

## V SUMMARY AND CONCLUSION

Microgreens are young greens 2.5–7.6 cm (1–13 in.) tall, picked 7–14 days after germination and sold with the stem and attached cotyledons (seed leaves), depending on the species. Microgreens, despite their small size, may produce a wide range of powerful tastes, vibrant colours, soft textures and desired nutrients. As a result, microgreens may be utilized as a new element in salads, soups, and sandwiches to enhance colour, texture, and/or flavour, as well as an edible garnish to liven up a range of main courses.

Since there has been a surge in desire for healthy eating, gourmet cuisine, and indoor gardening in developed nations, micro greens have gained popularity.

Hence the present study entitled **“Cultivation and Nutritional Profiling of Selected Varieties of Microgreens and their Acceptability in Incorporated Recipes”** has been undertaken to achieve the following objectives: To study the type of medium and other growing conditions required for the cultivation of the selected microgreens, To study the growth of selected varieties of microgreens and to analyze the nutrient content, toxic elements and their shelf life, To develop recipes with grown varieties of microgreens and to analyze their sensory characteristics., To analyze the Knowledge, Attitude and Practice (KAP) of the selected subjects with respect to microgreens and to impart awareness to selected subjects regarding the cultivation techniques and benefits of microgreens.

The research study was approved by the Institutional Human Ethics Committee of Avinashilingam Institute of Home Science and Higher Education for women AUW/IHEC/FSMD-19-20/XMT-29 (Annexure I).

The study was conducted in three phases: Phase I: Growth and Cultivation of Microgreens, Phase II: Analysis of Micro-greens and Formulation of Microgreen Based Recipes, Phase III: Determination of Knowledge, Attitude & Practices (KAP) on Microgreens and Creating Awareness on Cultivation and Importance of Microgreens among selected subjects (Self Help Groups - Kudumbashree).

**In the Phase I, the Growth and Cultivation of Microgreens was studied.** Six types of microgreens were selected as samples for the conduct of study. The selected microgreens were (Mustard Microgreen (*Brassica juncea*) from Brassica family, Chia Microgreen (*Salvia hispanica*) from Mint family, Fenugreek Microgreen (*Trigonella foenum-graecum*) from the Fabaceae family, Beetroot Microgreen (*Beta vulgaris*) from the Amaranthaceous family, Sesame Microgreen (*Sesamum indicum*) from Pedaliaceae family and Radish Microgreen (*Raphanus sativus*) from Brassicaceae family. These varieties were selected as they had higher yield and the growth was faster compared to other microgreens.

The minor tools and other accessories selected for the cultivation of microgreens include potting container, cocopeat, vermicompost and black soil mixed with sand, microgreen seeds, water sprayer, aluminum foil paper and scissors.

Mud pots with the diameter of 34 and height with 18 centimeters were selected. These were an eco-friendly option and also the survival rate of greens was higher in mudpots (Saifullah, *et al.*, 2010). The growing media selected was Coco peat, Black Soil, Vermicompost respectively.

The selected six varieties of microgreens seed packets were purchased from the nurseries. Aluminum foils were used to cover the pot after sowing the seeds to black out the seeds 8 hours. Water sprayer was used to spray water evenly on the sown microgreen seeds. Scissors were used to harvest microgreens once it attains maturity. The scissors were always sterilized before use.

A pilot study was conducted to determine the best growing media, watering method and lighting condition suitable for the growth of microgreens. The pilot study was carried out with mustard microgreen. The different growing media taken for the growth of microgreens include black soil, vermicompost and cocopeat respectively. Kitchen waste can be utilized to produce vermicompost.

The watering methods considered were top and bottom watering. The top watering involves the sprinkling of water on the top portion of the mud pot sown with greens. The micro green was watered on its top layers using the water sprayer. The bottom watering method involves having stagnant water in contact with the

bottom portion of the mud pot containing the media and micro green seeds. A base was selected where water was sprayed and the mud pots with holes in the bottom were placed on top of it.

The lighting methods studied include direct lighting (full exposure to sunlight), partial lighting (indirect exposure to sunlight) and *Light-Emitting Diode (LED)* lighting. The microgreens were analyzed by subjecting them to various intensities of light.

Microgreens were grown in mud pots and the growth pattern was further analyzed. The cultivation is described in four steps : Step I : Preparation of the Mud pots, Step II: Sowing of seeds, Step III: Covering the mud pot, Step IV: Watering the seeds.

The mudpot was made wet by sprinkling some water. Once the media is evenly spread, water was sprinkled on to it. Later the entire seeds in the packet was sown in the media. After sowing seeds, the mud pot is covered with an aluminum foil and placed in a dark area. Twice a day, the aluminum foil was removed and water was sprinkled on top of the seeds. The growth of microgreens was analyzed each day and findings were recorded. The length of the stem and leaf size of the microgreens were determined using the vernier caliper. Based on the pilot study results, the best growing media, watering methods and lighting were finalized for the conduct of further study on the six selected micro green varieties

The design of experiments was used to assess the effect of different variables on the growth of microgreens. For each selected microgreen, parameters such as the leaf length, leaf size and stem length were measured to analyze the impact of each variable.

Among the three selected media namely vermicompost, black soil and cocopeat, the growth of microgreen in cocopeat was found to be the best and hence cocopeat was selected as the preferred media for the conduct of further study on the six selected micro green varieties.

The microbial analysis and nutrient content in Cocopeat was analyzed and reported as a medium which is relatively resistant to harmful microbial and fungal growth, and an ideal medium for the cultivation of microgreens .

Based on the lighting maximum growth was observed in the indirect lighting method. Hence this method of lighting was chosen for further cultivation. Among the two types of watering methods, top watering method yielded the best output of microgreens when compared to the bottom watering method. As a result it was resolved to use top watering method for further study

**In the phase II Analysis of Micro-greens and Formulation of Microgreen Based Recipes were performed.** The analysis was carried out to determine the Micronutrients, Phytochemicals, Heavy Metals present in selected microgreens. The shelf life of the selected microgreens was also determined.

The analysed micronutrients in Cultivated Microgreens were compared with their Mature Counterparts (Regular Microgreens). Vitamins including Vitamin A, Vitamin D, Vitamin E, Vitamin K, Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic Acid and Folic Acid and minerals like Calcium, Phosphorous, Iron, Selenium, Potassium, Sodium, Magnesium, Fluoride, Manganese, Zinc and Copper were analyzed using the AOAC method.

Antioxidant and Phytochemical content such as flavonoids, total antioxidants, chlorophylls and total carotenoids were analyzed in the selected microgreens. The presence of heavy metals such as Lead, Cadmium, Mercury and Arsenic was analysed.

The shelf-life analysis of microgreens was conducted in different storage conditions using different storage containers. The microgreens were stored in food grade plastic container, glass container, stainless steel container and paper bag. The shelf life was determined in normal room temperature and refrigerator temperature and the visible changes were noted.

After the formulation of microgreen based recipes, determination of nutritive value and sensory evaluation was done. Nutrients such as calories, carbohydrates, protein, fat, fiber, calcium, phosphorous, potassium, iron, zinc, vitamin A, vitamin C and vitamin E were calculated using Indian Food Composition Table, 2017. The Sensory Evaluation of the developed Microgreen based Recipes were done by semi-trained panel members using a nine-point hedonic rating scale. Based on the score

obtained during the evaluation, the dishes were graded from most acceptable (highest score) to least acceptable (lowest score). Each of the panelists tasted the recipes and gave scores from 1 to 9, for each sensory parameters like appearance, colour texture, taste and flavor, where 9 indicates the best acceptability and 1 the least acceptability. Based on the scores the overall acceptability was determined out of 45 and the most acceptable recipes were determined in each course.

**In the Phase III, Determination of Knowledge, Attitude and Practices (KAP) on Microgreens and Creating Awareness on Cultivation and Importance of Microgreens among Self Help Groups (Kudumbashree) was done.**

Initially the Assessment of Pre-Knowledge, Attitude and Practices (KAP) on Microgreens among Self Help Groups (Kudumbashree) was carried out. For this married women of age group between 35-65 from the self-help groups situated at Kottayam district, Kerala. women were selected for the study. The sample size was determined using the formula by Vishwakarma (2017). Based on the formula, the sample size was determined as 81 numbers, and same number of subjects were selected for the conduct of the study. The samples were selected using the purposive random sampling method.

Knowledge was assessed using the Interview schedule that contains background information and socio economic status of the subjects. Knowledge regarding importance of microgreens and presence of nutrients in the same, consumption pattern of greens and importance of kitchen garden were assessed from the selected subjects.

Attitude questions on the need of microgreen farming, general attitude towards the microgreen cultivation, attitude that the microgreen seeds are not available for purchase and expensive for cultivation were analysed.

Practices or behaviours are the observable actions of an individual in response to a stimulus. The questions regarding the practice of microgreen farming in home garden, encouraging the consumption of microgreens in family and the practice of continuing the microgreen farming in future were recorded.

The interview schedule was structured in such a way that majority of the questions were of Yes or No type. The correct answers were given 1 point and the wrong answers were not given any score (zero). The total score was fixed to 25. The samples who got more than 10 points were considered as having reasonable knowledge and those having a score of less than 10 were considered to have less awareness. Before the assessment, the subjects were oriented about the study and this helped in smooth conduct for collection of data.

After the pre assessment, awareness was imparted to the selected subjects in Self Help Groups (Kudumbashree) on cultivation and importance of microgreens. A live training session was conducted to the selected subjects on the cultivation techniques of microgreens and its importance for self-help groups. The sessions were conducted with the help of the minor tools and the necessary accessories used for the cultivation process of microgreens like mud pots, microgreen seeds, cocopeat and water sprayers.

After the awareness creation, the Post Awareness Knowledge among Self-Help Groups (Kudumbashree) on the Cultivation of Microgreens were assessed. The assessment was done using an interview schedule (Annexure IV). The scoring was similar to the pre-awareness scoring. The pre awareness and post awareness knowledge scores were recorded and analyzed to determine the impact of awareness.

**The Salient Findings of the Study are Summarized below:**

**Growth and Cultivation of Microgreens / Results of the pilot study:**

The pilot study aided to determine the best growth media, lighting condition and watering method suitable for the growth of microgreens. The microgreens exhibited different changes based on the growth media, lighting condition and watering methods. Mustard microgreens was selected for the conduct of pilot study.

**Determination of Growing Media for Cultivation of Microgreens**

- The mustard microgreens grown in the Vermicompost was weak and unsuitable for consumption.
- Microgreens grown in the Black soil were found to be having yellow discoloration at 3<sup>rd</sup> day of cultivation.

- In the cocopeat medium, adequate growth was observed in terms of increased leaf size and stem length.
- Analyzing the growth of mustard microgreens from day 1 to day 7 in different medias the cocopeat had a very good yield. Therefore, Cocopeat were selected for the further conduct of the study.

#### **Analysis of the Growing media used for the Cultivation of Microgreens**

- The cocopeat was tested to determine the nutrient content of the medium in which the microgreen were grown. Tests were also done to elicit the microbial counts in the growth media.
- The pH value of the medium was 7.2, which depicts that the peat is basic in nature. The average Phosphorus content in the growth media was 12.6-13.01 mg/kg and Potassium content was 4.1-4.31 mg/kg. The growth media contains the total nitrogen content of 4.09 percent. The organic carbon present in cocopeat was 47.4 percent, which is essential for plant fitness in natural environments.
- The total bacteria found in peat was maximum (76 CFU/g of sample) on the 7<sup>th</sup> day. The total fungi was high on Day 6 that was 23 CFU /g of sample. The actinomycetes was found to be 7 CFU/g of sample on Day 5 and 7, and on Day 6 the actinomycetes count was 5 CFU/g of sample. The Phosphobacteria was present in more on the 7<sup>th</sup> day with a 41 CFU/g of medium. The amount of Pseudomonas sp. were high (67 CFU/g of the sample) in the 6<sup>th</sup> Day of cultivation. The count of Azotobacter was reported to be high on day 7 with CFU of 27 per gram of sample. The count of Azospirillum and rhizobium was 0 CFU/g of sample.

#### **Analysis of lighting pattern and watering methods used for the cultivation of microgreens**

Microgreens were grown in the cocopeat medium under different conditions. The different conditions were categorized into three treatments based on the lighting such as Direct Sunlight (Treatment I), Indirect Sunlight (Treatment II) and LED Light (Treatment III) and each treatment was categorized into two, in which one set of

microgreens was top watered and other bottom watered. Based on the lighting pattern and watering methods visual appearance of the microgreens was observed and noted.

- The microgreens subjected to Direct Sunlight (Direct lighting) and Top Watering were Slightly Bending at the 7<sup>th</sup> day. The Leaves and stems appeared to be thin and weak. In a treatment with Direct Sunlight (Direct lighting) and Bottom Watering, Severe Bending at the 7<sup>th</sup> day was observed. The stem were long and frail.
- On Indirect Sunlight (Partial Lighting) and Bottom Watering treatment, the leaves of microgreens shrank at 6<sup>th</sup> day and the stem started to bend on 7<sup>th</sup> day. The microgreens under Indirect Sunlight (Partial Lighting) along with top Watering had a Perfect stature.
- Smaller leaf size and Slight Bending of leaves at 7<sup>th</sup> day was observed among microgreens treated with LED lighting and Top Watering treatment. In the LED lighting treatment with Bottom Watering, Severe Bending was observed on the 7<sup>th</sup> day and the water started to clog and the stems rotted.
- Hence based on the pilot study it was concluded that cocopeat is the best suitable media, partial/ indirect lighting was found to be the best lighting condition and the top watering was the suitable watering method for the efficient growth of microgreens.
- After determination of the best growing conditions, all the selected six microgreens were cultivated and the growth was analyzed.

#### **Analyzing the Growth of Cultivated Microgreens**

- Each microgreen was cultivated and the stem length, leaf size and leaf length were measured for seven days. The growth of each microgreen was compared for its leaf and stem length from day 3,5 and 7.
- The leaf size and stem length of fenugreek microgreens was maximum compared to the other microgreens on day 3 and day 5. On the 7<sup>th</sup> day, the radish microgreen had the largest leaf that was 0.82 inches. And the stem length of fenugreek microgreen was the maximum (1.78 inches) on day 7.

In regard with the weight of microgreens at the time of harvest, the mustard microgreen weighed the most that is 28.34 g followed by fenugreek microgreens (27.12 g) and sesame microgreen (24.5 g). The chia microgreen weighed the least, that is 15.02 g.

- The Mean Difference Between Stem Length and leaf size of the Selected Microgreens from Day 1 to Day 7 was analysed using One-Way ANOVA. Significance was observed between the stem length and microgreen on day 1, day 2, day 3, day 4 and day 6. Between the leaf size and microgreen significance was observed on day 1, day 5 and day 6. The growth pattern of the microgreens was analyzed with design of experiments for determination of the impact of different variables on the growth of microgreens.

#### **Analysis and Comparison of Vitamin Content in Selected Microgreens with the Mature Counterparts.**

Beet microgreen had the highest Beta carotene (48.8 mcg) than its mature counterpart and all other microgreens. The tender shoots had more beta carotene than the mature parts. Chia microgreen and radish microgreen did not contain Beta carotene. Vitamin D was not present in all the selected microgreens. Mustard microgreen had the highest amount of Vitamin E (2.89 mg) than its mature counterpart and all other microgreens. The Chia microgreen had highest amount of Vitamin K, that is 302 mg. The mature counterpart of Chia microgreen had more Vitamin K than other matured microgreens.

Vitamin C a potential antioxidant is present more in Mustard microgreen (89.5mg). The Vitamin C content of the mature counter parts was low. Sesame microgreen did not contain Vitamin C. Vitamin B1 was high in Fenugreek Microgreens (8.3 mg) than the mature part. Vitamin B2 (4.17 mg) and B3 (5.83 mg) was more in chia microgreen. Radish microgreen did not contain Vitamin B1, B2 and B3. Vitamin B5 was present more in radish microgreen followed by its matured part. The Mustard Microgreen, Beet Microgreen, Chia Microgreen did not contain Vitamin B5. Vitamin B9 was present more in Fenugreek Microgreen (36 mcg) followed by Radish microgreen (34.6 mcg). On the whole, the young parts had more vitamin content than the mature counter parts.

### **Analysis and Comparison of Mineral Content in Selected Microgreens with the Mature Counterparts**

The tender chia microgreens had the highest amount of calcium (402 mg) and potassium (860 mg). The sesame microgreen had the highest amount of iron (15.0mg). Mustard microgreen had the highest amount of selenium (71.47 mcg) and potassium (694 mg). The radish microgreen did not contain iron, selenium, fluorine, manganese, zinc and copper. The fluorine content was present only in sesame microgreens, the quantity was less but tender part (0.31 mg) had a higher concentration of fluorine than the mature part (0.20). The Manganese content was high in chia microgreen and copper was high in sesame microgreen.

### **Phytochemical Content in Selected Microgreens**

The chlorophyll a was present in higher concentration in mustard microgreens. Sesame microgreens had the higher concentration of chlorophyll b (0.43 mg), and Flavonoids (465.8 mg). The antioxidant activity was also higher in the sesame microgreens. Hence the sesame microgreen had the highest concentration of phytochemicals than the other selected microgreens.

### **Heavy Metals in Selected Microgreens**

Heavy metals such as lead, cadmium, mercury and arsenic were analysed using AOAC.15.01 method. The results shows that no elements were in detectable level and all the microgreens were found to be safe.

### **Shelf Life of Selected Microgreens**

The characteristics of microgreens stored in food grade plastic container, glass container, stainless steel container and paper bag were analyzed for appearance, color, shape and other characteristics were analyzed visually and physically for three days.

On Day 1, no changes were observed in the microgreens and the leaves were fresh both in the refrigerator and at room temperature.

On Day 2, microgreens stored in paper bag were wilted very much, which made it unsuitable for consumption. Microgreens stored in plastic and glass containers were fresh till Day 3.

### **Formulation of recipes with Cultivated microgreens (n= 80)**

Different courses of microgreen recipes were formulated and prepared. The course includes starters, accompaniments, main course, desserts, salads, juices, ready to eat and ready to cook foods. Ten recipes in each of the above categories were prepared.

### **Sensory Evaluation of the Microgreen based Recipes**

- All prepared recipes were sensory evaluated.
- Among the Ready To Cook products, instant green payasam mix ( $44.3 \pm 0.21$ ) and instant sambar mix ( $44.3 \pm 0.20$ ) scored the highest. The green leaves steam Cake Powder scored the least ( $37.3 \pm 0.24$ ).
- Among the Ready To Eat Products, green cookies were more acceptable and scored the highest ( $44.5 \pm 0.31$ ) and the green bhelpuri scored the least with a mean sensory score of  $38.1 \pm 0.38$ .
- Among the accompaniments, green dal curry and green mezhukuperatty were more acceptable and scored the highest ( $43.2 \pm 0.32$ ), ( $43.2 \pm 0.61$ ) respectively. the green pachadi scored the least with a mean sensory score of  $38.24 \pm 0.20$ .
- Among the main courses, green kozhukatta was highly acceptable with a mean score of  $44.6 \pm 0.31$  and the green chappathi was least acceptable ( $38.2 \pm 0.31$ ).
- Among the starters, green dal vada was highly acceptable with a mean score of  $44.6 \pm 0.24$ . The green bajji scored the least with a mean sensory score of  $40.6 \pm 0.31$ .
- Among desserts, green khoa was highly acceptable with a mean score of  $43.6 \pm 0.49$ . the green fruit yoghurt scored the least with a mean sensory score of  $37.2 \pm 0.44$  and was least acceptable.
- Among the salads, the Protein green salad scored the highest ( $42.3 \pm 0.38$ ) and the Classic green salad scored the least ( $37.1 \pm 0.12$ ).
- The Green Apple Juice scored the highest ( $44.4 \pm 0.50$ ) and Mustard Shot scored the lowest ( $35.5 \pm 0.41$ ). among the juices prepared.

**Background Information of Selected Subjects for Determination of Knowledge, Attitude and Practices (KAP) on Microgreens and Creating Awareness on Cultivation and Importance of Microgreens among Self Help Groups (Kudumbashree) was done.**

**Age and Religion of the selected subjects**

- The majority (48 percent) of the subjects belonged to the age group of 55-65 years, 40 percent of the subjects were at the age group of 45-55 years, and the least (2 percent) of subjects were between 35-45 years.
- In regard with the religion, majority (43 percent) of the subjects were Hindus followed by Christians (32 percent) and Muslims (25 percent).

**Educational Qualification of the Selected Subjects**

- Majority of the subjects had an undergraduate qualification (25 percent).
- Among the selected subjects, 11 percent had minimal qualification of SSLC.
- Another 10 percent had completed the Higher secondary examination /schooling.

**Occupation of the Selected Subjects**

- Among the selected subjects 11 percent were teachers, followed by 22 percent home makers.
- A least percentage of 3 percent were accountants and four percent were farmers.

**Socio-Economic Status of the Selected Subjects**

- Subjects of about 18 percent belonged to the upper class category.
- Subjects at Upper middle and Lower middle class were 20 percent and 22 percent respectively.
- Minimum percentage (3 percent) of the selected subjects belonged to the lower class.
- As the women from lower socio economic status were mostly daily wagers, they were not able to take part in the study and hence the participation number was less.

### **Type of Family of the Selected Subjects**

- Majority of the subjects belonged to nuclear family (93 percent) and none of the subjects belonged to extended family.
- A minimum of seven percent subjects lived as a joint family.

### **Marital Status of the Selected Subjects**

Majority of the subjects were married (84 percent) and about 12 percent were widows. Only a minimum of four percent of the subjects were single/ unmarried.

### **Food Frequency Pattern of the Selected Subjects**

- Cereals, grains, pulses, legumes, vegetables, green leafy vegetables, spices, condiments, nuts and oil seeds were consumed by all the subjects on a daily basis.
- The other food groups such as milk and milk products, roots and tubers, fruits, meat, egg and poultry were also consumed daily by majority of the selected subjects on a daily basis in comparison with other food groups.
- Fruits were consumed more than other foods on a weekly basis.
- Among the selected subjects, about 2.46 percent of the subjects claim they never consume roots, tubers, meat, egg and poultry.

### **Knowledge on Microgreens among Selected Subjects**

- According to the KAP Assessment, 95 percent of the subjects were not aware of microgreen seed, their availability for sales, growth media of microgreens and it is not surprising that they were also not consumers of microgreens.
- Only three percent were aware that microgreens are rich in micronutrients.
- Only two percent of the subjects claimed that they like the taste of microgreens.
- Among the selected subjects 96 percent were not aware about the health benefits of microgreens. None of the selected participants had awareness on shelf life of the microgreens.
- More than 95 percent of the population had no knowledge on the storage and cultivation of microgreens.

- Maximum of the subjects claim it's a plant (5 percent) followed by subjects who claim it as a sprout (7 percent). About 77 percent of the subjects do not know what microgreens are.
- All the population wanted to know more about microgreens and were ready to grow microgreens if proper training is given.
- Most of the subjects (92 percent) claimed that they need a booklet containing all the steps of cultivation that would serve as reference for future.
- Among the selected subjects 31 percent agree that they can put in the required amount of work needed for the production of microgreens.
- And 46 percent of the subjects have strongly agreed that they think, they have the technical ability to produce microgreens in their farm within next five years.

#### **Attitude towards Adoption of Microgreen Farming**

- All the selected subjects strongly agrees to the statements such as governmental support for microgreen cultivation, local consumers would not be willing to pay high for cultivation and on consultations and advices regarding microgreen farming.
- Majority (91 percent) strongly agrees that microgreen farming is complex.
- Among the selected subjects about 87 percent of the subjects strongly agrees that without using chemicals high pest infections may occur.
- Twenty one percent of the subjects strongly agrees that information on microgreens are very difficult.
- Majority (83 percent) of the selected subjects strongly agrees to the statement that there is a lack of subsidies and only a 3 percent disagreed.
- Fourty four percent of the subjects strongly agreed to the statement that microgreens are healthier.
- All the subjects strongly agree to the statements that cultivation of microgreen seeds and farming tools are expensive and it is also hard to find business buyers.

- It was surprising that 81 percent of the subjects strongly agreed, that obtaining information about the growth of microgreens is difficult, 16 percent agrees and three percent neither agree nor disagree.
- Thirty two percent strongly agreed and least (2 percent) strongly disagreed to the statement producing microgreens within the kitchen garden was very good idea.

**Awareness on Kitchen Garden among Selected Subjects (N=81)**

- Greens consumption was predominant among all the selected subject (100 percent).
- Among the selected subjects 61percentdid not have a kitchen garden.
- Regarding the cultivation of green leafy vegetables, 70 percent of the subjects did not cultivate green leafy vegetables and 54 percent knew the importance of green leafy vegetables
- A majority (60 percent) of the subjects agree that farming of vegetables will add to expenses.
- And 43 percent of the subjects had the opinion that large amount of water is lost for cultivation purpose.
- Regarding the use of pesticides or insecticides for the protection of the kitchen garden, 80 percent of the subjects reported that they don't use.
- Most of the subjects (91 percent) confirmed that there is need for cultivating green leafy vegetables.
- Majority of the subjects had no awareness about microgreens. The subjects had nil or very less knowledge on microgreen cultivation, place of purchase and nutrients present in microgreens.
- Social Media being the popular means of awareness these days, five percent of the subjects claimed that they got awareness from social media and another four percent mentioned their source as journals and 1 percent learnt from magazines.
- Among the Home makers, about four percent of them received awareness through facebook and about 1 percent through instagram.
- Minimum of the subjects (1.23 percent) claimed that microgreens are bitter in taste.

### **Consumption Pattern of the Cultivated Microgreens by the Selected Subjects**

- Majority of the subjects (14 percent) had grown ladies finger in the kitchen garden and consumed.
- This is followed by the cultivation and consumption of mint and coriander.
- Fenugreek microgreens was not grown for consumption.

### **Consumption Pattern of Green Leafy Vegetables among Selected Subjects**

- Forty Eight percent of the selected subjects used greens in less than one meal.
- A minimal population of about, twenty-seven used greens in two to four meals.
- All the subjects (100 percent) incorporated curry leaf for meal preparation and least (65 percent) used amaranth leaf (green) for meal preparation.
- Coriander chutney was the most prepared green leafy based dish, which was prepared by 92 percent of the subjects.

### **Purchase of Green Leafy Vegetables and Budget Used Per day**

- Sixteen percent of the subjects purchased less than 150 gm of green leafy vegetable for meal preparation per day and no samples purchased more than 250gm of green leafy vegetables.
- Twenty four percent of the subjects spend Rs.20-30 for the purchase of green leafy vegetables and 14 percent of the subjects spend the least amount less than Rs.20 for purchasing green leafy vegetables.

### **Pre-and Post-Awareness Knowledge Assessment**

- In the pre awareness assessment, majority of the subjects scored low (5 marks), which is depicted as 25 percent awareness level.
- In the post awareness assessment majority of subjects scored 60 percent awareness level. And most of the subjects had more than fifty percent.
- The intervention programme conducted positively influenced the homemakers regarding the knowledge of microgreens and growing method of microgreens.
- Hence it is understood that the awareness was effective and a positive impact was noticed.

## **Conclusion**

The Microgreens despite their advantages like minimum area required to grow, less time needed to cultivate, highly nutritious, flavourful etc is still not popular among the public due to low awareness levels. On the other side people tend to eat healthy and consume a lot of mature greens (normal green leafy vegetables). Hence more awareness need to be brought to the attention of public on the advantages of microgreens to encourage them convert from regular greens to micro greens.

It is possible even for families living in a small area to cultivate adequate micro greens for their family needs. Further large scale cultivation is also possible. This can be converted into a profession/ entrepreneurial opportunity.

It is established that microgreens are nutrient dense and contain over 40 times more nutrient content compare to matured greens. Further they are rich in antioxidants and phytochemicals which are needed to live a healthy life. Hence spreading awareness and enhancing the consumption of micro greens will lead to a healthier society.

## **Limitations**

- The study did not include all varieties of microgreens.
- Growth media was limited to three and did not include all types.
- The nutrient loss on cooking / processing of microgreens was not studied
- Subjects from lower socio economic class was less.

### **Recommendations**

- In the current study, nutrient profile of only a selected six varieties of microgreens was analysed. There are so many under utilized microgreens for which the nutrient profile can be analysed. The nutrient profile of other microgreens, when analyzed can be used as a reference.
- In the study three different soil medium were used for cultivation of microgreens. The cultivation can also be trialed in soil less medium such as hydroponics and the outcome can be compared.
- The shelf life of microgreens are less compared to matured regular greens. Hence research on possible pre and post harvest treatments can be performed, in order to increase the shelf life of microgreens.
- In connection to the nutrient and phytochemical profile of the microgreens, its use as functional food / therapeutic food can be identified.
- New novel packaging and storing techniques for microgreens can further be explored to enhance its shelf life post harvest.
- Nano encapsulation studies using different varieties of microgreens can be conducted.