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English journal

The First English farm journal from the house of Kerala Karshakan



AN INSIGHT INTO
**FRUIT &
VEGETABLE**
PROCESSING

The First English farm journal from the house of Kerala Karshakan

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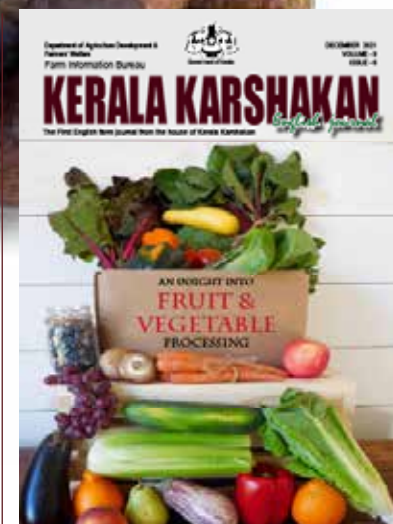


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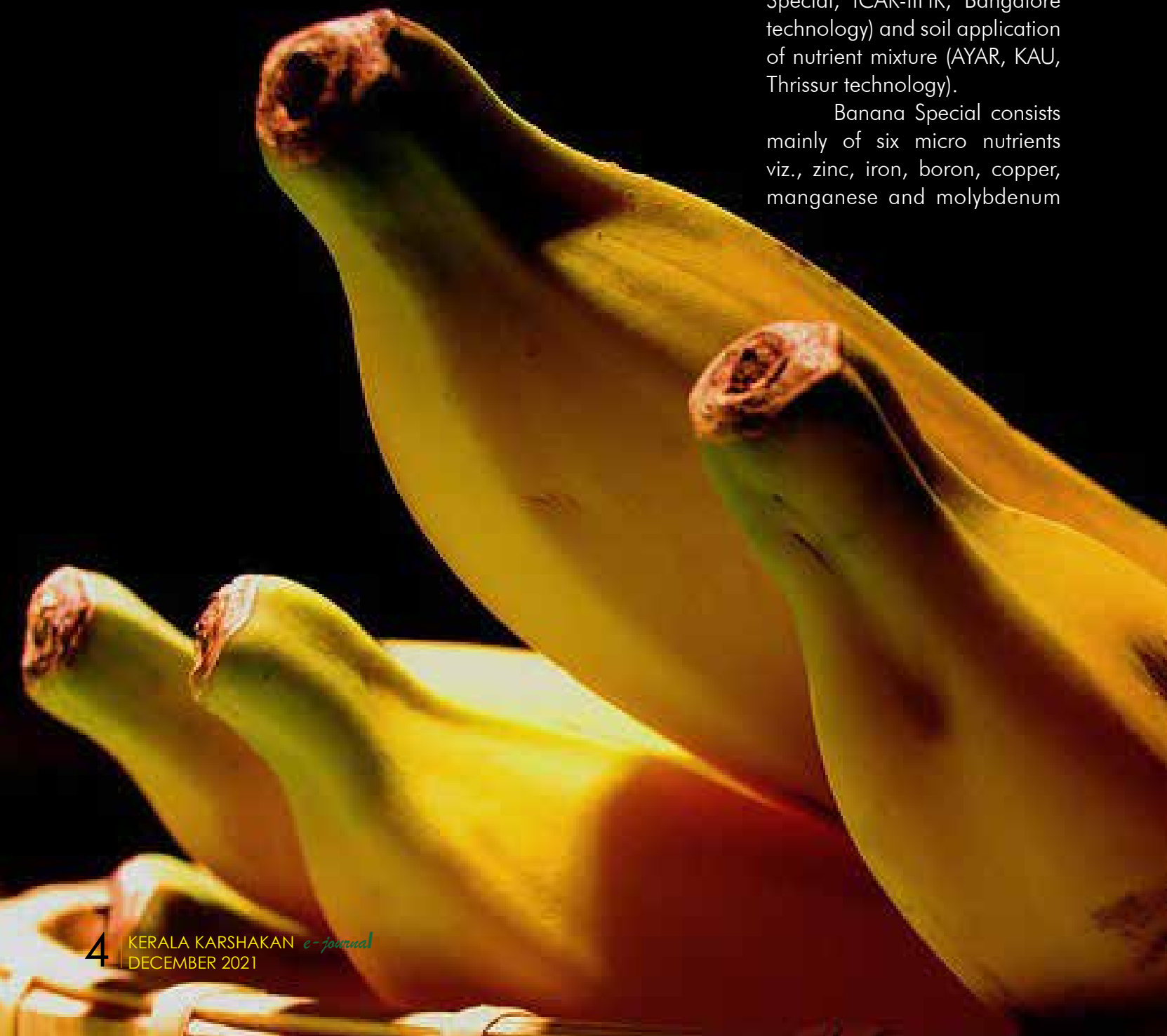
YIELD ENHANCEMENT IN NENDRAN BANANA THROUGH THE APPLICATION OF SECONDARY AND MICRO - NUTRIENTS

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Profile of Technology

Application of secondary as well as micro nutrients has been found to be beneficial in improving yield and quality parameters in banana. At present, two technologies are available viz. foliar application of the nutrient solution (Banana Special, ICAR-IIHR, Bangalore technology) and soil application of nutrient mixture (AYAR, KAU, Thrissur technology).

Banana Special consists mainly of six micro nutrients viz., zinc, iron, boron, copper, manganese and molybdenum



and three secondary nutrients viz., calcium, magnesium and sulphur. The foliar application @ 5g/l of water is to be carried out from four months after planting till bunching at monthly intervals and thereafter two sprays on the bunches after its emergence. AYAR consists of secondary and micro nutrients namely calcium, magnesium, sulphur, zinc and boron. Soil application is done at two months and four months after planting @ 100 g eac

Challenges

Nendran is one of the most important banana cultivar of Kerala. It occupies an area of 56,211 ha with a production of 3,83,102 t in the State. The average yield realized in this popular variety is only about 4.35 t/ha against the average yield potential of 25 – 30 t/ha. Of the several reasons attributed for its low productivity, yield loss due to pests and diseases is affecting majority of the farmers. But this can be overcome by following proper prophylactic measures in a timely manner. Still the productivity remains low, the reason being attributed to the deficiency of secondary and micro-nutrients especially calcium and boron. In this backdrop, attempts were made to increase the yield of Nendran banana through the application of secondary and micro-nutrients

Target Beneficiaries and Key Benefits

In order to test the potential of these nutrient formulations, On-farm trails were first conducted in Kozhikode district by ICAR-Krishi Vigyan Kendra, Kozhikode during

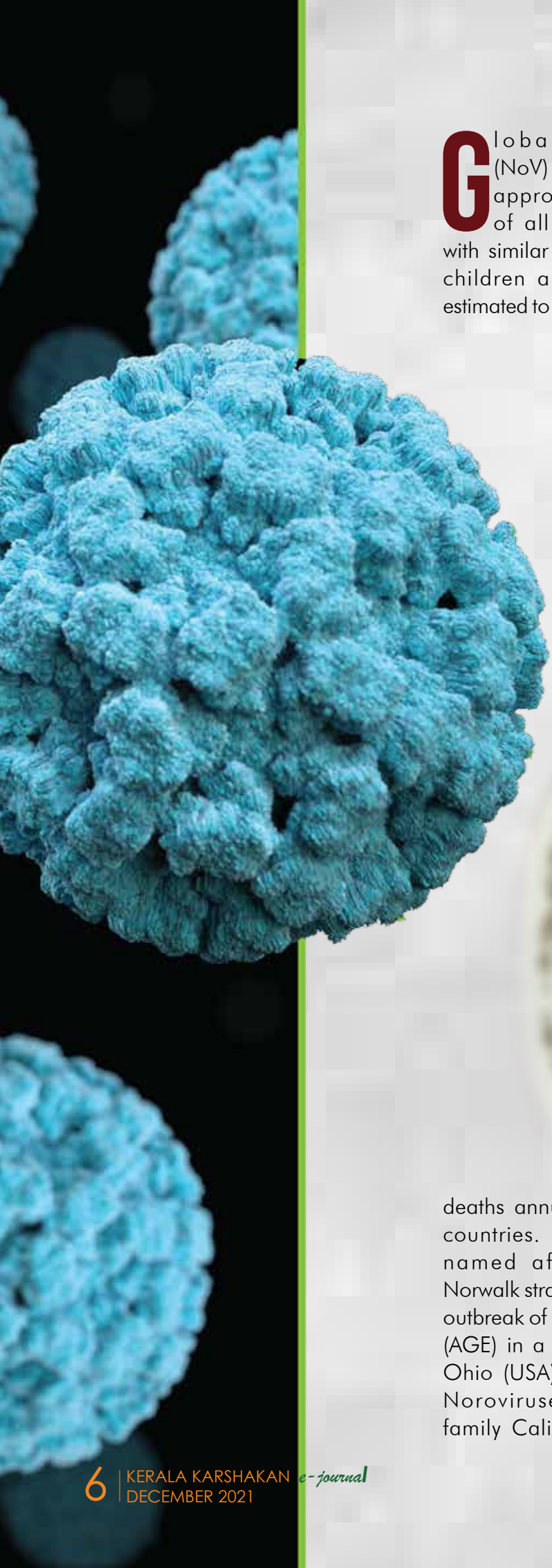
2012- 2013. Consequent to its success, these technologies were further demonstrated for enhancing productivity in nendran banana and ultimately to increase the net income of farmers. These 2 programmes were implemented in Naduvannur, Ulliyeri, Changaroth, Perambra, Kavilumpara, Cheruvannur and Maruthonkara panchayats of Kozhikode district during 2012 to 2016. After soil nutrient analysis, soil health cards were issued to the farmers and critical inputs such as micronutrient formulation and essential PP chemicals were also supplied. KVK scientists frequently visited the demonstration plots for proper monitoring of the programme and timely guidance. In addition, training and awareness programmes were also organized for farmers with emphasis on method demonstration.

The demonstration was a huge success with foliar application leading to early bunching and enhanced bunch weight. The plants bunched by about six months after planting while check plots showed bunching by seven months only. About 36.54 per cent increase in yield with the production of bunches of about 14.2 kg per plant was reported while it was only 10.4 kg per plant in check plots. Like foliar application of micro-nutrients, soil application also evoked similar results. In the demonstration plots, a yield increase of 19.59 per cent with 11.6 kg per plant was obtained

compared to 9.7 kg per plant of local check. Moreover, banana bunches in the micronutrient applied plots were of more uniform in size with attractive golden yellow coloured fingers. It also helped the farmers to reduce harvesting and transportation cost due to its uniform maturity and assures quick sale owing to attractive size and colour.

Economic Benefits

All the participating farmers were convinced by the success of the technology and they continued to use micro-nutrient formulations for banana even after the completion of the demonstration. The technology is also spreading to all the banana growing tracts of the district in a very fast manner. The interventions of soil nutrient test based application of major and secondary nutrients along with micronutrients in nendran banana costs an additional amount of about Rs.6,000 (foliar application) to Rs.25,000 (soil application) per ha, while enhanced the income to Rs.9.68 lakhs/ha from Rs.7.53 lakhs /ha (of control). If this technology is popularized and adopted by farmers, the yield of nendran banana – the most sought after variety of Kerala - can be enhanced manifold. Involving Local Self Government Departments (LSGDs) and Block Level Agencies in the production of these micro- nutrient formulations may also have the potential to popularize the technology in every field of banana farmers.

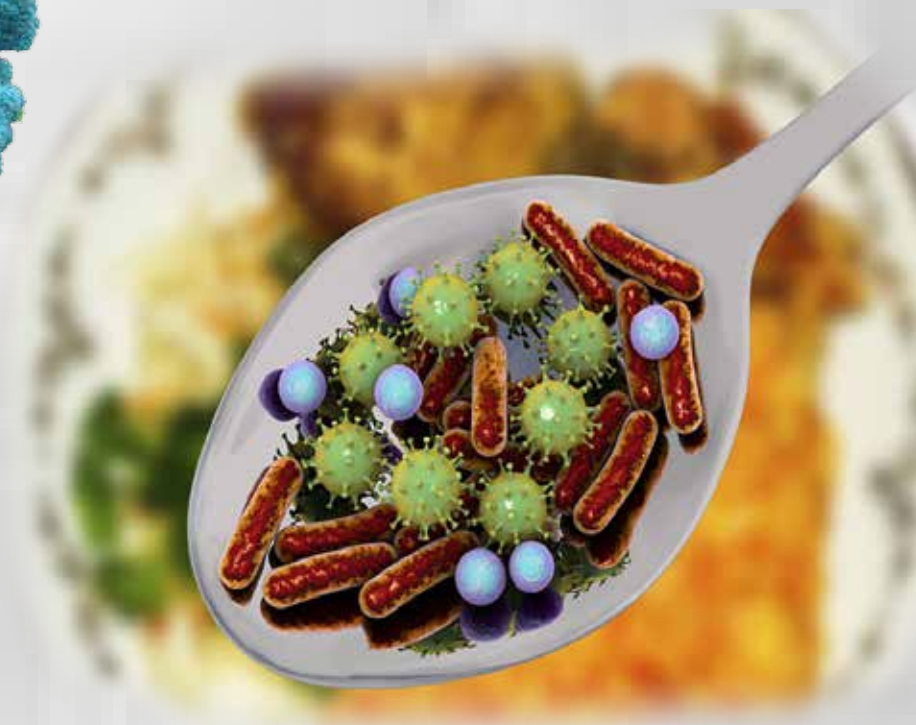


Globally, Norovirus (NoV) is associated with approximately one-fifth of all diarrhoea cases, with similar prevalence in both children and adults, and is estimated to cause over 200,000

Dr. K. VRINDA MENON

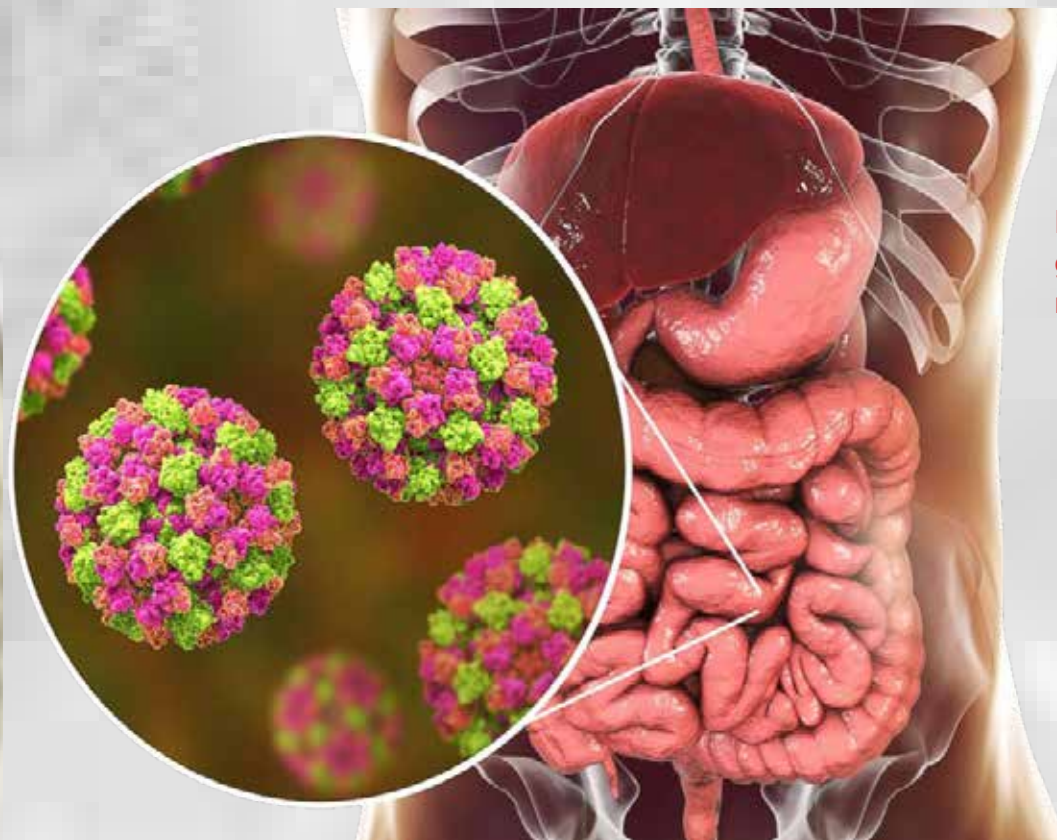
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NOROVIRUS INFECTION



deaths annually in developing countries. Noroviruses are named after the original Norwalk strain, which caused an outbreak of acute gastroenteritis (AGE) in a school in Norwalk, Ohio (USA) in 1968. Human Noroviruses belong to the family Caliciviridae, a small,

single-stranded, non-enveloped, positive sense RNA virus. These viruses are currently classified into five different genogroups (G) GI – GV, of which GI, II, and IV infect humans and GIII and GIV infect bovine and murine species, respectively. In India, NoV infections are common



cause of childhood AGE cases. The foods commonly associated with norovirus outbreaks include green leafy vegetables, fresh fruits and shellfishes (such as oysters). People with norovirus illness can shed billions of norovirus particles but only a few virus particles can make other people sick. Infection with

one type of norovirus may not protect you against other types. It is possible to develop immunity to specific types. But, it is not known exactly how long the immunity lasts.

Routes of transmission:

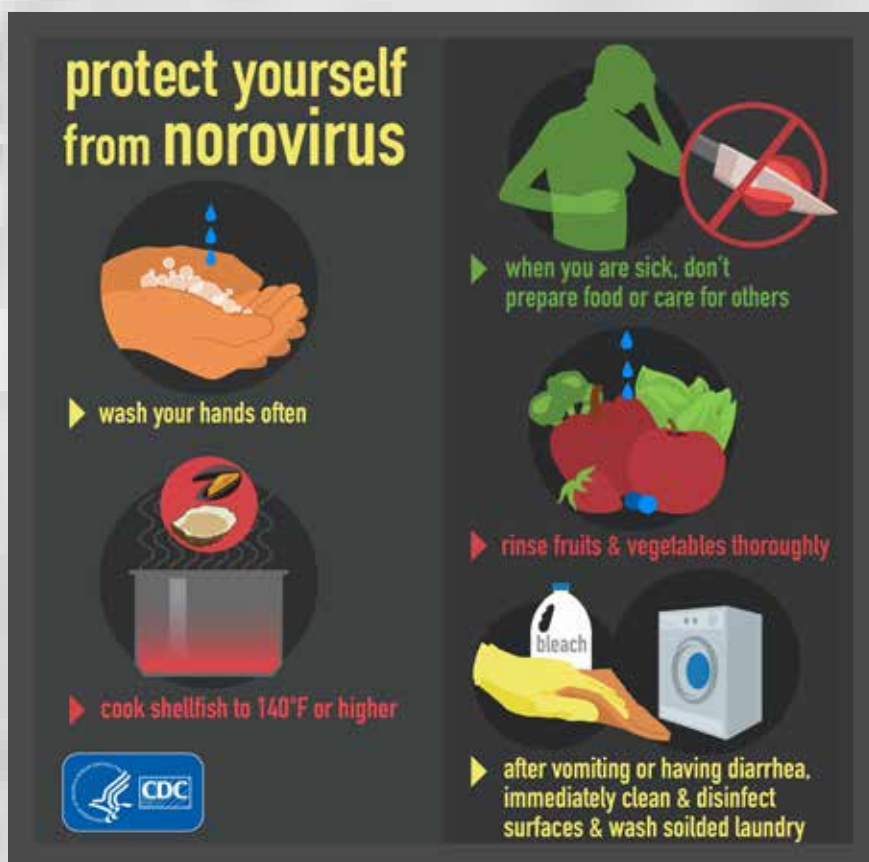
- Having direct contact with an infected person
- Consuming contaminated

food or water.

- Touching contaminated surfaces and then putting the unwashed hands in your mouth.

Food and water can get contaminated with norovirus

- When an infected person when touches food with their bare hands that have faeces or vomit particles on them
- When food is placed on a counter or surface that has faeces or vomit particles on it
- When tiny drops of vomit from an infected person spray through the air and land on the food
- When the food is grown with contaminated water, such as fruit and vegetables irrigated with contaminated water in the field
- When food is handled by food handlers who are infected , especially if they do not wash their hands regularly
- When private well water get contaminated with infected faeces or contamination



from septic tank

Symptoms :

Asymptomatic Infection:

Faecal excretion of norovirus infection in asymptomatic individuals is common, especially in children

Symptomatic Infection

- Norovirus causes inflammation of the stomach or intestines. This is called acute gastroenteritis. A person usually develops symptoms within 12 to 48 hours after being exposed to norovirus. Most people with norovirus illness get better within 1 to 3 days. The most common symptoms include
- diarrhoea
- vomiting
- nausea
- stomach pain

This can lead to dehydration, especially in young

children, older adults and people with other comorbidities. Some people also have a slight fever, headache, painful stomach cramps and aching limbs.

Currently, the Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) is a standard method for norovirus diagnosis.

Treatment

No specific therapy exists for noroviral gastroenteritis. Replacing fluids in very young children and older adults is especially crucial, as people in these age groups are particularly susceptible to dehydration that comes on very rapidly. People with norovirus should eat a light diet consisting of foods that are easy to digest.

Prevention and Control

- Practice proper hand hygiene: Always wash hands carefully with soap and water

especially, after using the toilet and before eating, preparing, or handling food. Alcohol-based hand gels are usually not effective against the virus.

- Wash fruits and vegetables and cook seafood thoroughly. Thorough cooking is important because noroviruses can survive temperatures as high as 60°C
- Food workers should stay home when sick and for at least 48 hours after symptoms stop. This also applies to sick workers in schools, daycares, healthcare facilities, and other places where they may expose people to norovirus.
- Clean and disinfect contaminated surfaces. Use a chlorine bleach solution with a concentration of 1000–5000 ppm. Leave the bleach on the affected area for at least 5 minutes and then clean the area with water
- Wash clothes or linen that may be contaminated with vomit or stool with detergent
- Boil water (rolling boil for at least 1 minute) to inactivate the virus.
- Chlorination of contaminated well water

India, being a country of extreme geo-climatic diversity, faces a constant threat of emerging and re-emerging viral infections of public health importance. Hence, there is a need for strengthening disease surveillance in the country focusing on the epidemiology and disease burden.

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Kalettes

*A New Novel
Vegetable*

Kalettes - An overview:

Kalettes, often known as “flower shoots,” are a brassica family member. It is a cross between kale and Brussels

sprouts, and it is the newest hybrid vegetable to enter the market in the United States. The novel vegetable was created by Tozer Seeds, a British vegetable

breeding business, and was presented to the United States in fall 2014. They receive their name from the vegetable kale, with the ‘ette’ alluding to its little



Kale



Brussels Sprout



Kalettes

Macronutrients & calories

RDA/RI Male 31-50 years

	Fiber/Fiber	Protein	Carbohydrate	Total sugars	Kilocalories- calories	Fats	Lactose	Added sugars	Natural sugars	Glycemic load
Amount Per Portion	1.9g 5%	1.8g 4%	1.76g 2%	0.88g 2%	19.6cal 0.87%	0.38g 0.54%	None / No data yet	None / No data yet	0.88g --	None / No data yet

Vitamins with RDA/RI

RDA/RI Male 31-50 years

	Vitamin K	Folate (B9)	Vitamin C	Vitamin B6	Vitamin A	Pantothenic Acid (B5)	Vitamin E	Thiamin (B1)	Riboflavin (B2)	Niacin (B3)	Choline	Biotin (B7)	Vitamin B12	Vitamin D
Amount Per Portion	155.2µg 130%	51µg 13%	13.4mg 13%	0.13mg 8%	55.6µg 7%	0.27mg 6%	0.54mg 4%	0.05mg 4%	0.04mg 4%	0.24mg 2%	3.82mg 0.69%	0.18µg 0.45%	None / No data yet	None / No data yet

Minerals with RDA/RI

RDA/RI Male 31-50 years

	Manganese	Iron	Phosphorus	Potassium	Calcium	Magnesium	Selenium	Zinc	Copper	Sodium chloride - salt	Iodine
Amount Per Portion	0.2mg 7%	0.48mg 5%	27.6mg 4%	180mg 4%	30mg 3%	8.4mg 2%	0.72µg 2%	0.18mg 2%	0.01mg 0.75%	0.02g 0.40%	0.2µg 0.13%

Essential amino acids /fatty acids with RDA/RI

RDA/RI Male 31-50 years

	Isoleucine	Tryptophan	Valine	Threonine	Leucine	Lysine	Histidine	Phenylalanine	Methionine	Omega 3 ALA	Omega 3 EPA/DHA	Omega 6
Amount Per Portion	0.06g 5%	0.02g 5%	0.06g 4%	0.05g 4%	0.07g 3%	0.06g 3%	0.03g 3%	0.05g 2%	0.01g 0.84%	None / No data yet	None / No data yet	None / No data yet

Phytochemicals with CYF recommendations

RDA/RI Male 31-50 years

	Lutein and zeaxanthin	Quercetin	Flavonoids	Resveratrol	Lycopene	Myricetin
Amount Per Portion	1957.6µg 98%	4.9mg 49%	14.8mg 4%	None / No data yet	None / No data yet	None / No data yet



Autumn Star F1

stature. They're a sprout-sized leafy vegetable that looks like a little cabbage. They have a deep purple and brilliant purple colour. Their leaves have a ruffled look and are not as densely packed as sprouts'. They have a sweeter flavour than Brussels sprouts, which may appeal to certain people. Kalettes, which are high in vitamin C and K, have been called a "super food" by health enthusiasts because of its nutritional advantages. Kalettes have a kale-like texture and a savoury, nutty flavour akin to sprouts. Seeds are sown in March, and young plants are placed in the fields in May. Kalettes may be picked from November onwards. From the middle of November until the end of March, kalettes are offered. As a consequence, they're fantastic in hearty winter dishes and light spring salads. They can even take the place of Brussels sprouts in a Sunday roast.



Snowdrop F1

Flavorful, Nutritional Powerhouse

The taste of baby Brussels sprouts is particularly strong, according to Farmer Lee, since they have all of the rich flavour of their bigger relatives, but possess none of the cabbage-like harshness which some people find to be a deterrent factor in consuming this crop. It is possible that the crew at The Chef's Garden will be able to harvest these gorgeous babies as early as August, but we like to be patient. Baby Brussels may be likened to grapes in a good ice wine if we wait until after a frost has fallen on them. Kalettes are excellent sources of vitamin C, folic acid, calcium, and potassium. Kalettes have double

the Vitamin B6 and twice the Vitamin C than regular Brussels sprouts.

Varieties: **Garden Mix**

It is the first variety and is a brand-new vegetable with curled leaves and a tiny green and purple sprout. It is derived from the cross between two real 'Superfoods,' Brussels sprouts and British kale, yielding a sweet and nutty vegetable.

Cropping Period: October-end of February.

Period of Maturity: 180 – 300days.

Sprout Colour: Green, Red and bi-colour.

Autumn Star F1

Autumn Star is the first of the three Kalettes types to

mature, with harvest beginning in October. This cultivar is very vigorous and produces large quantities of Kalettes that are very simple to harvest. This type, which stays in excellent shape until at least upto the end of November, develops a wonderful sweet and nutty flavour as the season continues.

Snowdrop F1

It is a Kalettes cultivar that is highly winter hardy, with stems that are somewhat shorter and less prone to lodging in strong winds. This variety develops from January to February and has slightly shorter stems. The Kalettes will stay in good condition during this difficult growing season, and they have shown exceptional performance

in trials even in the face of heavy snow and cold temperatures. Cropping Period is January to February. It will take 300 days to mature and Sprout Colour: is Green, Red and bi-colour.

Christmas Rose F1

The tallest of the three Kalettes types. It has excellent maturity up the stem and will produce large quantities of delicious Kalettes for the all-important Christmas season, staying in peak quality throughout November and December. Days to Maturity: 240 days; Sprout Colour is Green, Red and bi-colour.

Scientific cultivation

Kalettes come in three

different types. From seed to maturity, "Autumn Star" takes 110 days, "Mistletoe" 124 days, and "Snow Drop" 138 days. Before transplanting, start seeds inside and nurture them for 4-6 weeks in a greenhouse or on a sunny interior windowsill. Growers should transfer kalettes outside as soon as the ground is frost-free. Kalettes, like other brassicas, require nitrogen-rich soil. Before planting kalettes, amend the soil with a couple of inches of compost and/or well-aged manure. For a nitrogen boost, we may sprinkle a pinch of blood meal at the roots of each plant. Cover the seeds soon after you put the transplants

out, or give an organic mulch of grass clippings (from a lawn that hasn't been treated with herbicides) can assist to cool the soil, deter weeds, and give supplementary nitrogen. For a nitrogen boost, spray with fish emulsion or compost tea every two weeks.

In beds, space transplants 45-60cm apart. Give them plenty of water on a regular basis. Pinched tops are similar to kale in that they may be cooked and consumed. After a little frost, the kalettes taste is at its peak. When rosettes reach a width of 2-3.5cm, harvest them. All rosettes of any particular plant do not develop at the same time.



Christmas Rose F1

Introduction

Imbalanced use of chemical fertilizers to soil and crops, reduce soil fertility, increase environmental pollution and decrease crop productivity. Managing soil health and crop productivity on sustainable basis is a vital challenge for the growers, especially in the situation, when crop production resources are being costly day by day. Such conditions need utilization of low cost plant based nutrient sources like green manure crops. Green manuring is the practice of incorporating green manure crops into soil through ploughing, while they are green

or soon after they start flowering. Green manuring maintains and improves soil health through addition of organic matter, minimize nutrients fixation loss, produces huge mass of humus and helps in reducing leaching losses of soil nutrients. Green manuring practice not only improve composition and nutrient balance of soil, but also provides a basis for a more environment friendly approach to modern farming. This article provides knowledge about cultivation practices of some important green manure crops and the benefits of green manuring practices on soil health.

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Chemical Fertilization to Green Manuring “Moving towards Sustained Production”

Figure 1. *Sesbania aculeata* green manure crop (Source–Yadav et al., 2017)





Figure 2. Sunhemp green manure crop (Source- <https://www.southernexposure.com/products/sunn-hemp-cover-crop/>)

Table 1. Biological nitrogen fixation of in-situ and ex-situ green manure crops

Green manure crops	Biological nitrogen fixation (kg/ha)	References
In-situ green manuring crops		
<i>Sesbania aculeata</i> (Daincha)	96-135	(Masood and Bano, 2016)
<i>Sesbania rostrata</i> (Sesbania)	83-109	(Masood and Bano, 2016)
<i>Crotalaria juncea</i> (Sunhemp)	95-100	(Mendonça et al., 2017)
<i>Vigna unguiculata</i> (Cow pea)	60-65	(Keston et al., 2017)
<i>Vigna radiata</i> (Mung bean)	35-50	(Hayat et el.,2008)
Ex-situ green manuring crops		
<i>Leucaena leucocephala</i> (Subabul)	260-320	(Rajendren and Mohan, 2014)
<i>Pongamia glabra</i> (Karani)	200-210	(Rajendren and Mohan, 2014)
<i>Gliricidia sepium</i> (Gliricidia)	105-110	(Mendonça et al., 2017)

Green manure crops:

Green manure crops are those, that are grown either in-situ or ex-situ and to be turned in to the soil to improve physical, chemical and biological properties of soil (FAO, 2011).

There are two types of green manuring:

1. In-situ green manuring:

When green manure crops are grown in the field itself either as a pure crop or as intercrop with the main

crop and buried in the same field, it is known as in-situ green manuring e.g. sunhemp, daincha, pillipesara, shervi, urd, mung, cowpea, berseem, senji, etc.

2. Ex-situ green manuring-

It refers to turning of green leaves and tender green twigs of shrubs and trees into the soil, collected from bunds, waste lands and nearby forest area e.g. glyricidia, wild daincha, karanj etc.

Potential green manure crops

1. *Sesbania aculeata* (Daincha)

Daincha crop is originated from Africa. It is one of the most preferable green manure crops among the farmers. It is a quick growing succulent crop, which can be incorporated at about 6 to 8 weeks after sowing. This crop adapts to varying conditions of soil and climate and can be

Table 2. Nutrient compositions of green manure crops (Source-Sangma,2017)

Crop	Nutrient content (%) on dry weight basis		
	N	P	K
Green manure crops			
<i>Sesbania aculeata</i>	3.3	0.7	1.3
<i>Crotalaria juncea</i>	2.6	0.6	2.0
<i>Sesbania speciosa</i>	2.7	0.5	2.2
<i>Tephrosia purpurea</i>	2.4	0.3	0.8
Green leaf manure crops			
<i>Pongamia glabra</i>	3.2	0.3	1.3
<i>Glyricidia maculeata</i>	2.9	0.5	2.8
<i>Azadirachta indica</i>	2.8	0.3	0.4

successfully grown even under drought, water logging and salinity situations. Recommended seed rate for *Sesbania aculeata* is about 40-50 kg per hectare. The green biomass yield of daincha is about 20-30 t/ha. Daincha can fix about 96-135 kg nitrogen per hectare through biological nitrogen fixation.

2. *Sesbania rostrata* (Sesbania)

Sesbania rostrata green manure crop has nodules both on the stem and root. It thrives well under waterlogged condition. The normal seed rate is about 30-40 kg per ha. It can produce about 15-20 t/ha fresh matter. *Sesbania rostrata* fixes about 80 -110 kg biological nitrogen per hectare within a period of 7 to 8 weeks. *Sesbania* crop has good potential for incorporation in alley-cropping system. Farmers also plant *Sesbania rostrata* on field bunds. Pruning of *Sesbania* crop grown on bunds would be a source of readily available green manure.

3. *Crotalaria juncea* (Sunhemp)

Sunhemp crop has originated from South Asia (Bangladesh, Bhutan and India). Sunhemp as a green

manurecrops are generally grown during rainy season. Fast growth habit of sunhemp makes it ideally suited for planting in late summer. Sunhemp is normally incorporated in soil at 30-45 days of crop age. The normal seed rate of sunhemp is about 35 kg/ha. Sunhemp crop can fix about 95-100 kg atmospheric nitrogen per hectare. Sunhemp crops are very high yielding and generally drought resistant.

4. *Leucaena leucocephala* (Subabul)

Leucaena leucocephala is native to Central America. This multipurpose tree is used for fuel wood, lumber, animal fodder, and green manure. It is a promising forage tree crop, the leaves of which contain about 3-4% N. *Leucaena* tree fixes about 260-320 kg N/ha per year. The incorporated leaves of *Leucaena* decompose quickly, providing a rapid influx of nutrients. Other important green manure crops for improving soil fertility and crop productivity are *Vigna unguiculata* (cow pea), *Vigna radiata* (mung bean), *Vigna umbellata* (rice bean), etc.

Incorporation techniques of green manure crops

Effective incorporation

of the green manure crop is as much important as the growing of the crop.

Degradation of green manure crops in the field should be quick and this requires good moisture and mixing with adequate aeration in the soil. It is also important that the green manure crops should be incorporated at succulent stage (almost at flowering) it should not be too mature and woody. In heavy soils the green manure crops should not incorporate too deep as it can slow down or prevent the decomposition.

Benefits of green manuring in crop production

1. Effect on soil properties

Adoption of green manure crops add soil organic matter through biomass decomposition. Increased organic matter in soil as a result of incorporation of green manure, improves soil physical properties by increasing the distribution and stability of soil aggregates and decreasing soil bulk density (Yadav et al., 2017). Soil aggregation may reduce soil bulk density and increase soil porosity with greater water retention capacities. Vegetative cover of green manure increase

infiltration rate and moisture retention capacity of the soil.

2. Protection from soil erosion

Conventional tillage system offers dominance of bare soils in which intensive and direct fall of raindrops breaks soil aggregates and create obstruction to the soil pores. This causes the sealing of the soil surface and reduces infiltration which in turn leads to soil erosion.

Green manure crops protect soil from soil erosion by preventing the direct impact of raindrops on soil and reducing the velocity of surface runoff by acting as barrier for water flow. Furthermore, green manures crops cover also reduces the loss of soil nutrients and organic matter through soil erosion.

3. Biological nitrogen fixation and nutrient addition

Green manure crops add large quantities of nitrogen to the soil through biological nitrogen fixation in the nodules, located on their roots or stem. The amount of nitrogen fixation is depending on species of leguminous green manure crops (Table 1).

4. Effect on Weeds

Growing of green manure crops offer saving of labour, reduce the use of herbicides thus lowering production costs and promote ecological farming practices. Green manure crops

suppress the weed growth at early stage and cut down the amount of water, light and nutrient resource used by weed population.

5. Increase crop productivity

Cultivation of appropriate green manure crops and their efficient incorporation, increase crop production and also cut down cost of cultivation through saving of resources, mainly the chemical fertilizers. The amazing results from green manuring practices could be seen, when adopted at long term basis as a soil management tool.

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AQUATIC ORNAMENTALS FOR CONTEMPORARY LANDSCAPING

Aquatic plants are those plants whose photosynthetically active parts are permanently or at least, for several months each year, submerged in water or float on the surface of water. The ornamental plants that are adapted to aquatic environment are generally referred to as aquatic ornamentals.

TYPES OF AQUATIC ORNAMENTALS

Floating plants

These are the plants which simply float on water surface. Roots drift below and act as filters. These easy-care plants provide surface cover, shade and hiding places for fish. Floating plants use nutrients from the water and improves water clarity. These plants reduce the amount of sunlight that can penetrate and thus help in the control of blanket weed and green water algae. However if the floating plants overgrows in the pond, action needs to be taken to keep them under control.

Eg. Waterlily (*Nymphaea* sp.):-

Water lilies can be classified into two types. They are Hardy Water lilies and Tropical Water lilies.

Hardy water lilies can be used as a center piece in water gardens. These are available in Yellow, pink, red, and white colours. These types of water lilies are situated 6-12 inches under water. Most are in bloom for much of late spring and then bloom sporadically until they fall. The major speciality of this plant is that, flowers float on the top of water. Tropical Water lilies begin blooming when the weather

becomes hot, about mid-June. Colours of tropical lilies include deep red, yellow, pink, white, and blue. Their blossom size is much larger than hardy types, ranging from 2 inches to 8 inches or more across. Flowers generally bloom 6-12 inches above the surface of water. Most of them are very fragrant. They are again divided in to two groups' i.e, day bloomers and night bloomers (Osman, 2006).

Other plant species which are coming under the category are Water snow flake (*Nymphoides indica*), Fringed Water lily (*Nymphoides peltata*), Water lettuce (*Pistia stratiotes*), Duck weed (*Lemna minor*), Water fern (*Ceratopteris* sp.), Water soldier (*Stratiotes aloides*), Fairy moss (*Azolla caroliniana*), Frog bit (*Limnobium spongi*), Water hyacinth (*Eichhornia crassipes*) etc.

Emerged plants/Emersed plants

Emerged plants are rooted in shallow water with much of their vegetative growth above the water. Roots grow deep under water in planters on the pond bottom and leaves and flowers emerge and spread up on the surface.

Lotus (*Nelumbo* sp.):- Lotuses are one of the most spectacular plants in aquatic garden collections. There are two types of lotuses, Egyptian types (*Nelumbo nucifera*) and American types (*Nelumbo lutea*). The Egyptian types have very large flowers, some up to 12 inches in diameter, and are red, deep pink or white in colour. The American types have small,

yellow flowers.

Other plant species which are coming under the category of emerged plants are Cat tail (*Typha latifolia*), Spatterdock (*Nuphar luteum*), Rushes (*Juncas* spp.), Nutsedges (*Cyperus* spp.), Spikerushes (*Eleocharis* spp.), Bulrushes (*Scripus* spp), Purple loosestrife (*Lythrum salicaria*), Water willow (*Justicia americana*) etc.

Submerged plants

Submerged plants are rooted in the bottom and have leaves and stems that grow permanently under water. All photosynthetic parts are partially or completely submerged.

This can be classified into two categories. The plants which are coming under the category of submerged plants are Coontail/Hornwort / Foxtail (*Ceratophyllum demersum*), Leafy Elodea (*Egeria densa*), Water purslane/Swamp Ludwigia (*Ludwigia pallustris*), Water Milfoil (*Myriophyllum* sp.), Anacharis (*Egeriadensus* or *Elodia canadensis*), Dwarf Sag (*Sagittaria subululata*), Eel grass (*Valisneria* sp.), American waterweed (*Elodea Canadensis*), Nuttall's waterweed (*Elodea nuttallii*), Water moss (*Fontinalis antipyretica*), Water nymph (*Najas flexilis*), White water-buttercup (*Ranunculus aquatilis*), Needle spike-rush (*Eleocharis acicularis*), Creeping Jenny (*Lysimachia nummularia*), Lemon Bacopa (*Bacopa caroliniana*), Water Hyssop (*Bacopa monniera*) etc.

Marginal/ Amphibious/ Bog plants

Plants which grow in the



shallow water or saturated soil around the rim or margins of a pond are generally referred to as Marginal/ Amphibious/ Bog plants. They are placed on the margin of the pond typically in 2 – 6 inches of water. They are heavy root feeders. They improve water quality by extracting excess detrimental nutrients from the pond environment before they can accumulate (Foster and Smith, 2012). It can be planted in pots set on underwater shelves, or can be planted directly in soil around a pond or stream.

The plants which are coming under the category of marginal plants are Hardy water Canna (*Thalia dealbata*), Variegated Society Garlic (*Tulbaghia violacea*), Pickerel (*Pontederia cordata*), Sweet flag (*Acorus calamus*), Fools Water Cress (*Apium nodiflorum*), Flowering Rush

(*Butomus umbellatus*), Marsh Marigold (*Caltha palustris*), Lesser Pond Sedge (*Carex cutiformis*), Greater Pond Sedge (*Carex riparia*), Reed Sweet Grass (*Glyceria maxima*), Pennywort (*Hydrocotyle vanunculoides*), Water Willow (*Justicia americana*), Water Celery (*Oenanthe javanica*), Parrot's feather (*Myriophyllum aquaticum*), Pond Sedge (*Carex acutiformis* Lesser), Reed Sweet Grass (*Glyceria maxima*), Cyperus Sedge (*Carex pseudocyperus*), Flowering Rush (*Butomus umbellatus*) etc.

Propagation and planting of Aquatic ornamentals

Generally there are 3 ways by which aquatic plants can be propagated (de Goosh, 2014).

1. Fragmentation: Some plants can reproduce when just a portion of the plant is cut off

(fragmented) and carried by wave or wind action to other areas. The plant fragment will grow roots for nutrient uptake and resettle in another area to grow. Fragments can also become attached to birds, animals and/or boats to be transported to other water bodies.

2. Root systems (rhizomes, stolons and tubers): Aquatic plants may branch out and expand through rhizomes (underground stems) or stolons (above ground stems). These stems may develop tubers or dormant buds that will survive in lake sediments for years, and can eventually produce new plants. As this occurs over time, plants may accrue very hardy, complex root systems. Examples are Hydrilla and Curly leaf pondweed.

3. Seeds and Seed banks: In flowering plants, a pollinated

flower will produce seeds (fruits) that often overwinter to germinate the next year. Seeds that do not germinate remain dormant in the sediment for as many as ten years. When this occurs over time, a supply of seeds may build up and produce what is called a seed bank to ensure plant reproduction. Birds and other animals that eat the fruits (seeds) may also transport the plants to other areas when intact fruits pass through their digestive tract. Example: water chestnut.

Aquarium plants

Aquarium plants can be classified in to three major groups,

1.Ferns and mosses: - They are non-flowering plants. Ferns and mosses produce roots which will attach to rocks and woods. They propagate through spores and vegetatively through rhizomes. Ex: Crystal wort, Java fern etc.

2.Rosette plants: - These are beautiful leafy flowering plants with shortened stem axis. They are lattice type plants which produce runners. These types of plants can be used as a focal point in aquarium. These plants need a bit more specialized plant care than other types. Ex: Amazon Sword plant, Duck weed etc.

3. Stem aquarium plants: - Hardy plants that gets fit anywhere in aquarium. These plants are propagated by using cuttings. Ex: Anacharis, Hornwort etc.

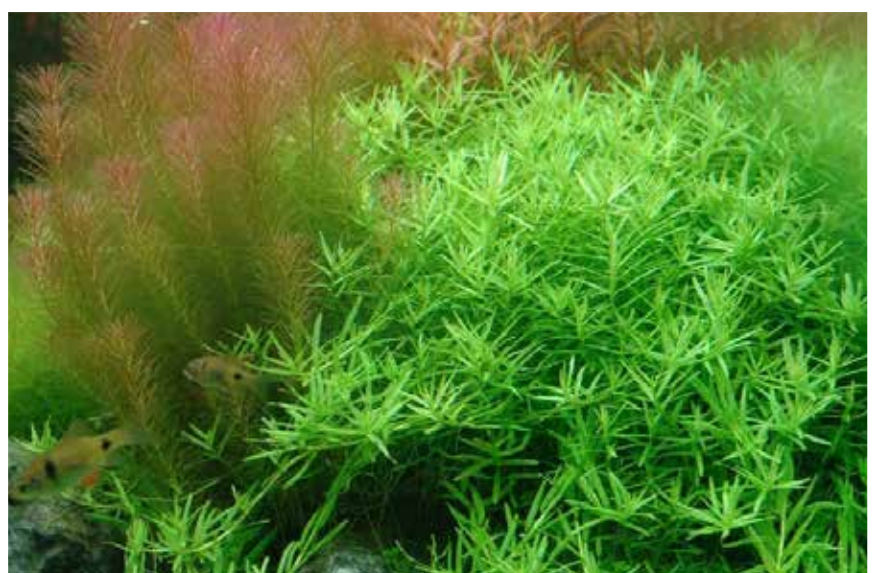
There are two types of aquarium plant culture, Terrarium



Ferns and mosses



Rosette plants



Stem aquarium plants



culture and Submerged culture. Under Terrarium culture, plants can be cultured either through soilless culture (Plants are cultured in a medium other than soil) or Hydroponics system.

Problems in Water garden

1. Algae: -A heavy algal bloom is usually a sign that there are too many nutrients in the water. Management of algae can be done by flushing with water, reducing feeding or fertilizer,

adding more aquatic plants or bacterial water conditioners, application of herbicides etc. When floating plants or other plants are used, closely shade the water to cover 50 to 75 percentage of the pond's surface and thereby reduce the algal population

2.Higher rate of fish reproduction: - Over-population of fish will limit their growth, jeopardize their health,

and degrade water quality. Many fish eggs and fry may be eaten by the larger pool fish and aquatic insects, but if only a few survive the water garden will become over-populated. One biological control method is to stock one sunfish (e.g., bluegill). Sunfish are voracious and aggressive enough to eat all fish eggs and fry in most water gardens.

Invasive species

We refer to a species as invasive if it spreads widely and causes measurable environmental, economic, or human health impacts. Water hyacinth (*Eichhornia crassipes*) is one of the major invasive species which is found in India. It is introduced from Brazil during AD 1914–1916. It causes hindrance in navigation, chokes irrigation systems and reduces aesthetic value of water bodies. This plant has capacity to remove chlorofluoro carbons and there by restoring actual condition of water. But, due to its invasive nature, it is not grown as an aquatic ornamental in India. Some invasive species in India are Brazilian waterweed (*Egeria densa*), Eurasian watermilfoil (*Myriophyllum spicatum*), Giant weed (*Arundo donax*), Yellow flag iris (*Iris pseudacorus*) etc.

Conclusion

Gardens are always a place of refreshment due to its immense beauty. Water gardens can be said as the heart of a garden. So selecting water plants for a garden should be done with at most care by which we can increase the aesthetic value of the whole garden.

The Hunger Project, in November 2017, reported that out of 7.6 billion of the population in the world, 815 million do not have enough food to sustain themselves. Amongst them, almost three quarters of the population is directly dependent on agriculture and allied activities. The exponential population spurt threatens to reduce levels of food security as time progresses. According to The Future of Food and Agriculture, a report by UN's Food and Agriculture Organization, "expanding food

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MICROALGAE

*A Source Of Nutraceuticals
And Food Supplements*



production and economic growth have often come at a heavy cost to the natural environment. It also stated that the Earth is capable of fulfilling the demands of food security, however, the agricultural sector will require 'major transformations' to reach its full potential. Microalgae have been utilized as food by humans for thousands of years and supplementation with help of microalgae will release the stress on intense resource demanding terrestrial food crops. Algae

are considered to be one of the oldest plants in the world. Their first appearance dates back to about 3.5 billion years. These photosynthetic species constitute multi-cellular structure (Macroalgae) of length up to 60 m and unicellular organisms (Microalgae) with size as small as 0.2 μm . Microalgae are an extremely diverse group with estimated number of species ranging from 200,000 to 800,000. Some of these species are cultivated in an industrial

scale to extract bioactive compounds for human and animal consumption, cosmetics and biofuel industry.

Numerous species of microalgae are reported to contain similar amount of protein compared to the traditional protein sources like milk, soybean, egg and meat. However, extraction of protein from microalgae has various benefits in terms of nutritional value, efficiency and productivity. The protein yield

from microalgae is reported at 4–15 tons/Ha/year compared to terrestrial crops yielding 1.1 tons/Ha/year, 1–2 tons/Ha/year and 0.6–1.2 tons/Ha/year for wheat, pulse/legumes and soybean respectively. The production of terrestrial crops via agriculture accounts for roughly 75% of total global freshwater. Meanwhile, animal protein sources consume 100 times more water compared to plant sources for equivalent protein extraction. Additionally, marine microalgae can be cultivated without freshwater and arable land further maximizing the resources required for additional terrestrial food crops production.

Food and supplementation from microalgae

In some developed nations, people consume high calorific foods due to their busy and modern lifestyle. This results in various health issues such as obesity, high blood pressure, diabetes and other heart related

problems. For a healthy lifestyle, a balanced diet constituting of antioxidants, vitamins, PUFAs, etc is required. Numerous species of microalgae are reported to be rich in proteins, carbohydrates, lipids and other bio-active compounds. According to Becker et al.(2007) microalgae are excellent sources of vitamins such as vitamin A, B1, B2, B6, B12, C and E and minerals such as potassium, iron, magnesium, calcium and iodine.

Currently the microalgae derived foods are marketed as healthy foods and are available in industry as capsules, tablets, powders and liquids. They are also mixed with candies, gums, snacks, pastes, noodles, breakfast cereals, wine and other beverages. The microalgae species widely used include *Spirulina plantesis*, *Chlorella* sp., *Dunaliella terticola*, *Dunaliella saline* and *Aphanizomenon flosaquae* due to their high protein content and nutritional

value. However, in recent years, *Chlorella* and *Spirulina* species are dominating the global microalgae market as they are gaining popularity in the health-food supermarkets and stores.

This is attributed to the nutrient-rich profiles of these species. Similar to human supplementation, microalgae is also a source of food for many aquatic species, ruminants, pigs, poultry and other animals. The microalgal species of *Spirulina*, *Chlorella*, *Tetraselmis*, *Nannochloropsis*, *Nitzschia*, *Navicula*, *Scenedesmus*, *Cryptocodinium*, and *Chaetoceros* are reported to be used as feed for terrestrial as well as aquatic animals.

Extensively used Microalgae

Haematococcus pluvialis is an extensively used microalgae since it can accumulate the highest level of astaxanthin in nature (1.5-3.0% dry weight). This carotenoid pigment is a





potent radical scavenger and singlet oxygen quencher

Chlorella is considered as an important source of various nutrients e.g. carotenoids, vitamins, minerals and is being used in the food product market as well as for animal feed and aquaculture. It contains beta1,3-glucan, which is an active immune stimulator, a free radical scavenger and a reducer of blood lipids. It is also found to be an important health promoting substance in disorders such as gastric ulcers, wounds, constipation, anaemia, hypertension, diabetes, infant malnutrition, neurosis and also has a preventive action against atherosclerosis and hypercholesterolemia by glycolipids and phospholipids, and antitumor actions by glycoprotein, peptides and nucleotides.

Dunaliella salina is a halotolerant microalga, naturally occurring in salted lakes. It is able to accumulate very large amounts of β -carotene & estimated to contain up to 14% of this carotenoid in their dry weight.

Arthrospira (Spirulina) grows profusely in certain alkaline lakes in Mexico. It is broadly used in food and feed supplements, due of its high protein content and excellent nutritive value. It has high γ and is also a main source of natural phycocyanin. It is used as a natural food and for cosmetic colouring (blue colour extract) and as biochemical tracer in immunoassays.



Isochrysis galbana and *Diatrypa vijkianum* (Haptophyceae) produce long chain polyunsaturated fatty acids (LC-PUFA), mainly eicosapentaenoic acid (EPA, 20:5 ω 3) and also docosahexaenoic acid (DHA, 22:6 ω 3), that are accumulated as oil droplets in prominent lipid bodies in the cell. These are also potentially promising for the food industry as a valuable source of LC-PUFA's, in alternative to fish oils, supplying sterols, tocopherols, colouring pigments and other nutraceuticals.

Microalgae as a source of beneficiary components

One of the important characteristic of algae is their pigment. Chlorophyll is the primary pigment in algae and can be used in pharmaceuticals and food product development. It has anti-inflammatory, wound healing and Ca oxalate controlling properties. In combination with this, algae also contain phycobiliproteins and a wide variety of carotenoids which protect them from harmful sunrays. The main carotenoids produced by microalgae are

β -carotene and astaxanthin. β -carotene can be used as a pigment in cheese, butter or margarine etc. Astaxanthin, natural pigment is having high antioxidant property than vitamin C, vitamin E and other antioxidants. Phycobiliproteins which are present in algae are used as natural colourants in food products and also have antioxidant, anti-inflammatory and hepatoprotective property.

Microalgae is rich source of polyunsaturated fatty acids such as omega-3 series, i.e. eicosa pentaenoic acid (EPA) and docosa hexaenoic acid (DHA), which cannot be synthesized by humans or animals & which is ideal in food and feed industry. These help in production of prostaglandins, thromboxanes, etc. which are important for the reduction of cholesterol and triglycerides in the blood as well as the prevention of cardiovascular diseases, atherosclerosis, skin diseases and arthritis.

Microalgae are rich source of protein because of which they are considered as nonconventional source of

protein. Apart from this, they are also good source of essential amino acids which cannot be synthesized in human or animal bodies. Becker (2007) states that the content of amino acids (lysine, methionine, tryptophan, threonine, valine, histidine and isoleucine) in some microalgae is comparable with that of egg or soybean.

Microalgae is also an important vitamins source which includes tocopherols, ascorbic acid, B1, B2, B6, B12, nicotinic acid, biotin and so on as well as macrominerals (Na, K, Ca and Mg) and microminerals (Fe, Zn, Mn and Cu).

Conclusion

Due to the increasing awareness regarding the health aspects of the food consumed, the demand for natural nutritious food is increasing significantly. The right food with a healthy lifestyle can give way for a healthy life. Microalgae, a photosynthetic organism, act as a promising source for various food products and applications due to its rich nutritional value. A healthy diet supplement of microalgae can add to good health.

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LEASE LAND FARMING

NEED FOR A LEGAL FRAME WORK

Introduction

In all agrarian economies, the system of agricultural tenancy in which a landowner does not cultivate his land himself and leases out to others for cultivation against payment of rent plays a key role. At the same time, it was portrayed as an inefficient and exploitative system without examining its impact under different situations (Deiningert.

al.,2012). Between the landlord and tenant, there were several layers of intermediaries all of whom had to be supported by backbreaking labour of the tenants (Haque,2012).As a result, many reforms came in almost all states which not only aimed at giving occupancy right to tenants for all tenanted land, but also prohibited or restricted leasing of land in future. The

Kerala Land Reforms Act (1963) rendered tenancy legally invalid in the state and prohibited future tenancy as well (Thomas and Devi, 2016).

While laws governing land leasing in Indian states vary relating to restrictions, period of lease, tenant rights studies show that all these restrictive land-leasing legislations have led to informal tenancy without security

Complete ban on leasing land, without exception	J&K, Kerala
Leasing out only by certain disabled categories of land owners	Bihar, Telangana, Jharkhand, Karnataka, M.P., Chhattisgarh, Orissa, UP, Uttarakhand and Tripura
No explicit ban on land leasing but restrictive clauses	Other states

(Bhatnagar,2016)

Reasons for land leasing

		Reasons
Leasing in	Small peasant	a) Lack of sufficient area for cultivation b) To earn subsistence for the family c) Lack of employment opportunities
	Rich peasant	a) Expansion of the scale of production b) Profit maximization Leasing out
Leasing out	Big landlords	a) To save capital and the interest on it b) Net income from agriculture may be less than that of the aggregate interest on capital invested in agriculture and income from rent.
	Small peasant	a) Lack of sufficient capital for investment b) A higher income can be obtained by hiring out labour power c) Inconvenient location of the inherited land, which are uneconomic in size

(Patnaik, 2000)

of tenure. There is agreement on the fact that the lease farming continues in India either as share cropping or as fixed rent tenancy, even in states where it is banned (Vijay, 2012). Similarly, Land Reforms Act prohibited the creation of any future tenancies in Kerala, but tenancy very much exists in the state.

A lease is a contractual arrangement calling for the lessee (user) to pay the leaser (owner) for use of an asset. Lease contracts might be in written or oral form.

In Kerala the total holdings constitute 1377.57 lakh holdings of which 85% are small and marginal farmers. In 1995-96, the number of holdings with less than 1 ha area was 59,18,000 (94.08%), making the average holding size 0.15 ha (NSSO, 2013). Over a span of 15 years, the number rose by 11% with average holding size at 0.13 ha ie. average size operated by these

groups is on continuous decline (Viswanathan, 2014).

This makes farming uneconomic due to the economies of scale naturally forcing them to opt for lease land farming arrangements, if they wish to continue the vocation.

Why there is a need?

Agricultural land leasing has hitherto been informal due to legal restrictions imposed by some states, and these restrictions have affected agricultural productivity and growth. Prohibitions and restrictions regarding agricultural land leasing had forced the land owners and lessee cultivators to have informal agreements and thereby deprived the lessee cultivators of the benefits that were normally due to them. Absence of a sound institutional framework facilitating land leasing is a major obstacle in agriculture resulting in poor productivity.

Studies on lease land farming in Kerala revealed

that insecure and informal tenancy had adversely affected cultivator's access to institutional credit, insurance and other support services (Raj, 2018). Such situation fuels the problem of farmer suicides, default on agricultural loans etc.

Besides, tenancy laws in some states are generally very restrictive in the sense that they had almost prohibited agricultural tenancy. Such restrictive laws of states had adversely affected agricultural efficiency and occupational diversification. It is indeed alarming that 10-20% of cultivable land remains fallow across the country. The land use pattern in Kerala shows a decline in total cropped area while there is an increase in cultivable waste and fallow land which has a drastic impact on agricultural production. However, in a restricted land-leasing regime, the fear of losing the land continues even today if the landowners lease their

own lands and migrate out for other activities. All these factors compound the non-realisation of India's agri-potential.

Way forward

A well-defined framework to legalise and liberalise land leasing would address many critical issues. A legal framework seeks to create security among landowners to lease-out agricultural land without fear and invest in non-farm enterprises which is vital for vocational diversification and rapid rural transformation. Moreover, it would have the potential to put to use millions of hectares of fallow land in the country while also providing landless poor and marginal farmers a means of livelihood and protection through credit and insurance cover.

An active lease market would make the system of lease agreement transparent and would improve production efficiency (Cheriyann, 2004). Studies have shown that inclusion of women as co-owners lead to "improved security of tenure and participation in food and agricultural decisions". It will be progressive to recognise women's land rights while taking ahead the land reforms agenda. Such initiatives have gained momentum in Kerala. Collective farming by Kudumbashree units on leased lands is transforming women from farm labourers to farm managers.

At the village level, panchayat could play a lead role in promoting lease land farming by creating land banks, which can act as a formalized institution for safeguarding the interest and rights of lessors

and lessees. Such pro-farmer moves are expected to benefit agriculture and, ultimately, raise farmer's incomes. Thus, ensuring land rights through a legal framework incentivises the cultivators (lessees) to invest in the land resources.

Conclusion

It becomes clear from the studies that land leasing could be an important source of rural poor's access to land and livelihoods, if lease market is activated through a process of legalisation and liberalisation. There exists a direct linkage between tenure security and income security. Ensuring land leasing through a legal framework incentivises tenant cultivators to invest and conserve agricultural land resources, which, in turn, leads to increased land productivity and profitability. As recently recognised by NITI Aayog that land lease should be viewed as an "economic necessity", not mere "feudal agrarian structure". Implementing appropriate land leasing laws should be given highest priority by the state governments. Tenure security of cultivated land is thus an essential intervention to enhance food security.

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Novel Plant-Based Meat Analogues

Sustainable Diet for Healthy People and A Healthy Planet

The current global food system is under pressure from climate (increased temperature, CO₂ production) and non-climate stresses (food production, processing, distribution, consumption and food disposal)

contributing to increased production of greenhouse gases (GHGs) about 21-37 % of total emissions (Lynch et al., 2021). Besides, meat-based food system is critiqued as a major contributing sector for land degradation, biodiversity loss, overuse of water, and increased

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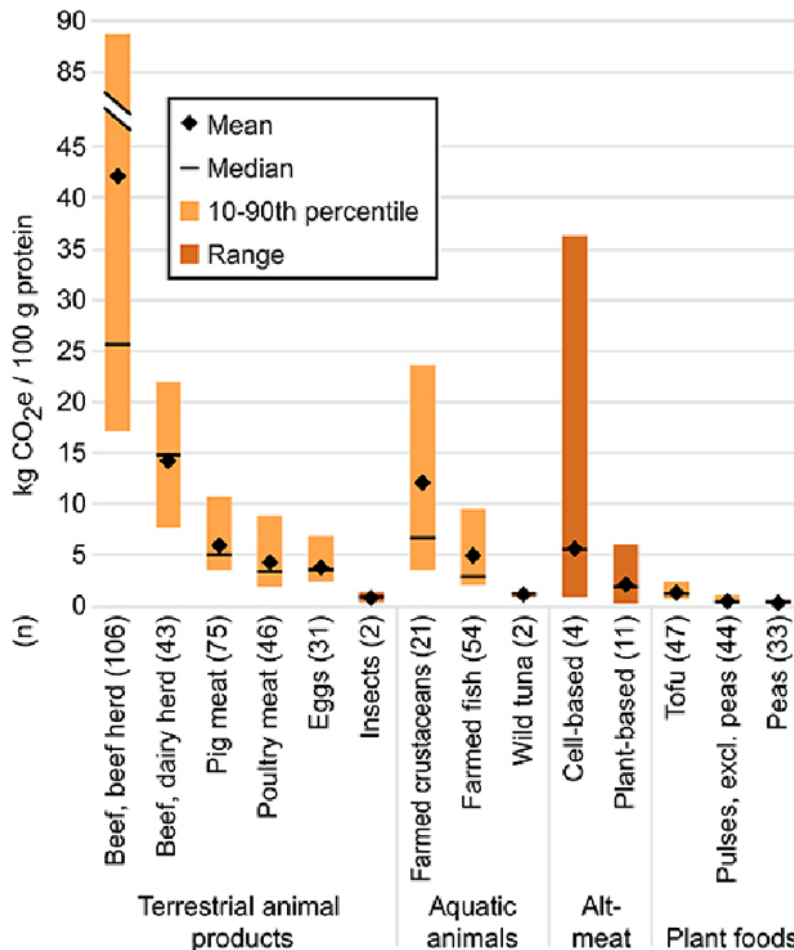


Figure 1: Carbon footprint for 100 g protein production from various food sources. Data and graphic credits: Poore and Nemecek (2018) and Santo et al. (2020)

greenhouse gas generation (GHGs) globally (Van Vliet et al., 2020). According to the 2017 Carbon Balance and Management report, animal rearing generated 11 % of higher GHGs than previous estimations of the Intergovernmental Panel on Climate Change (IPCC) worldwide (Dickinson, 2006). Similarly, Indian agriculture, as well as animal rearing practices, are contributing about 18 % of total GHGs emissions. In this context, Figure 1 shows the amount of carbon footprint produced per 100 g protein production from various food sources and data suggests that

plant-based meat alternatives produce a way lower CO₂ than cell-based meat. Additionally, the ongoing COVID-19 pandemic conveyed the true connection between animal meat consumption and public health implications such as the resurgence of novel viruses (Giliver, 2021).

Therefore, dietary changes towards regional-based, plant-based, organic-based foods have been proposed to address the GHGs production around the globe, without such interventions GHGs projected to increase from 30 to 40 % by 2050 (Vicente and Piorr,

2021). Moreover, increased consumption of plant-based foods and decreased intake of animal-based foods can help to tackle the climate crisis and improve overall health by lowering the risk of communicable and non-communicable diseases (Hu, 2003). Therefore, plant-based foods are gaining quick popularity among health-conscious consumers due to their unique nutritional attributes as well as awareness of the excess use of antibiotics in the animal rearing process. To keep up with this growing consumer trend global plant-based food manufacturers and operators are stepping up to produce plant-based meat, milk, eggs in recent years. According to Grand View Research (2019) global plant-based meat market was USD 3.3 million in 2019 and it is expected to grow at the rate of 19.4 % per year from 2020 to 2027, for instance, projected U.S Plant-based meat market size, by product, 2016-2027 (USD Million) is presented in figure 2. Similarly, India became the second largest growing plant-based meat market contributing to 4.11% of its total GDP. Table 1 shows the list of prominent key players in plant-based meat at the international and national level and plant-based meat substitutes released. On other hand, few startups like Novameat and Redefine Meat are using the high-throughput technologies to 3D print the plant-based meat to resemble the texture of plant-based meat products as original meat product (<https://www.youtube.com/watch?v=JtsyXMuGHBo>).

Plant-based meat substitutes/meat analogs are

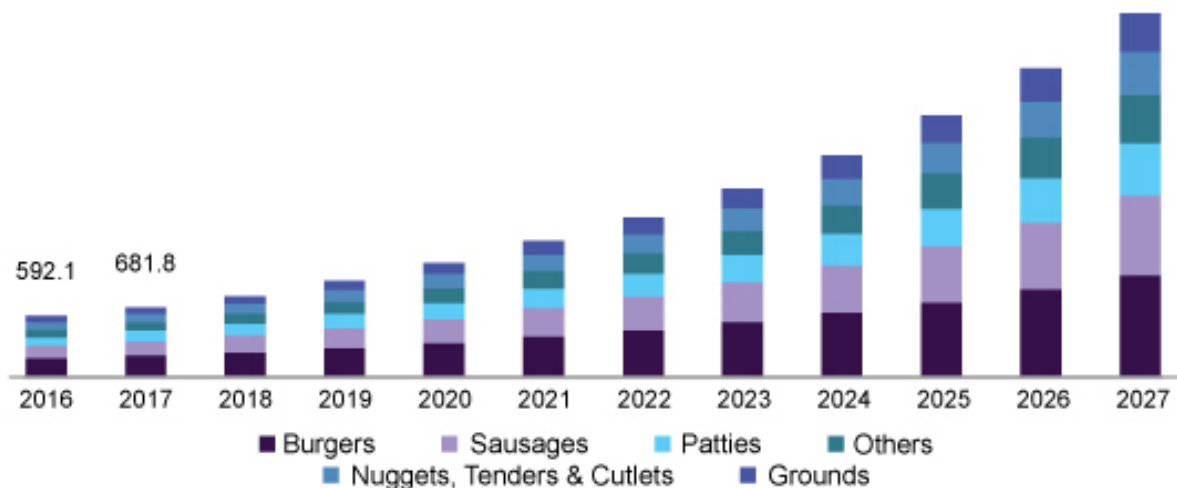


Figure 2: U.S Plant-based meat market size, by product, 2016-2027 (USD Million), credits: www.grandviewresearch.com.

quickly gaining admiration among consumers especially among flexitarians who make up a greater percentage of the market and increased awareness towards health benefits of plant-based meat over animal meat. By definition ‘meat analog’ refers to the food which is structurally the same but different in composition from an animal meat product. It is also referred to as mock meat, imitation meat, substitute meat, vegan meat, or faux meat (Joshi and Kumar, 2015). The main objective of plant-based meat is to replace animal-derived meat in the diet by production of structurally similar meat through manipulation of amino acids, carbohydrates, fats, minerals etc. from plant-based sources as shown in Figures 3 & 4. In this context, Food engineering is taking entirely a new dimension in developing plant-based meat which is beyond anyone’s imaginations. Usage of different ingredients in the development of plant-based meat includes protein, seasonings, salt, and

binders (polysaccharides, hydrocolloids, fibers) which act as thickeners, gelling agents, emulsifiers, and stabilizers.

According to Pat Brown, founder and CEO of plant-based meat giant ‘Impossible Foods’, the future of foods is all about Biochemistry and Science. For example, a plant-based meat is nothing, but imitation meat derived from plant-based sources such as soy, pea, rice, flax, mung bean, etc. Moreover, different types of plant proteins such as globular proteins (present in pea, soy, rice, mung bean) and fibrous proteins (glutenin) are largely used in plant-based meat production to resemble the texture and appearance of animal-based meat products. Therefore, several companies are stepping up for plant-based meat production to meet the growing demand for diversifying proteins of consumers. However, replacing animal meat can be especially challenging given meat texture and functionality role in different meat recipes.

The main challenge is the structural arrangement of proteins derived from plant sources for meeting functional and physicochemical attributes contributed by animal protein such as mouthfeel, texture, appearance (McClements and Grossmann, 2021). In addition, animal protein is highly recommended to meet daily protein requirements with a very less calorific load (FAO/WHO/UNI, 2011) compared to plant-based protein. However, the use of a purified form of plant-based proteins in preparation of meat analogs showed comparable protein digestibility-corrected amino acid score (PDCAAS) and digestible indispensable amino acid score (DIAAS) to animal proteins (Hodgkinson et al., 2018). Moreover, purified or concentrated plant-based proteins are very low in anti-nutritional factors such as phytates, lectins, and certain fibers. Additionally, plant-based proteins are well known for their potential to build and

Table 1: List of prominent key players in plant-based meat market

S.No	Prominent key players in plant-based meat market	Plant-based meat analogues/ substitutes/alternatives
INTERNATIONAL LEVEL		
1	Impossible Foods	Impossible burgers, Impossible sausages
2	Beyond Meat	Plant based patties, beyond burgers, Ground meat, Beyond Beef, Beyond Beef crumbles, Beyond sausages, Beyond meatballs, Beyond breakfast sausages,
3	Maple Leaf Foods	Natural Beacon, vegan hotdogs
4	Vegetarian Butcher	Vegan meatballs, vegan chicken nuggets, vegan sausages
5	Redefine Meat	Vegan burgers, ground beef, sausages, kabab, cigar
6	Novameat	Vegan steak, vegan pork
7	NotCo	Vegan ice cream, milk, and meat
8	Zoglo's	Vegan nuggets, burgers
9	V2food	Vegan pork mince and sausages
10	Baskin-Robins	Non-Dairy Salted Fudge Bar
11	Silk	Plant based Greek style yogurt
12	Good PLANeT Foods	Vegan cheese wedges (available in Pepper Jack, and Smoked Gouda flavors)
13	Wicked Kitchen	Vegan snacks (cookies, crackers)
14	The CO-op	Vegan latte, vegan strawberry doughnuts
15	NOMO	Vegan chocolate
16	Zero Meat	Frozen chilled burgers
17	The Better Meat Co.	'Meat Enhancers' for beef, chicken, crab, fish, pork, and turkey
18	Moving mountain	Vegan burger, vegan hotdog
NATIONAL LEVEL		
1	Plantmade	Vegan scrambled egg
2	EVO Foods	Plant based egg
3	BlueTribe	Chicken Keema and Chicken Nuggets
4	GoodDot	Chicken bites called Proteiz, Veg Achari Tikka, Biryani
5	Vegeta Gold	Vegan chicken, vegan mutton. vegan fish, vegan lollipop, vegan prawn
6	VeZlay	Vegan kebabs, shawarma, cutlets, biryani, noodles, chicken chunks, chicken tikka, mutton tikka
7	Veggie Champ	BBQ Hotdog, sausage, chicken, fillets, burger, mock duck, classical chicken
8	Vegitein	Veggie hotdogs
9	Mister Veg	Fishless Pomfret
10	Greenest	Shami kebabs
11	Imagine Meats	Vegan Kababs, vegan biriyani
12	Good Do—The Vegan Eatery	Patties, kebabs
13	Wakao Foods	Vegan jackfruit meat, burger patty
14	Poke Bowl	Vegan Tuna

A)



B)



C)



D)



A)



B)



strengthen body muscle as well as they tend to grow easily and their cultivation and production on large scale generates a very lower carbon footprint compared to animal rearing. Plant-based protein sources are very good sources of human health-relevant nutrients such as protein, fiber, phosphorus,

manganese, thiamine, folate, and vitamin C & K. Therefore, these plant-based sources are highly suitable and satisfactorily substitute the place of chicken, beef, mutton, and pork for the development of meat analogs. In addition, several food companies are experimenting with new plant-based protein

sources like jackfruit as a plant source for the development of meat analogs due to its excellent texture like meat. For example, Wakao Foods an India-based company manufactured various jackfruit-based meat products such as BBQ jack, Teriyaki jack, Butter jack, Jack burger patty. This large diversity in plant-

based protein sources in the form of delicious meat substitutes/alternatives provides consumers a wider option to fulfill their nutrient requirement as well as to create a better world by reducing carbon footprints, health risks, environmental risks, and animal welfare implications directly associate with large scale animal rearing. In this context, a survey of consumer preference plant-based meat in the USA, India, and China by Bryant et al. (2019) revealed a more significant higher acceptance of plant-based meat substitutes/alternatives in India and China compared to USA consumers. Plant-based meat purchase likelihood was observed very or extremely likely among 56.3 %, somewhat or moderately likely among 32.9 %, and not at all likely among 10.7 % of people under the study (Bryant et al., 2019).

According to Reuters, plant-based foods are surging in Hong Kong and China during COVID 19 pandemic by giving importance to the intake of more plant-based proteins compared to animal-based proteins. However, there is growing consensus about public health perspectives to remain cautious and nuanced about the introduction of plant-based meat substitutes into food supply chain.

Therefore, it is very important to address unexplored factors such as human and environmental health outcomes in response to plant-based vs. animal-based food products because consumer acceptance and healthfulness of plant-based meat substitutes are likely to have an important role to play in our future food supply systems by replacing animal-derived

products.

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Processed food have become an integral part of our food habit which starts from the consumption of coffee early in the morning to relishing milk after dinner. Our ancestors found it palatable when the foods were processed by cooking and they also found an excellent way of preservation through processing. This paved the path for us to take food processing to the extent that today most of the foods consumed are either processed or preserved. Researchers have innovated many possible ways of processing and preservation through which one can store food for years together and can just relish them without cooking. A number of scientific and technological interventions

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AN INSIGHT INTO FRUIT & VEGETABLE PROCESSING

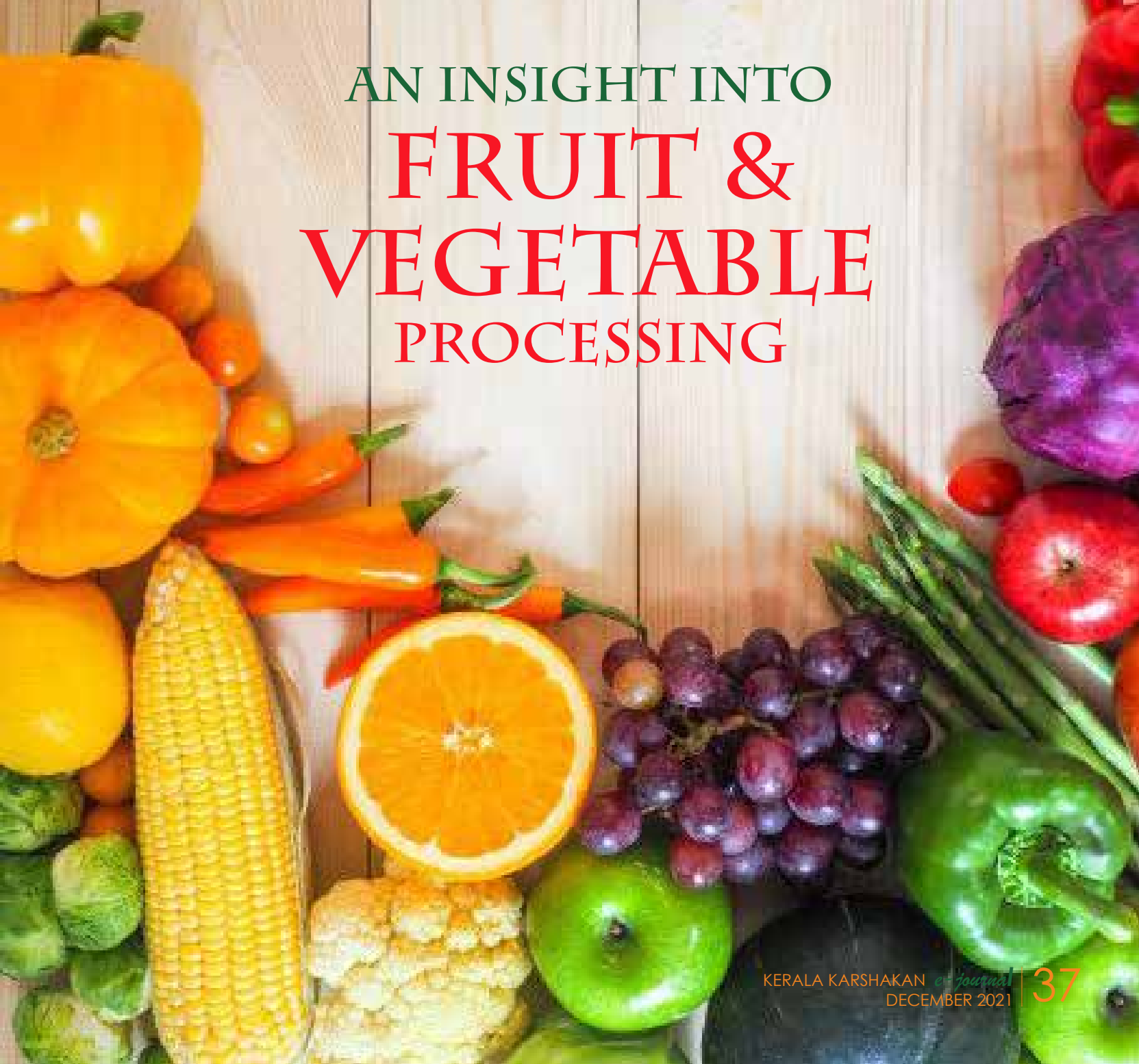


Table 1: Quality parameters of fruits to be considered for processing

Attributes	Factors
Appearance	Size, shape, color, non-defective and non-decay
Texture	Firmness, crispness, juiciness
Flavour	Sweetness, sourness, astringency, bitterness, aroma, off-flavor.
Nutrition	Vitamins, minerals, dietary fibre, carbohydrates, phenols, antioxidants
Safety	Pesticide residue, heavy metals, mycotoxins and microbial contamination

Source: Kader and Barrett (2005)

are required to convert a raw food into a palatable and tasty product available on the shelves of super market.

Fruits and vegetables are such raw products that need many technical steps to get converted it as processed products like beverages, dried fruits and vegetables, jams, fruit powders, pickles, fresh cut fruits and vegetables etc. Fruits and vegetables are perishable in nature and either should be consumed within a short period or it should be preserved or processed into products.

In India, the production of horticultural crops is estimated to be 329.86million tons during 2020-21 from an area of 27.23million hectares. An increased production of vegetables from 101.2 to 184.40 million tons occurred during the period 2004-05 to 2017-18. Not only vegetables, production of fruits also has increased from 50.9 to 97.35 million tons during the said period (<http://agricoop.nic.in>).

Even though India is the world's largest producer of many fruits such as banana, papaya, mango and guava, the post harvest losses in fruits

and vegetables are alarming, accounting for about 4.6-15.9% of the total production (Jha et al., 2015). Currently, fruits and vegetables are processed into frozen and canned pulp, puree, paste, sauces, snacks, dressings, flakes, dices, dehydrated products, pickles, juices, slices, chips, jams, jelly, RTS drinks etc. As per the information available from the Ministry of Food Processing Industries, Government of India, India has exported processed fruits and vegetable products worth around 1.1 billion USD in 2016-17, in which dried and preserved vegetables and mango pulp had a major share. The quality of any processed products depends on the quality of raw materials used. Therefore, usage of matured, firm, pest and disease free and pesticide residue free fruits and vegetables results in high quality end product.

Quality of raw material required for processing

The quality parameters of fruits considered suitable for processing are given in Table 1. India has produced 21.8 million MT of mango during 2017-18 (<http://agricoop.nic.in/>). But processing accounts

to only mere 1 % (Vijayanand et al., 2015). In India, many cultivars are grown in different parts, but not all the cultivars are suitable for processing. The physico-chemical parameters of the fruits are important under consideration in processing. Selection of fruit should be conducted efficiently in order to remove physically damaged, dirty or completely decayed fruits which could spoil the final product (Silva and Abud, 2017). Texture of the ripened fruit plays a very important role in handling and other unit operations during processing. So, the cultivar with high firmness is better suited for processing. Totapurimango is found to have high firmness compared to cultivars likes indhura and mallika (Vijayanand et al., 2015).

Guava production in India during 2017-18 was 4 million MT. Uttar Pradesh is having largest area and production but productivity was found high in Andhra Pradesh. Highest post harvest loss was found in guava fruits (15.88%) compared to other major fruits (Jha et al., 2015). Among the five cultivars of guava grown in north India viz., Lucknow-49,

Allahabad Safed, Lalit, Shweta and Gorakh Bilas Pasand; Lucknow-49 is found to have the best pulp quality for processing (Tiwari et al., 2016).

Tomato is one of the highly processed commodities in India. Different processed products of tomato are tomato puree, sauce, ketchup, chutney, soup mix, dried powder and flakes. Its total production was 19.75 million MT in 2017-18 and ranks second in the world. The average post harvest loss of tomato is around 12.44% which is the second highest after guava (Jha et al., 2015). An estimated 130,000 tonnes of tomato was processed in India in 2015, which is 0.3% of the global tomato processing market. India's annual ketchup consumption is estimated at 13,000 tonnes with a market value of Rs 1.8 billion (US\$ 28 million) (Green Innovation Centre, India).

Benefits of fruit and vegetable processing

Development of any sector depends on its contribution to country's Gross Domestic Product (GDP). In India, agriculture sector is contributing a major share to nation's GDP. About 3% contribution to GDP from food processing industry was observed during 2012-13 with an annual growth rate of 8.4% (MOFPI). Food processing, especially fruit and vegetable processing handles much perishable raw material compared to grains and other foods and hence needs to be properly processed to prevent

the post harvest loss. Processing of fruits and vegetable not only prevents the post harvest loss, it also generates employment and adds revenue to the country. Apart from the economic benefits, processing of fruits and vegetables improves the nutritional quality of the food. Compared to other food groups; fruit and vegetables add color, taste and texture to the diet. In addition being appealing to eyes, nutritionally also fruits and vegetables are categorized as protective foods since they are rich in many health benefiting bioactive compounds. Many epidemiological studies have reported that consumption of fruits and vegetables are beneficial in reducing the risk of non communicable disease development and also enhance immunity (Wallace et al., 2019).

Though fruits and vegetables can be consumed fresh, a major share of many of them such as mango, orange, guava, banana, apple, pineapple, tomato, potato, peas etc are consumed in processed form at high level. Fruits and vegetables contain a number of bioactive compounds other than vitamins and minerals which have been proven for their health benefits (Lupton et al., 2014). The general recommendation for fruit and vegetables intake is at least 400 grams per person per day (five serving of 80 g each day) (FAO, 2003). Indian Council of Medical Research suggested a consumption of about 100 g of fruits in a day. However, consumers are in belief that only

fresh fruits and vegetables are good for health and processed fruits and vegetable products can in fact harm human health. But when we look at the time taken for harvested fruits to reach the consumers' table, it is quite long.

During this transit period a lot of physiological changes happen to fruits and vegetables as they contain about 70-90% water. Moisture loss, nutritional loss and microbial spoilage can occur. Consumption of 100% pure orange juice by children of 2 to 18 years of age for about three years showed a higher percentage of children meeting the Estimated Average Requirement for vitamin A compared to non consumers of orange juice. Concurrently, a significant difference was not observed for the risk of being overweight or obese between consumers and nonconsumers of 100% orange juice (Oneil et al., 2011). All kinds of fruits and vegetables are not available in all places as well as throughout the year since they need different agro-climatic zones and seasons to grow and bear. So, processing of these commodities into dehydrated, pickled, canned or frozen form can make them available year round and can be transported to any region of the world. Processing has not only made fruits and vegetables available all the time, it also reduced the loss during glut in addition to providing nutrients. When the processing methods such as freezing and canning were

compared to fresh commodities it is found that depending on the commodity these processing methods retained the nutritional quality during long term storage (Howard et al., 1999; Hunter and Fletcher, 2002). It is not likely that processing methods enhance the nutrient concentration, but they may make nutrients more detectable instrumentally and perhaps increases the bioavailability (Barret, 2007).

Conclusion

Fruits and vegetables are contributing to Indian agricultural economy significantly. Similarly its health benefits have been proved by many epidemiological studies. Information about the nutritional and health benefits of consuming lots of fruits and vegetables is been given by experts to promote consumption. The Ministry of Food Processing Industries, GOI has created a platform to encourage processing and preservation with the view of minimizing post harvest losses, to increase the trade opportunities, to make available seasonal commodities throughout the year and to provide a nutritional product to the consumers. While processing provides lot of opportunities to the researchers to develop an innovative product with high nutritional values by minimizing the post harvest losses. Therefore, processing and preservation of fruits and vegetables is necessary to provide consumers a healthy, safe and variety of products.

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Introduction

Mangosteen is one the most praised fruits regarded as 'Queen of tropical fruits'. Many people consider it as the 'finest fruit of the world' as it has an exquisite, uncomparable, appealing taste and flavor. Its botanical name is *Garcinia mangostana* and the fruit belongs to family *Guttiferae*. The fruit was originated in Sunda Islands in Indonesia. Mangosteen is known by different names in

different parts of the world. Among Spanish it is called as 'mangostan', to the French, it is 'mangouste' and in Philippines, it is 'mamgis' and so on. In the vernacular languages, it is called 'Mangustaan' in Hindi, 'Ivarumamidi' in Telugu and 'Kaattampi' in Malayalam. It is so praised by the inhabitants of South East Asia and they call it as 'Fruit of Gods' because of its health benefits and delicious taste of the fruits (Radha and

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Mangosteen

*The Queen Of
Tropical Fruits*



Mathew, 2007).

Plant description

Tree: Trees are slow growing, erect with pyramidal crown and can reach a height of 9.5 mtr.

Leaves : Evergreen, short stalked, glossy, leathery and ovate-oblong in shape.

Flowers : Produced at the terminal portion of branches and are usually solitary, tetramerous and bisexual with non functional stamens.

Fruits : Fruits are produced without pollination and fertilization through parthenogenesis. Green fruits turn dark purple or red on ripening and are capped by prominent calyx at distal end. The hard outer shell of this exotic fruit is deep purple in colour and can be opened easily, showcasing the inner white edible flesh with small almond-shaped seeds.

Uses

Mangosteen fruits are consumed fresh as dessert when they are completely ripe and can also be used for preparation of jam, jelly and marmalade. Mature fruits has astringency, are used for preparing medicines and pickles. Immature fruits have high tannin (13 %) content and are frequently used for colouring boats, nets, tanning leather and extraction of colour for various purpose.

Mangosteen health benefits:

Mangosteen has been a part of the traditional medicine of various Asian countries for a very long time. The health benefits of mangosteen is known since 18th century and it has been proven that these benefits are not just mythical. It is a

storehouse of essential nutrients which are required for normal growth, development and overall nutritional wellbeing. Different parts of the fruit and plant are used in the treatment of various diseases and disorders. Here are some of the mangosteen fruit health benefits.

- **Anti inflammatory:** Mangosteen contains a class of naturally occurring polyphenol antioxidant compounds known as xanthones. Xanthones have anti-inflammatory property which is highly beneficial for people who suffer from sciatica pains which cannot be controlled by drug treatment.
- **Prevents flu:** Mangosteens are rich in vitamin C and contains about 12 per cent





RDA per 100g. Being a powerful water soluble anti oxidant, vitamin C provides resistance against flu like infectious diseases and scavenge harmful pro-inflammatory free radicals.

- **Prevents anaemia:** Mangosteen aids in promoting red blood cells and prevents against anaemia. It improves the blood flow by causing dilation of blood vessels which helps to protect us against certain diseases like atherosclerosis, high cholesterol, heart congestion and severe chest pains.
- **Tuberculosis:** Mangosteen

fruit contains strong antibacterial and antifungal properties besides being highly effective in boosting weak immune systems. Its inhibitory action against harmful bacteria is effective for patients suffering from tuberculosis.

- **Gum disease:** Mangosteen acts as a weapon to fight against the gum disease known as periodontitis. The gel of mangosteen helps to cure gum problems.
- **Infections:** Xanthones present in mangosteen have the natural ability to attack fungal and viral infections.

They even help to get rid of certain carcinogens from attacking our skin.

Not just mangosteen fruit, Mangosteen rinds and other plant parts also possess many health benefits.

- Dried powder of mangosteen rind is used in the treatment of diarrhoea, its paste can be used to treat eczema and some other skin disorders.
- A decoction made of mangosteen roots is used for regulating menstruation.
- A decoction made of mangosteen leaves and bark is beneficial in bringing down body temperature and also to treat thrush and urinary disorders.

Conclusion

A healthy body is one of the greatest blessings. But due to the frequent consumption of junk foods and unhealthy life choices, debilitating diseases have become rampant affecting both the young and old people. We can control the adverse effects of junk foods by replacing them with healthier foods in our diet. Fruits and vegetables are of course essential in this regard. And consuming mangosteen can do wonders for our health. The miraculous fruit contains phenolic compounds such as xanthones and procyanidins prevents various diseases and helps in maintaining a healthy body.

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Automatic Family Drip System (FDS)

Sustainable Technology for Urban Farming in Vegetable Production

Introduction

Farm fresh vegetable production is gaining much importance in urban area. This is a turning point for agriculture in urban and peri-urban areas, to introduce new technology like DIS. Nowadays urban people take due care by cultivating vegetables in their roof-top, because of high pesticide residues in market produce. But urban farming initiatives lack supervision and guidance in whole cultivation practices especially in irrigation. Here comes the role of low cost drip irrigation to solve acute water shortage and labor problem.



Drip Irrigation Installation at Kallara

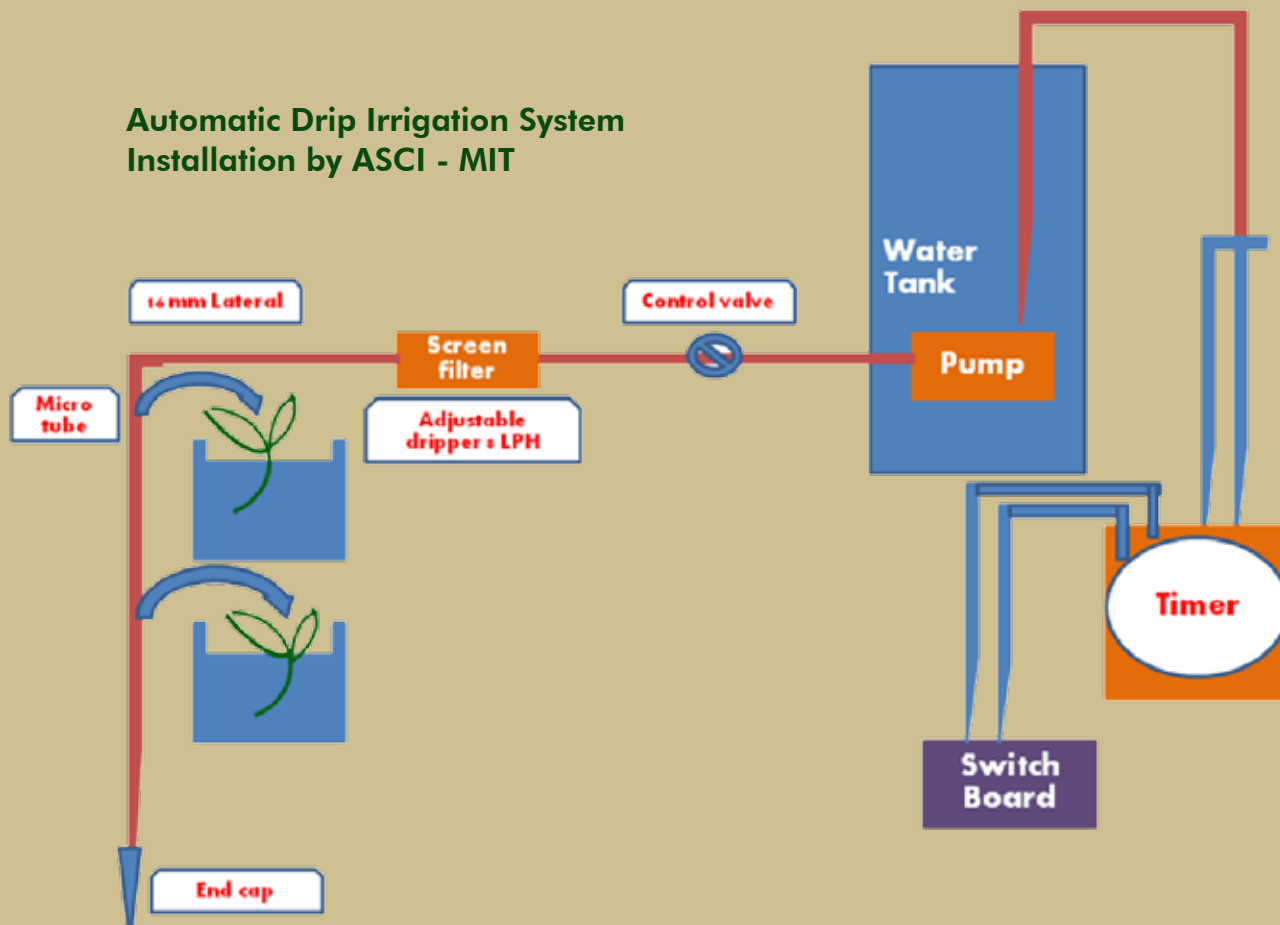
Automated DIS helps to irrigate plants in sixty poly bags in an automated manner. Drip irrigation applies water drop by drop to the root zone area of the plant for effective utilization. This model precision irrigation helps to manage water resources in a

proper way.

Main advantage of this is that the time and duration of the irrigation sequence can be programmed with very little or no manual intervention. Each plant will get a minimum of 1ltr. of water in 1 hour. Adjustable

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Thiruvnanthapuram – 695 543

Automatic Drip Irrigation System Installation by ASCI - MIT



dripper discharge rate is 8 ltr./hr. The system contains screen filter that ensures that the emitter does not get clogged. The advantage of this system is that its durability is at least five years and that only water as required will be used for irrigation and that wastage of water can be minimized.

In summer, plants face severe water stress and water shortage and this will lead to permanent wilting point. Absence of irrigation affects vegetative growth, which directly influences the yield of the crop. The closure of the stomata is the first symptom of plant water stress. This is followed by the plant wilting and finally damaging the plant through overheating. Crop loss occurs once the plant wilts. Part time cultivators and aged people can easily adopt this technology which gives easiness in irrigation.

Cost

Drip kit	1250/-
Booster pump	1000/-
Timer	2500/-
Installation charges	1250/-
Total	6000/-

Being a labour enhancing technology, automatic drip irrigation avoids man power utilization for watering the plants at the right time, right quantity, right place and right manner. Drip kit, digital timer and 0.2hp pump can be used as a unit to irrigate plants in scheduled time. Technically, per day crop water requirement for vegetable is 2 – 4 ltr. Total cost for the entire system come around Rs.6000/-. The system can be extended to more than 60 plants.

Digital timer

Automatic timer is a convenient option in a drip

irrigation system. Battery powered timers let you to set the frequency and duration of watering schedules for different applications. With automatic shut-off, you can set the timer and leave the place. We can pre -set seven programmes in a timer for whole days from Sunday to Saturday. Timer out must be connected to switch board and timer in to the pump. Simple installation method attracts people to adopt the technology.

Booster pump

0.2hp submersible pump, pumps the water from the tank to the laterals. Pump is needed when the tank is kept on the level of the terrace itself. Minimum of less than 1 kg/cm² pressure is needed to obtain the desired discharge. If the tank is above the ground level at a height of more than 2m, by gravitational pressure itself water directly



Digital timer

flows without pumping pressure. Connect 16mm lateral to pump to obtain the sufficient pressure.

Drip kit

Drip kit consists of 16mm LLDPE lateral, adjustable dripper / emitter (8 LPH), 6 mm pin with micro tube, screen filter, fittings and accessories.

Laterals (irrigating lines):

These are the smallest diameter pipelines of the system. They are fitted to the manifolds, perpendicular to them, at fixed positions, laid along the plant rows and equipped with water emitters at fixed frequent spacing.

Emitters: A water emitter for irrigation is a device of any kind, type and size which, fitted on a pipe, is operated under pressure to discharge water in any form: by shooting water jets into the air (sprinklers), by small spray or mist (sprayers), by continuous drops (drippers), by small stream or fountain (bubblers, gates and openings on pipes, small diameter hoses), etc.

Sixty numbers of poly bag can be irrigated by using this drip kit having a discharge rate of 1LPH / Poly bag. Screen filter, filter the water efficiently @ 700 litre per hour. Drip kit will last for more than two years without any fail.

Durability

The laterals are made of LLDPE (Linear Low Density Poly ethylene) material and also mixed with carbon black polymer resin, block UV rays and increases the life of lateral pipe. The advantage of this system is that its durability is at least five years and that only water as required will be used for irrigation and that wastage of water can be minimized

Care to be taken:-

- Clean the filter every week to avoid clogging
- Clean the dripper, flush out the lateral for the removal of suspended particles

Farmers' Feedback:-

According to farmers



Submersible pump

feedback, drip irrigation is widely recognized as one of the most efficient methods of irrigation. They said that the water use was cut down by 30-70 percent and the yields increased by 25 percent. Additional advantages of drip irrigation include reduction in weed growth, better quality yield, less labour requirement, less electric power consumption, early maturity of crops and applicability even with the use of mildly saline water. The main advantage of it is that the vegetables obtained are free of harmful chemicals that are usually associated with the vegetables obtained from the market that are sprayed with fertilizers.

Technical Programmes Organized by KVK in Drip Irrigation Systems:

Water is a limited natural resource. It has to be judiciously used for irrigation to avoid wastage. Manual watering of plants results in lot of wastage that must be avoided with adaptation of suitable irrigation techniques. One such system



is drip irrigation. Going a step further, automation of this technique reduces the drudgery faced by farmers apart from water savings.

Therefore, as a part of Front Line Demonstration of ICAR for the year 2014 and 2015, KVK demonstrated automatic

DIS for terrace vegetable cultivation in urban areas. Field demonstrations by KVK on micro irrigation for various crops helped the farmers in efficient use of water and improving soil properties that in turn increased the crop productivity. The success of the field demonstrations

of micro irrigation helped broaden its acceptance in the farming community of Thiruvananthapuram District. This concept is being adopted by more and more farmers.

With the technical support of KVK, more than 150 Automatic DIS units have been installed in Kerala through training and other extension activities. KVK in association with KIIDC has trained more than 500 beneficiaries under Urban Agriculture Project in Thiruvananthapuram Corporation area. KVK also carried out consultancy services for the benefit of farmers interested in drip irrigation based farming system. In addition, with the financial support of Agricultural Skill Council of India, Mitraniketan KVK (ICAR) has conducted skill oriented training to rural youths as a part of one month programme. Quite a large number of micro technicians are available in TVM district, trained by Mitraniketan KVK, who have the expertise in installation of these DIS in homesteads and in farms.

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