content (92% fresh weight) and with excellent antioxidants, has diuretic properties, and is antiglycative, antioxidative and anti-inflammatory properties; therefore, pepino is recommended for diabetic and sugar-free diets due to its low sugar content. It also contains several minerals which are crucial for the metabolism and health of the bones. It contains flavonoids and phenol, which help in building the immune system. The fruit extract also contains immunomodulatory and anticancer properties. Thus, pepino has a great potential for use as a natural antioxidant and beyond its nutritional potential. Promotes digestive health, supports weight loss, and strengthens bones. Enhances liver health and assists in fighting liver damage caused by alcohol.

Aroma

The aroma of a pepino fruit has been described as green, fresh, and reminiscent of melon and mango fruit (Shiota et al., 1988). A ripe pepino has a scent reminiscent of a cantaloupe melon, but when it is not fully ripe, it has a cucumber-like scent. The main volatile components identified in pepino were 3-methyl-2-buten-1-ol, 3-methyl-3-buten-1-ol, and their respective acetates, butyl acetate and (Z)-6-non-1-ol.

Culinary Uses

This exotic fruit is versatile in the kitchen. It can be eaten raw, added to salads, blended into smoothies, or used as a delectable addition to desserts. This fruit appears to be seedless because the seeds are very small. Therefore, it can be consumed without worry, eating the entire fruit. It can added to a fruit salad that includes apples, oranges, grapes or strawberries. It also goes great with other vegetables, like zucchini or bell peppers.

Soil and Climate

Pepino melon requires warm soil and

temperatures to grow successfully. It is best grown in full sunlight, where the temperature can reach up to 24 oC or higher. This tropical plant prefers a well-draining, acidic soil with a pH of 5.5 – 6.8 and plenty of organic matter added for nutrition. Proper soil and temperature conditions are essential to keep the plant healthy and productive. When the soil starts to dry out, give it plenty of water, and add fertilizer regularly to encourage healthy development. the plant is moderately tolerant to salinity and grows well under poor soil conditions. However, pepino plants are sensitive to high temperatures, particularly during pollination and fruit setting.

Propagation

In general, clonal propagation by

cuttings is the only mean of reproduction. This is also recommended for the cultivars released by Spain and other breeding programs, where each cultivar must be vegetatively propagated by stem cuttings to maintain the characteristics. It appears as a bushy plant capable of reaching a height of one meter. It produces purple or white flowers with purple streaks. Pepino melons require a trellis or stake for support as they produce vines with fruit-bearing branches. When the fruit seems plump and is grown, it should be picked. Pepino melon plants can grow up to 8 feet tall and bear up to 4-5 melons per season under ideal conditions. Plants cultivated inside or in greenhouses must be kept out of direct sunlight and given enough air circulation to avoid mildew or other illnesses.

Physiology of Pepino Fruit

The pepino fruit has been described as a berry that develops on a cymose inflorescence. The fruit presents a simple sigmoid growth curve, and its maximum fruit size is reached nearly 60 days after anthesis, corresponding to morphological stage 8 according to the BBCH numerical scale, at which point the maximum sugar accumulation is also reached. The fruit takes between 30 and 60 days to grow to full size, after which, depending on the cultivars, can take between 7 and 25 days to fully ripen. Pepino fruit has been considered non starchy and a sucrose accumulator. Slightly more than 50% of the sweetness of pepino is attributed to its sucrose content, which increases dramatically during maturation. Glucose and fructose are also present in pepino, representing 28% and 18% of total sugars, respectively. Organic acids are almost exclusively represented by citric acid, which accounts for 91% of the total non-volatile organic acids found in the fruit. pepino contains vitamin C at higher levels (48–68.8 mg/100 g fresh tissue) than normally found in most fruits.

Harvest and storage

Fruit harvest is carried out when ground color is green or white. Storage Temperatures of 1 and 3 oC favoured superficial injury so 5, 8, and 10 oC to be optimal temperatures for pepino storage.

Conclusion

Pepino, a Solanaceae fruit known for its unique sweet taste, has garnered only modest scientific attention over the years. Its commercial production has been largely overlooked, mainly due to a lack of information on storage and handling, leading to poor-quality outcomes for consumers. Despite this, pepinos hold significant potential as a horticultural crop due to their adaptability to various agroclimatic conditions and their notable quality characteristics, particularly in flavour. Fruit maturity is crucial for consumer-level fruit quality, influencing attributes such as appearance, texture, and flavour. The stage of maturation strongly impacts storage conditions and shelf life, with the loss of firmness being the main limiting factor for riper fruits. Further research, especially at the molecular level, is necessary for this species. This research should leverage the sequenced genomes of its closest relatives, such as tomatoes and potatoes. Future efforts should focus on improving quality and storability. Including Pepino melon in your diet not only pleases the palate but also provides health benefits.

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