QUALITY ANALYSIS AND DEVELOPMENT OF RTE AND RTC PRODUCTS FROM IVY GOURD (*Coccinia indica* L.).

by

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(2015-16-008)

THESIS

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DECLARATION

I, hereby declare that this thesis entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica* L.)." is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Gayathri Devi. V

DEDICATED TO

MY

FAMILY AND FRIENDS

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LIST OF ABBREVIATIONS

%	Per cent
CD	Critical Difference
°C	Degree Celsius
Cfu/ml	Colony forming units per milliliter
et al	And other co workers
Fig.	Figure
G	Gram
µg	Micro Gram
g/ 100g	Gram per 100 gram
°Brix or °B	Degree brix
ml	Milli litre
mg	Milli gram
viz.	Namely
TSS	Total Soluble Solids
ND	Not detected
i.e	That is
Rs.	Rupees
RTE	Ready to eat
RTC	Ready to cook

INTRODUCTION

INTRODUCTION

Plants have always been an exemplary source of drugs and many drugs currently available have been derived directly or indirectly from them. A huge majority of population especially those living in villages depend mostly on medicinal plants for treating and healing diseases. One such medicinal plant is Ivy Gourd. All most the therapeutic, nutritional and medicinal values are blended in a locally available vegetable that is ivy gourd which belongs to the family cucurbitaceae (Tanaka *et al.,* 2007). The literature survey revealed that *Coccinia Indica* has been widely studied for its pharmacological activities and regarded as Universal Panacea in Ayurvedic medicines (Pekamwar *et al.,* 2013). As it is an inevitable one in folklore medicine its leaf, fruits, roots and stem are equally beneficial (Deshpande *et al.,* 2011). Though it is rich with nutrients and antioxidants (Umamaheswari and Chatterjee 2008), it is not a part of our daily diet. It's anticancer and anti dyslipidaemic actions are not known to general public. Indian system of traditional knowledge i.e. Ayurveda is well known for its effective herbal treatments.

Botanical name of Ivy gourd is *C. Indica* L. a perennial herbaceous vine. It is commonly known as kundru. Ivy gourd is a tropical plant in the cucurbitaceae family and it is a climber and trailer that (Nasir and Ali, 1973) spreads quickly over trees, shrubs, fences and other supports. The origin of ivy gourd lies in the North and central Africa, tropical zone of Asia. Ivy gourd is mainly distributed in Africa, Pakistan, India, Thailand, Malaysia, Indonesia and Sri Lanka (Muniappan *et al*., 2009). *Coccinia* comprise 29 additional species and they are found only in tropical Africa (Singh *et al*., 2007). It is cultivated abundantly in India (Assam, Bihar, Orissa, Maharashtra, Andhra Pradesh, Tamil Nadu). The ivy gourd fruit belongs to the berry type, oval and hairless with thick and sticky skin. The raw fruit is green in color resembles a small dark green cucumber with paler stripes. These fleshy fruit (2.5-6 cm long and up to 3.5 cm wide) turn bright scarlet red as they mature and contains several pale, flattened seeds.

The South-East Asians have long made use of this plant in their traditional medicine and local cookery (Orech *et al.,* 2005). Several uses of *Coccinia* make it different from other vegetables. When it is tender, it can be eaten raw or in a salad makes an excellent curry as well as a fried vegetable. *C. Indica* is also used as a cooked vegetable in various preparations. In southern India, dehydrated chips are prepared so that they can be stored over a long period of time (Ramachandaran and Subramaniam, 1983). Green fruits are prepared in soups and curries and widely used in this way in Ethiopia and India.

Ivy gourd is rich in beta-carotene and also it contains a good amount of complex carbohydrates, fibreas well as a vast array of vitamin B and minerals. It is also a valuable source of nutrients. Rahman *et al.,* (2015) found that the hydroethanolic extract of *coccinia indica* showed strong antioxidant activity, reducing power and free radical scavenging activity due to the presence of phenolic, flavonoid compounds and other phytochemicals. The phytochemical screening of the 50% methanolic extract obtained from whole parts of ivy gourd revealed the presence of carbohydrates, glycosides, oil and fats, proteins, amino acids, saponins, tannins, phytosterol, alkaloids, phenolic compounds, gum, mucilage and flavonoids (Chandira *et al.,* 2012).

Traditionally different parts of this plant namely roots, leaves and fruits have been used in the folklore medicine for numerous purposes like healing wounds, ulcers, jaundice, diabetes, stomach-ache, as an antipyretic and an astringent (Mazunder *et al.,* 2008). *Coccinia indica* L. has wide range of medicinal properties viz analgesic, antipyretic, anti-inflammatory, antimicrobial, antiulcer, antidiabetic, antioxidant, hypoglycaemic, hepatoprotective, antimalarial, antidyslipidemic, anticancer, and mutagenic properties (Pekamwar *et al.,* 2013). Polyprenol (C60- polyprenol) is the main yellow bioactive component in ivy gourd shown to have antidyslipidemic action (Anon, 2010). Birdee and Yeh (2010), reported that *Coccinia indica* L. may produce hypoglycaemia in a

mechanism similar to insulin. Two randomized, controlled trials and one controlled, non randomized trial have suggested decrease in fasting blood glucose without adverse effects among type 2 diabetes.

According to Bunkrongcheap *et al.,* (2014), ivy gourd root possesses an anti-obesity property. It acts directly on pre-adipocytes by inhibiting their differentiation through down-regulation of adipogenic transcription factor. On the basis of present phytochemical examination done on ivy gourd conclude that it depict anticancer activity (Gautam *et al.,* 2014).

Ivy gourd which is an antioxidant and store house of many nutrients. It has also the ability to prevent diabetes. A thorough and detailed study on the therapeutic properties of ivy gourd is highly essential as not much detailed study in this area has been conducted as far the knowledge of investigator goes.

The present study aims to ascertain the antioxidants in ivy gourd so that this locally available vegetable could be promoted for ensuring health, nutrition and security. Development of RTE and RTC products from ivy gourd will also enhance the consumption of this valuable vegetable in the daily diet.

Review of literature

2. REVIEW OF LITERATURE

The literature of the present study entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica L.).*" is reviewed under following subheads:-

2.1.Nutritional significance of ivy gourd

2.2.Therapeutic and medicinal properties of ivy gourd

2.3.Value added products of ivy gourd

2.4.Importance of dehydration of vegetables.

2.1 Nutritional significance of ivy gourd

Ivy gourd contains vitamin 'A' in the form of β-carotene and also a good source of protein. The phytochemical screening of the 50 per cent Methanolic extract acquired from entire parts of ivy gourd exhibit the presence of carbohydrates, proteins, glycosides, oil and fats, amino acids, saponins, tannins, phenolic compounds, phytosterol, alkaloids, mucilage and flavonoids. The nutritional value of edible portion of ivy gourd per 100 gms reveals energy (21Kcal), protein (1.4g), carbohydrate (3.4g), fat (0.2mg), calcium (25mg), and iron (0.9mg) (Chandira *et al.,* 2012).

Pandit and Hazra (2008) reported that Ivy gourd has higher nutrient content than other cucurbits. It is rich in proteins, protein levels are 10 times higher than that of bottle gourd and 4 times that of snake gourd and Ridge gourd. It is also a rich source of beta carotene complex carbohydrates fibre Vitamins B, vitamin C and minerals like Mg, P, K and Ca (Gopalakrishnan *et al.*, 2001). According to Akhtar *et al.*, (2007) ivy gourd is rich in beta-carotene and it also contains a good amount of complex carbohydrates, fibre, and a vast array of vitamins B and minerals. The aqueous extract of fresh leaves of ivy gourd exhibited anthraquinons in addition to alkaloids, carbohydrates, proteins and amino acids, tannin, saponins, flavonoids, phytosterol and triterpenes (Rastogi *et al*, 1993). Major phytoconstituents present in ivy gourd are cardenolides,

saponins, flavonoids and polyphenols. The seed fat mainly contains palmitic (16.3%), oleic (22.4%) and linoleic (58.6%) acids. Plant also contains arabinogalactan, xyloglucan and xylan (Hussain *et al.*, 2010).

PHYTOCHEMICALS

The ivy gourd contains saponins, flavonoids, sterols and alkaloids. Saponins and flavonoid are found to be responsible for antidiabetic activity (Deokate and Khadabadi, 2012). The fruit contains beta-amyrin and its acetate, lupeol, β- Sitosterol, Taraxerol and cucurbitin B, Cephalandrol, cephalandrine A & B. The phytochemical screening of the 50 per cent methanolic extract obtained from whole parts of ivy gourd studied by Chandria *et al.*, (2012) revealed that it contains carbohydrates, glycosides, fats, proteins, saponins, tannins, phytosterol, alkaloids, phenolic compounds, flavonoids, gum and mucilage. The methanolic extract obtained from fruits of Ivy gourd contains steroids, saponins, ellagic acid, lignin's, triterpenoids, in addition to alkaloids, tannins, flavonoids, glycosides, phenols. The aqueous extract of fresh leaves of ivy gourd exhibited anthraquinons in addition to alkaloids, carbohydrates, proteins and amino acids, tannin, saponins, flavonoids, phytosterol, triterpenes. cephalandrol A and cephalandrol B, sigma-7-en-3-one, taraxerone and taraxerol as reported by Rastogi *et al.*, (1993) and "Ray and kundu (1987). Phytochemical screening of ivy gourd reported the presence of saponin, cardenoloids, flavonoids and poly phenols which may be attributed to anti bacterial activity. Phenolic compounds are generally noted for their anti microbial activities (Sastri, 1950). Ivy gourds are known to contain active constituents like taraxerone, taxerol, amyran, lupeol and glycoside cucurbitacan B.

Phyto chemical constituents in different parts of Ivy gourd

Aerial part - Heptacosane, Cephalandrol, β -sitosterol,Alkaloids Cephalandrins A and B (Pekamwar *et al.*, 2013).

Fruits- β- Amyrin Acetate, Lupeol, Cucurbitacin B, Taraxerone,Taraxerol, β-carotene, lycopene, cryptoxanthin, xyloglucancCarotenoids, β-sitosterol, Stigma-7-en-3-one. (Pekamwar *et al.*2013).

Root - Resin, alkaloids, starch, fatty acids, carbonic acid,triterpenoid, saponin coccinoside, flavonoid glycoside, lupeol,β-amyrin, β-sitosterol, taraxerol (Deokate and khadabadi, 2012).

Whole plant- Aspartic acid, glutamic acid, asparagine, tyrosine, histidine, phenylalanine and threonine valine arginine (Akhtar *et al.*, 2007).

2.2. Therapeutic and medicinal properties of ivy gourd

In traditional medicine, fruits have been used to treat leprosy, fever, asthma, bronchitis and jaundice. The fruit possesses mast-cell stabilizing, anti-anaphylactic and antihistaminic potential. Extracts of ivy gourd reduced blood sugar levels by almost 20 percent (Shaheen *et al.,* 2009). The raw fruits are chewed to cure mouth sores, the fruits are also used for treating coughs and skin eruptions (Rastogi and Mehrotra 1993). It also helps to stimulate the digestion and bowel movements. The leaves are used for treating some kidney disorders. It is quite effective in the treatment of certain sexually transmitted Diseases, like syphilis. A paste made of leaves is applied to the skin to treat scabies. In Bangladesh, the roots are used to treat osteoarthritis and joint pain. Ivy gourd is rich in beta-carotene. The juice of the roots and leaves is used in the treating skin eruption the plant is used as a laxative. It is used internally in the treatment of gonorrhoea. Aqueous and ethanolic extract of the plant have shown hypoglycaemic principle (Kamble *et al.*, 1996).

Anti-inflammatory activity

Study conducted by Rao *et al.*, (2004) reported that 60%methanolic extract of ivy gourd produced maximum anti-inflammatory activity even more than the standard drug, diclofenac sodium after 3 hours. The leaf powder of Ivy Gourd showed an extensive dose related decrease in ulcer index, with significant increase

in mucous discharge and decrease in level of lipid peroxidation (LPO) and superoxide dismutase (SOD) activity.

Anti Obesity Property

The presence of possible anti-adipogenic agent in this plant might be relevant to its use to improve metabolic diseases induced by obesity, in addition to having a blood sugar lowering effect. It acted directly on pre-adipocytes by inhibiting their differentiation through down-regulation of at least the key adipogenic transcription factor-PPARγ.(Bunkrongcheap *et al.*, 2014).

Anti helmintic

A Study conducted by Tamilselvan *et al.,* (2007) suggested that the methanolic leaf extract of *Coccinia indica* L. shows anthelmintic activity. The activity is evaluated by examining the time taken for the paralysis and death of the Indian Earthworms (Pheretima posthuma), tapeworms (Taenia solium) and round worms (Ascaris Lumbricoides). The anthelmintic activity is inversely proportional to the time taken for the paralysis and death of worms. It is observed that the plant extract is more active against Indian earthworms followed by human roundworms and tapeworms.

Antibacterial Activity

The bioactive compounds of fruits of ivy gourd were investigated for their antibacterial activity against some pathogenic bacteria. The aqueous extracts did not show much significant activity, while the organic extracts (petroleum ether and methanol) showed the highest activity against the test bacteria (Dewanjee *et al.*, 2007 and Farrukh *et al.*, 2008). Aqueous extract of leaves of ivy gourd showed antibacterial activity against *Shigella flexneri* NICED, *Bacillus subtilis Escherichia coli, Salmonella choleraesuis,* and. *Shigella dysenteries.* Aqueous extract of ivy gourd showed more significant antibacterial activity in comparison to ethanol extract. A polar moiety of the extract was more responsible for the antibacterial properties. The chloroform extract of ivy gourd moderately active

against *Sarcina lutea,* and *Bacillus subtilis*. Ethyl acetate extracts active against staphylococcus aurous. Hexane extract was active against the *Sarcina lutea, Pseudomonas aeruginosa* (Bulbul *et al.,* 2011). Sivaraj *et al.,* (2011) evaluated the antibacterial activity of *Coccinia indica* leaf extract with solvents such as acetone, ethanol, methanol, aqueous and hexane against five bacterial species. Ethanol leaf extract of *Coccinia indica* showed high antibacterial activity against S. pigeons, E. Coli, B. Ceres, K. pneumonia and S. Aureus. Antibacterial activity of ivy gourd extract was tested gram positive and gram negative bacteria. Hexane extract was moderately active against all gram positive and gram negative bacteria except *Proteus mirabilis*. Ethyl acetate extracts were moderately antibacterial against all except *Proteus mirabilis* and *staphylococcus aeruginosa* (Girish and satish, 2008).

Antimalarial Activity

Extract of *Coccinia indica* shows excellent antiplasmodial activity against the *Plasmodium falciparum* (Sundaram *et al.,* 2012). Aqueous leaf extract of *Coccinia indica* decreases the SGPT, SGOT, ALP, total protein, blood urea nitrogen concentration. Hydrophilic moiety of *Coccinia indica* extract was responsible for antimalarial activity (Bhuiyan *et al.,* 2009).

Antipyretic Activity

Methanolic extract of ivy gourd showed antipyretic activity at the doses of 100 and 200 mg/kg in yeast-induced fever. The extract showed antipyretic activity by influencing the prostaglandin biosynthesis. Prostaglandin is considered as a regulator of body temperature.

Anticancer activity

In addition to its anti-diabetic and antihistaminic effects, some natural care enthusiasts also insist that the regular intake of ivy gourd can even help to prevent cancer (Ashwini *et al.,* 2012*).* Consuming ivy gourd may help to some extent as it is a rich source of antioxidants that help protect against free radical damage to cells and DNA. This could have an anti-mutagenic effect, which means that the

risk of cell mutation is reduced. The anticancer activity of *Coccinia indica* is due to its the antioxidant nature. The antioxidant nature of ivy gourd reduces ferrocynaide to ferrous. Hydrogen peroxide scavenged from *Coccinia indica* neutralizes to water (Behera and Dash 2012). Bhattacharya (2011), evaluated the aqueous extract of leaves of *coccinia indica* for anticancer activity. Nitric oxide was a free radical which acting an important role in the pathogenesis of pain and inflammation. The antioxidant principle of ivy gourd decreases the nitrite generated by decomposition. Graded response produced by the cell was comparatively less. *Coccinia indica* significantly reduced viable cell count and increased non viable cell count suggesting comparable anticancer property with that of the reference drug (vinblastine) (Nanasombat and Teckcheun 2009).

Hypoglycemic Activity

Ivy Gourd is a wonderful plant having antidiabetic activity, different parts of the plant extracted with different solvents shows the antidiabetic effect. Leaf extract of *Coccinia indica* significantly depressed the glucose-6-phosphates and fructose -1, 6-bisphosphatese activities. *Coccinia indica* L. may produce hypoglycaemia in a mechanism similar to insulin. Two randomized, controlled trials and one controlled, non randomized trial have suggested decrease in fasting blood glucose without adverse effects among type 2 diabetes (Munasinghe *et al.,* 2011).

Ivy gourd benefits for diabetics are frequently stressed in herbal medicine and clinical trials seem to support these claims. Some studies, like a double-blind phase I clinical trial conducted in Matara in 2009 clearly showed that ivy gourd exercised a blood sugar lowering effect. (Mallick *et al.*, 2007). Researchers believe that this beneficial effect of ivy gourd could be because of glucose-6-phosphatase inhibiting compounds present in the fruit. According to most practitioners of ayurvedic medicine and naturopathy, the consumption of ivy gourd leaf, Ivy gourd juice and ivy gourd extract benefits diabetics. The pectin isolated from the fruit of ivy gourd at a dose of 200 mg/100g/day showed a significant hypoglycaemic action in normal rats (Shibib *et al.,* 1993). Leaf extract

of *Coccinia indica* significantly depressed the glucose-6-phosphates and fructose -1,6-bisphosphateseactivities in both normal and streptozotocin-diabetic rates (Vadivu *et al.,* 2008). Hydromethanolic mixture of root of *M.paradisiaca* and leaf of *C. indica* in composite manner treated in diabetic rats not only resets the blood glucose homeostasis to the control level but also corrects the protein metabolic disorders.

Sutar *et al.*, (2010) conducted Anti-hyperglycemic activity study through oral glucose tolerance tests in glucose-loaded mice. The methanol extract of the leaf when injected to mice at doses of 50, 100, 200 and 400 mg extract per kg body weight demonstrated significant dose-dependent anti-hyperglycemic activity.

Antitussive Activity

Coccinia indica has extensively used to get relief from asthma and cough by the indigenous people of India (Pattanayak *et al.,* 2009) . The methanol extracts of the fruit of *coccinia indica* showed the presence of alkaloids, tannins, steroids, triterpenoids, glycosides, carbohydrates and reducing sugar. The methanol extract of *Coccinia indica* fruit showed significant decrease in cough induced by the chemical simulation similar to codeine phosphate in a dose dependant manner. The methanol extract act through the central nervous system. (Pekamwar *et al.*, 2013).

Antihepatotoxic Activity

Vadivu, (2008) reported that Ethanolic extract of fruit and leaves of *C. Indica* revealed the presence of saponins. Ivy gourd showed significant dose dependent reduction in SGPT,SGOT, bilirubin, total protein, liver weight and lipid peroxide levels with reference to the standard, Silymarin (25 mg/kg).The compound also revealed significant dose dependent reduction in the hepatic antioxidant enzyme activities such as super oxide dismutase, glutathione, catalase, and peroxidise.

Anti-stress and free radical scavenging activity

The 50% methanolic extract of whole plant of Ivy Gourd showed the strong free radical scavenging activity and it was used for stress induced disorders. (Gradist and Purintrapiban, 2009)

Reno protective action

Gurukar *et al.*, (2013) conducted a study and suggested the effect of *Coccinia indica* consumption on diabetes-mediated kidney damage. Various parameters, such as fasting blood glucose, urine sugar, albumin excretion, kidney index, and glomerular filtration rate, were ameliorated to various extents by the supplementation of *C. indica* in the diet. Additionally, diabetic rats fed with diet supplemented with *C. indica* fruits or leaves showed improvement in glucose tolerance compared to control diabetic rats. They also exhibited beneficial effects on key antioxidant enzymes of the kidney. Kidney stone is in fact crystallized form of calcium as well as other minerals deposited within the human urinary tract. Higher consumption of calcium intake or high calcium absorption may result in kidney stones, however the modern research proves that higher dietary calcium intake reduces the chance of kidney stones significantly. In short dietary calcium present in Ivy gourd did not result in kidney stones but in fact excess calcium present in water lead to kidney stones. Other factors like high oxalate consumption of leafy vegetables like spinach and spinach, and less fluid consumption may result to kidney stones (Deepti *et al.*, 2012.)

Larvicidal efficacy of Ivy Gourd

Leaves extract of Ivy Gourd is effective malarial against parasites. Mosquitoes are the major vector for the transmission of malaria, dengue fever, yellow fever, filarisis. Bhuiyan *et al.*, (2009) worked on the cucurbitaceous plant for identifying there Larvicidal activity in which crude methanolic extract of Ivy gourd showed the highest mortality.

Hypolipidemic Effects of Ivy Gourd

Ivy gourd has the higher efficiency of lowering serum triglycerides in comparison to other plant. Extracts of Ivy Gourd (300 mg/kg) significantly reduced blood glucose by 47.4 and 37.1 % ($P < 0.01$) on the 7th day and by 59.7 and 48.5 per cent on 14th day. A significant reduction ($P < 0.01$) in serum total cholesterol of 31.7 and 43.3 percent and serum triglycerides of 45.5 and 39.4 per cent was observed on the 14th day with a single dose of the extracts of Ivy Gourd (300 mg/kg) most (Akhtar *et al.*, 2007)

Antidyslipidemic activity

Ethanol extract of ivy gourd showed significant triglyceride and cholesterol-lowering effect. The polyphenols which were isolated from chloroform fraction, showed antidyslipidemic activity (Singh *et al.,* 2007). Polyprenol is the main yellow bioactive component in ivy gourd shown to have antidyslipidemic action (Mongkolsilp *et al.*, 2004).

Hepato-protective avtivity

Alcoholic extract of the fruits of *C. indica* was evaluated for hepato-toxicity in rats and it was observed that it significantly ($p<0.05$) decreased at a dose level of 250 mg/kg. The activities of serum enzymes (AST, ALT and ALP) and bilirubin were comparable to that of silymarin revealing its hepato-protective effect (Vadivu *et al.*, 2008 ; Kumar 2012).

Fatigue

Fatigue is caused due to Iron deficiency. Ivy gourd consists of 1.4 mg of Iron which is 17.50% of the daily recommended value. So, inclusion of Ivy gourd in diet helping keeps fit, healthy, and energetic, both internally and externally. Iron deficiency may often cause body weakness, severe fatigue and other related health ailments (Wasantwisut and Thara 2013).

2.3. Value addition and formulations of ivy gourd

According to Nirmal *et al.*, (1999) value added products are raw or pre processed commodities whose value has been increased through the addition of ingredients or processes that make them more attractive to the buyer or more valuable by the consumer. Value addition is a term frequently mentioned in the context of the future profitability of agriculture. In general adding value is a process of changing or transforming the product from its original state to a more valuable state (Brown, 2000).

Importance of value addition lies in the fact of that it has the capability to meet food requirements of the growing population by eliminating avoidable losses and making more nutritive food items from low grade raw commodities, by their processing and fortification (Rasheed *et al.*, 2008).

According to Joseph (2001) value addition to food products chiefly in terms of cost value is a consequence of acceptability of enhancement. Value added processed product in India accounts for 2 per cent total production (Anvita *et al.*, 1993). Value addition through food processing generates demand for agricultural raw materials and also has a multiplier effect on the rural economy (Baisya, 2006).

Some value added products of ivy gourd are:-

Ivy gourd juice based soft drink

The juice of ivy gourd is highly effective in treating diabetes and keeping the sugars in check (Radhapriya and Lakshmi, 2012; Kurpad and Raj, 2008). It is an excellent cure for an array of skin infections like leprosy, psoriasis and scabies (Zakaria *et al.*, 2011).

A study conducted by Kumar *et al.*, (2016) reported that good quality and nutritious ivy gourd juice based soft drink can be prepared by mixing salt, sugar and Lime mixed with all other ingredients in a food processor for 2 min for

proper mixing. The carbohydrate content, protein content, vitamin C, total soluble solids, and pH of juice varied from 4.60-22.05g/100 ml, 0.43- 1.44g/100ml, 0.382-0.55 mg/100ml, 7-18°Brix and 1.9-4.9 respectively.

Dried ivy gourd sheet as a health snack

A study conducted by Saencom *et al.,* (2010) reported that dried ivy gourd sheet pre-treated by brine blanching and vacuum drying resulted in better retention of colour and β- carotene as well as texture. Higher drying temperature also resulted in higher β- carotene retention due to shorter drying time.

Ivy gourd fruit sauce

Sinclair, (2009) developed technology for the preparation of ivy gourd based sauce adding of ripe ivy gourd fruit 1(kg) along with salt 50(g), sugar 400(g), cinnamon 5(g), red chilli 200(g) and vinegar 150(g).

Enzymatic therapy (90 tabs)

Ivy leaf extract benefit buildings and maintaining healthy lungs and bronchial passageway function

Ivy extract-Natural's products (90 tabs)

Ivy extracts supports respiratory health it contains saponins which help controls high cholesterol

Oral ivy-Boericke and Tafel: 1(OZ)

Boericke and Tafel oral Ivy a homeopathic remedy for ichning and burning associated with poision.

2.4. Importance of dehydration of vegetables.

Food dehydration is still one of most relevant and challenging unit operations in food processing. Fruits and vegetables are dried to enhance storage stability, minimize packaging requirement and reduce transport weight (Sagar and

Kumar, 2010). Drying is a process in which water is removed to halt or slow down the growth of spoilage micro organisms as well as the occurrence of chemical reactions (Mercado *et al.*, 2001). Dehydrated foods are ideal for backpacking, hiking, and camping because they weigh much less than their non-dried counterparts and do not require refrigeration. Drying food is also a way of preserving seasonal foods for later use (Boyer, 2008)

Among the processes applied for fruit and vegetable preservation, drying has received special attention as this method is currently regarded as the most common way for obtaining food and pharmaceutical products. It mainly aims at extending the product and its constituent's shelf life by preventing the growth of microorganisms (Grabowski and Marcotte, 2003).

Removal of water from foods is the critical to enhance the shelf life of fruits and vegetables. Dehydration is one such technique, widely used to preserve agricultural produce. Dehydration simultaneously combines heat and mass transfer. The fundamental aspect of food dehydration is to reduce the availability of water in food to such an extent. There is a wide variety of dehydrated foods available nowadays to the consumer in the form of snacks, soups or dried fruits and pickles etc. The shelf life and energy saved compared to other materials make it inevitable in food industry (Krokida *et al.*, 2003). The pre-treatments and methods of dehydration have been reported to influence the quality of dried products (Kulkarni *et al.*, 2010; Krokida *et al.*, 2003).

Dried fruits are rich source of vitamins, minerals, anti-oxidants, and especially fiber due to their concentration during processing. These products are also rich source of energy. Dried fruits and vegetables are high in fiber and carbohydrates and low in fat, making them healthy food choices (Ahmed and Rehab, 2013).

Cucumber is a fruit which has low sugar content and low calorific value and has a high nutritional value (Maroto, 1995.). Henriques *et al.*, (2008) pinioned that, the air drying and freeze drying of cucumber produced product with

properties more similar to fresh cucumber, thus allowing to preserve the characteristics of this food product with respect to its colour, texture, antioxidant activities and phenolic compounds.

Cauliflower dried in connective hot air drier gave the best product with respect to higher rehydration ratio, minimum browning and maximum vitamin C content (Gupta *et al.*, 2013).

Gisele *et al.*, (2004) reported that dehydration of tomato products are increasing all over the world due to the possibility of using them in pizza toppings, snacks and other savory dishes.

Study conducted by Choudhary and Ahmed (1995), reported that osmotically dehydrated papaya slices had good colour, texture and flavour, it could be used as snacks.

The osmotic dehydration in combination with hot air followed by microvave finish drying can be used for preserving beetroot slices with retention of quality (Kaur and Singh 2013).

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The methodology of the present study entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica* L.)." is presented under the following heads:-

3.1 Selection and collection of ivy gourd

3.2 Quality evaluation of Ivy gourd

3.3 Assessment of changes in nutrients and antioxidants with processing

3.4 Standardization and product development on ivy gourd

3.5 Quality analysis of Ivy gourd based dehydrated products

3.6 Standardization of ivy gourd based RTC mix

3.7 Packaging and storage

3.8 Quality analysis of dehydrated RTC mix.

3.9 Cost of the developed product

3.10 Consumer acceptability of RTE and RTC products

3.1. Selection and collection of ivy gourd.

Ivy gourd (*Coccina indica* L.) fruit was utilized for the study. Fresh tender fruits were procured from the Instructional farm, College of Agriculture, Vellayani and local markets of Thiruvanathapuram, the vegetable was collected based on external visible maturity.

3.2. Quality evaluation of Ivy gourd.

Quality is an important parameter for judging the edible nature of any food product (Sharma, 2006). The quality of the fresh vegetable was evaluated based on parameters like nutrients, antioxidants and glycemic index.

3.2.1. Nutrient analysis

Nutrients such as protein (g), total minerals (g), fiber (g), carbohydrates (g), calcium (mg), iron (g), β-carotene (μg), sodium(mg) and potassium (mg). Present in the ivy gourd were estimated as per the following methods.

3.2.1.1. Protein

The nitrogen content of ivy gourd samples was estimated by the micro kjeldhal's wet digestion method. The values of nitrogen content were multiplied by the factor 6.25 to get crude protein content (AOAC, 2000).

3.2.1.2. Total minerals

Total mineral content was estimated as per the method described by Raghuramalu *et al.,* (1983).

3.2.1.3. Fibre

Fibre content of ivy gourd sample was estimated by AOAC (2000).

3.2.1.4. Carbohydrates

Total carbohydrate content was determined using anthrone method as described by Sadasivam and Manickam (2004).

3.2.1.5. Calcium

Calcium content was determined using EDTA method outline by Sadasivam and Manickam (2008).

3.2.1.6. Iron

Iron content was determined using method described by Sadasivam and Manickam (2008).

3.2.1.7. β- carotene

Carotene content was determined using the methods described by Sadasivam and Manickam (2008).

3.2.1.8. Vitamin C

Vitamin C content was determined using method described by Sadasivam and Manickam (2004).

3.2.1.9. Sodium

Sodium was estimated by the method suggested by Jackson, (1973) using flame photometer.

3.2.1.10. Potassium

Potassium was estimated using flame photometer by the method outline by Jackson, (1973).

3.2.2. Glycemic index

Glycemic index was calculated by dividing the IAUC of test food by the IAUC of the reference food multiplied by 100 for each individual using the following formula (Wolever and Boume 1990).

$$GI = \frac{\text{Area under blood glucose response for 50 g of test carbohydrate food}}{\text{Area under blood glucose response for 50g glucose}}$$

The average GI of ten individuals was taken as the GI of the test food.

3.2.3. Determination of antioxidants

The total antioxidant activity was analysed by phosphomolybdate method (Buratti *et al.*, 2001). Ivy gourd extract was dissolved in phosphomolybdate

Plate 1. Monitoring of blood glucose level

reagent and incubated in a water bath at 95°C for 90 minutes. It was allowed to cool and the absorbance was measured at 695 nm against the blank.

3.2.3.1. Tannins

The total tannin content of ivy gourd samples was determined by the method of Sadasivam and Manickam (2004).

3.2.3.2. Total phenols

Phenolic content of ivy gourd was determined by the method described by Slinkard and Slingeton (1997).

3.3. Assessment of changes in nutrients and antioxidants with processing

Food materials are usually processed in order to improve palatability and reduce toxicity and as a means of preservation (Ayankunbi *et al.*, 1991). In order to determine best processing and preservation method that will have minimal nutrient loss of ivy gourd, the effect of blanching, boiling and drying on the nutritional and antioxidant compositions were studied.

3.3.1. Blanching

Pre-treating the fresh produce by blanching is recommended to enhance quality and safety of vegetables. Blanching is a process of pre heating the product by immersing in steam or hot water. Inactivate the naturally occurring enzymes presenting in food, modifying texture, preserving colour, flavour, and nutritional value, and removing trapped air; these are the main purpose of blanching. The temperature and time of blanching are the important aspects for attain optimum quality of product. Ivy gourd slices blanched for 3 min in water at 98°C resulted in the improvement in colour and softening of the skin.

3.3.2. Drying

Drying of agricultural products is the oldest and widely used preservation method. It is one of the most relevant and challenging processes in the food industry, since a great number of food products are subjected to at least one

drying step during its production (Wankhade *et al.*, 2013). Dehydration or drying of foods is described as any process that involves thermal removal of volatile substances to obtain a dry solid (Xiao *et al.*, 2010). The main purpose of drying crops is to increase its shelf life, to better its quality, to simplify the handling, storage and transport of the products and also to prepare the product for subsequent processes. It involves reduction in water as much as possible from foods, to arrest enzyme and microbial activities and hence stopping deterioration. The ivy gourd slices dried at 55°C for 6 to 7hrs and loss of nutrients were studied.

3.3.3. Boiling

Most vegetables are commonly cooked before being consumed. It is known that cooking induces significant changes in chemical composition, influencing the concentration and bioavailability of bioactive compounds in vegetables. Ivy gourd was boiled at 100°C for 10min and the losses of nutrients were studied.

3.4. Standardisation and product development on ivy gourd

A standardised recipe is one that has been tried, adopted and retried several times for use by a given food service and which has been found to produce the same acceptable result and yield, each time when the exact procedure are used with the same type of equipment and the same quality and quantity of ingredients (USDA, 2001). Standardization of recipe is an essential strive for high quality products. According to Tolute, (2000) the procedure for recipe standardization begins with the process of recipe modification or adjustment.

Two popular ivy gourd based dishes were identified for standardization of RTE and RTC products namely 'salads' and 'olath mix' .

3.4.1. Standardization of ivy gourd based salads

3.4.1.1. Preliminary processing

3.4.1.1.1. Standardization of dimensions of ivy gourd slices

Cutting food into uniform shapes and sizes is important because it enhance the appearance of dish. So the dimensions of ivy gourd were standardized. The vegetables were cut into five different dimensions aesthetically termed as dice, cubic, batonet, slice and roll cut. The best of these variations were identified by analysing the overall visual quality (OVQ) using a 1-9 point scale where, 9 refers to excellent appearance, 7 to good, 5 to fair, 3 to fair usable, and 1 to unusable (Yuan *et al.*,2010) by a panel comprising of 10 members. The variations in dimensions of ivy gourd slices were evaluated.

Table1. Standardization of dimensions

Treatments	**Type of cut**
S_1	Dice
S_2	Batonet
S_3	Slice
S_4	Roll
S_5	Cubic

3.4.1.1.2. Standardization of pre-treatment media

Pre-treating fruits and vegetables for storage is an important step in preserving the produce. Its helps to retain the natural colour and also inactivate the enzymes that can cause food spoilage (Liji, 2012). The collected ivy gourd was cut into different shapes and sizes the best one was selected based on OVQ. The selected slices were pre-treated in different proportions of salt and vinegar the proportions are given in the table (2).

Table2. Composition of various pre-treatment media

SL NO	TREATMENTS	SALT (%)	VINEGAR(%)
1	T_1	1	1
2	T_2	1	2
3	T_3	1	3
4	T_4	2	1
5	T_5	2	2
6	T_6	2	3
7	T_7	3	2
8	T_8	3	3
9	T_9	3	1

Hundred grams of slices immersed 30 mints in one litre water with the respective additives were the best of these variations were again identified by analysing the scores of OVQ, as rated by sensory panel.

3.4.1.1.3. Standardization of immersion time

The ivy gourd slices were immersed in selected media, the most suitable immersion time in the selected media for retaining maximum sensory qualities was identified on the basis of scores obtained on hedonic scale for OVQ. The following table presents the various time periods for immersion.

Table3. Variation of immersion time

Sl. No	Treatments	Time (min)
1	T_1	10
2	T_2	15
3	T_3	20
4	T_4	30
5	T_5	45
6	T_6	60

3.4.2. Formulation of a Ready to Eat Product from ivy gourd

Different salad dressings such as curd, lime, mayonice, and commercial salad dressings in different combinations and proportions were mixed with the cut vegetables and evaluated for sensory qualities.

Table4. Combinations of salad dressings

Sl. No	Treatments	Ingredients
1	T_1	Lime
2	T_2	Curd
3	T_3	Commercial Salad dressing
4	T_4	Salad dressing with olive oil
5	T_5	Salad dressing with pepper
6	T_6	Salad dressing with mayonice

Organolaptic evaluation or sensory analysis is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses viz., sight, smell, taste, touch and hearing for the purpose of evaluating consumer products (IFT, 2005). The different combinations were evaluated by the sensory panel and the scores were analysed to identify the best combinations.

3.4.3. Evaluation of freshness of RTE (salad) product.

The freshness of the prepared salads were monitored after 4 hours using the hedonic rating scale. The best three combinations were thus identified.

3.5 Quality analysis of ivy gourd based dehydrated product

Drying or dehydration is one of the most ancient and traditional methods of preserving food, as it helps remove any extra moisture so as to prevent any spoilage or decay. Ivy gourd was dehydrated after different treatments.

Table5. Different Treatments for dehydration

Treatments	Drying methods
D_1	Plain drying.
D_2	Drying after blanching
D_3	Drying after blanching and treated with 0.2% KMS.
D_4	Drying after blanching and smearing with spices.

D_1 Plain drying.

Ivy gourd was cut into longitudinal slices and dried at 55°c for 6 to 7 hrs. Dried slices were packed in poly propylene covers and assessed at monthly intervals up to 3 months.

D_2 Drying after blanching

Scalding vegetables in boiling water or steam for a short time stops enzyme actions which can cause loss of flavour, colour and texture. Blanching cleanses the surface of dirt and organisms, brightens the colour and helps retard loss of vitamins. It also wilts or softens vegetables and makes them easier to pack. Blanching prior to drying improved the rate of drying and produced a product with lower acidity (Sharma, 2006) Blanching time is crucial and varies with the vegetable and size. Over blanching causes loss of flavour, colour, vitamins and minerals.

D3 Drying after blanching and treating with 0.2% KMS.

Hundred grams of blanched slices were immersed in one litre of water with 0.2%KMS and dried at 55°C. Drying characteristics and shelf life were studied.

D4 Drying after blanching and smearing with spices.

Ivy gourd slices were blanched and smeared with pepper and dried at 55°C till crisp.

3.5.1. Physical characteristics of dehydrated ivy gourd

Moisture loss, drying time and rehydration ratio and shelf life were studied at monthly intervals up to 3 months.

3.5.1.1. Moisture loss

Five gram of sample was weighed into a previously weighed moisture cup and dried in an oven at 130°c till a constant weight was attained.

$$\text{Moisture\%} = \frac{\text{initial weight (g)} - \text{final weight (g)}}{\text{Initial sample weight (g)}} \times 100$$

3.5.1.2. Drying time

Ivy gourd slices were dehydrated at 55°C till crisp or breaking stage and drying time was analysed.

3.5.1.3. Rehydration ratio

The rehydration capacity was used as a quality characteristic of the dried product (Velic *et al.,* 2004). Rehydration ratio of dried ivy gourd was recorded. About 10g of the dried sample was mixed with 100ml of distilled water and strained for 5 minutes. The contents were filtered using a filter paper. The rehydrated sample was weighed and rehydration ratio was calculated using the formula.

$$\text{Dehydration ratio} = \frac{\text{Initial weight of sample}}{\text{Drained weight of the sample}}$$

3.5.2. Shelf life study

Shelf life of dried product was evaluated at monthly intervals up to 3 months in terms of moisture, sensory parameters and microbial profile.

3.6. Standardization of ivy gourd based RTC mix

3.6.1. Preliminary processing

3.6.1.1. Standardization of size and thickness of slices

Selection of appropriate width of slices of the vegetables to be dried is very important, as thicker slices will dry at a slower rate or may not dry fully and it may not subsequently deteriorate after packing than thinner pieces. But in the case of thin pieces there is a tendency to stick to the drying trays and will also be difficult to remove. So the size and thickness of ivy gourd slices were standardized. The best of these variations were identified by evaluating the OVQ scores of ivy gourd as given in table (6).

Table 6. Dimensions of vegetable for RTC product.

Sl. no	Treatments	Dimension of slices
1	T_1	Longitudinal ($^1/_8$)
2	T_2	Longitudinal (¼)
3	T_3	Longitudinal (½)
4	T_4	Longitudinal ($^1/_{16}$)
5	T_5	Longitudinal ($^1/_{14}$)
6	T_6	Rounded (¼)
7	T_7	Rounded ($^1/_8$)
8	T_8	Rounded ($^1/_{16}$)

3.6.1.2. Standardization of pre-treatment media

The various treatments applied on ivy gourd slices are given in table (7).

Table 7. Composition of various pre treatment media

Sl no	Treatments	Particulars
1	T_1	Salt(0.5%)
2	T_2	Salt (0.5%)+KMS(0.2%)
3	T_3	KMS (0.2%)
4	T_4	KMS(0.2%)+citric acid(0.2%)
5	T_5	Salt(0.5%)+citric acid(0.2%)
6	T_6	Citric acid (0.2%)

Hundred grams of slices in one litre water with the respective additives were immersed for 30 mints. The best of these variations were again identified by analysing the scores of OVQ, as rated by sensory panel.

3.6.1.3. Standardization of immersion time

Immersion of various vegetables in alkaline or acid solution prior to drying affected the prevention of discolouration (Sunkja and Raghavan, 2004) the pre-treated slices were immersed in the selected media. The most suitable immersion time in the selected media for retaining maximum sensory quality was identified on the basis of score obtained by OVQ. The following table presents the various time periods chosen for the study.

Table 8. Variation of immersion time of sliced vegetable

Sl no	Treatments	Time (Min)
1	T_1	10
2	T_2	15
3	T_3	20
4	T_4	30
5	T_5	45
6	T_6	60

3.6.2. Formulation of dehydrated mix

The adjuncts in olath mix namely crushed red chilly, green chilly, red chilly powder, pepper, garlic, onion, turmeric, jeera, big jeera and curry leaves were mixed in different combinations and proportions as given in table (9).

Table 9. Proportion of adjuncts in olath mix

Sl no	**RTC product**	**Ingredients**	**Proportion of ingredients (g)**
1	RT_1	Ivy gourd + crushed red chilli + garlic + turmeric powder + curry leaves	2:10:5:1:5
2	RT_2	Ivy gourd + chilli powder + onion+ garlic + turmeric powder + curry leaves	2:10:5:1:5
3	RT_3	Ivy gourd + green chilli + onion + garlic +turmeric powder + curry leaves	2:10:5:1:5
4	RT_4	Ivy gourd + pepper + onion +garlic + turmeric powder + curry leaves + jeera	2: 10:5:1:5
5	RT_5	Ivy gourd + pepper green chilly + onion + garlic + turmeric powder + curry leaves + big jeera	1.5:1.5:10:5:1:5

The formulations were dehydrated at 55°C till crisp. These dehydrated formulations were cooked and subjected to organolaptic evaluation.

3.6.3. Standardization of cooking methods of RTC dehydrated product from ivy gourd

The dehydrated products are in an acceptable stage for cooking, only if they are reconstituted with water. Besides the details of reconstitution is essential to be conveyed to the consumer. Here the reconstitution time and media were standardized.

3.6.3.1. Optimization of reconstitution time of RTC product

The dehydrated olath mixes were reconstituted in different time durations. For the formulated RTC mixes were soaked in cold water and evaluated for sensory qualities after cooking till done.

Table 10. Variations in reconstitution time of formulations

Sl no	Treatments	Time(min)
1	R_1	10
2	R_2	15
3	R_3	20
4	R_4	30
5	R_5	45

3.6.3.2. Optimization of cooking procedure

For optimizing cooking procedures proportion of RTC mixes and water were in the ratio of 1:5. Water was strained out from the reconstituted mixes and subjected to different cooking methods. Cooking time was also evaluated by members of the panel. Variation studies are presented in table (11).

Table 11. Cooking procedure

Sl no	Treatments	Particulars
1	CP_1	Cooking in plain hot water
2	CP_2	Cooking in strained hot water
3	CP_2	Cooking in plain cold water
4	CP_4	Cooking in strained cold water

3.6.4. Cooking characteristics

3.6.4.1. Optimization of cooking time of dehydrated RTC mix

Reconstituted mix was subjected to cooking. Cooking time was evaluated for the mix by members of the sensory panel.

Table 12. Variation of cooking time

Sl no	Treatments	Time(min)
1	C_1	6
2	C_2	8
3	C_3	10
4	C_4	15

3.6.4.2. Cooked weight

The cooked weight of developed RTC olath mix was evaluated.

3.6.5. Optimization of additional ingredients to be added during cooking

Grated coconut and coconut oil are essential ingredients in Kerala dishes. Grated coconut and oil were added in olath mix in different proportions while cooking as given table (13).

Table 13. Proportion of coconut in 50g of olath mixes

Sl no	Treatments	Amount (g)
1	C_1	10
2	C_2	20
3	C_3	30
4	C_4	40
5	C_5	50

Table 14. Proportion of oil in 50 g of olath mixes

Sl no	Treatments	Amount (ml)
1	T_1	1.5
2	T_2	2.5
3	T_3	3.5
4	T_4	4.5
5	T_5	5.0

The different treatments were evaluated by sensory panel and the scores were analysed the best treatment.

3.7. Packaging and storage

The standardized dehydrated olath mix was stored in laminated pouches in ambient conditions and shelf life was assessed in periodic intervals for 3 months. The standardised procedure of ivy gourd RTC mix developed is presented in the following flow diagram (fig.1).

3.8. Quality analysis of dehydrated Ready To Cook mix

Quality parameters with respected to physical and chemical characteristics were analysed. Besides parameters like cost, sensory attributes and shelf life were also evaluated to ascertain consumer acceptance.

3.8.1. Physical properties of dehydrated mix

Appearance, moisture, yield, weight lose, rehydration ratio and bulk density of the developed RTC product were studied.

3.8.1.1. Yield

The weight of the product in relation to raw material used was calculated using formula.

$$\text{Yield\%} = \frac{\text{Weight of dried olath mixes}}{\text{Weight of fresh ivy gourd}} \times 100$$

3.8.1.2. Water absorption index

Water absorption index is the difference in weight of cooked (RTC mix), expressed as the percentage to weight of uncooked mix (Oclaloo *et al.,* 2010)

3.8.1.3. Rehydration ratio

Rehydration ratio of RTC olath mix was recorded. About 10g of sample (RTC mix) was mixed with 100ml of distilled water and strained for 5 minutes. The contents were filtered using a filter paper. The rehydrated sample was weighed and rehydration ratio was calculated using the formula.

$$\text{Rehydration ratio} = \frac{\text{Initial weight of sample}}{\text{Drained weight of the sample}}$$

3.8.1.4. Bulk density

Bulk density is an indicator of drying retention and accurate weighing repeatability. It helps to deciding the type of packaging. Bulk density is the ratio of the sample to weight of an equal volume of water. The sample was taken in a measuring cylinder. It was levelled without compressing. The weight of sample with beaker was recorded. The sample was then removed from the beaker and

water was filled into the same level. The weight of the beaker was recorded and calculated using the formula.

$$\text{Bulk density} = \frac{\text{Weight of the sample}}{\text{Weight of equal volume}}$$

3.8.2. Chemical composition

Chemical composition of the ivy gourd based RTC olath mix was ascertained with respect to moisture, total acidity, reducing sugar, TSS and pH.

3.8.3. Shelf life study

The shelf lives of dehydrated products were evaluated at monthly intervals up to 3 months in terms of microbial profile, sensory attributes and moisture.

3.8.3.1. Microbial profile

The stored product samples were analysed for the presence of various micro-organisms viz., bacteria, fungi, actinomycets and coliforms at monthly intervals up to 3 months. Serial dilution of the samples followed by pour plating was employed to estimate the population of viable micro- organisms in developed products.

3.8.3.2. Moisture

Moisture content of the dehydrated food material is an important factor which affects the stability of the food. The moisture level was noted periodically, for a period of 3 months.

3.8.3.3. Sensory attributes

Sensory quality evaluation plays an important role in acceptability of a new product. Sensory characteristics like appearance, colour, flavour, texture, taste and overall acceptability of ivy gourd based RTC olath mix was assessed by a panel of judjes using a five point scale periodically for 3 months.

3.8.4. Statistical analysis

In order to obtain suitable interpretation the generated data was subjected to statistical analysis, One way analysis of variance (ANOVA) at 0.5% significant level and Kruskal wallis test mostly used. Graphical interpretation of analysed data was also adopted.

3.9. Cost of the developed products

Cost of the product of the mixes were analysed based on input cost i.e. cost of different ingredients used for the preparation of product, cost of packaging materials and output charges (10% of the cost of product were added as overhead charges for fuel and labour to the total input cost).

3.10. Consumer acceptability

Preference test allow consumers to express a choice between samples, one sample is preferred and chosen over other samples (watt *et al.*, 1989). A preference test was conducted among the consumers by scoring (hedonic scale) the products (salads and prepared olath mix). The preference evaluation was in order to select the most promising product for popularising among consumers.

RESULTS

4. RESULTS

The result of present study entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica* L.)." is presented under following heads:-

4.1 Quality evaluation of Ivy gourd

4.2 Assessment of changes in nutrients and antioxidants with processing

4.3 Standardization and product development on ivy gourd

4.4 Quality analysis of Ivy gourd based dehydrated products

4.5 Standardization of ivy gourd based RTC olath mix

4.6 Packaging and storage

4.7 Quality analysis of dehydrated RTC mix

4.8 Cost of the developed product

4.9 Consumer acceptability of RTE and RTC products

4.1. QUALITY EVALUATION OF IVY GOURD

To assess the nutrient composition of ivy gourd in the fresh form, the following parameters were determined with respect to protein, total minerals, fibre, carbohydrates, calcium, iron, β-carotene, sodium, potassium.

Determination of nutrient composition of ivy gourd

4.1.1. Protein

Proteins are single, unbranched chains of amino acid monomers. Proteins are required for the structure, function and regulation of the body's cells, tissues and organs; and each protein has unique functions. Some are involved in the structural support and movement, others in enzymatic activity. Vegetable protein provide

good source of protein and will reduce the intake of saturated fat and cholestrol From the table, (15) it can be seen that ivy gourd contained 2.13g of protein.

4.1.2 Total minerals

Ash content represents the total minerals content in food. Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food. This helps determine the amount and type of minerals in food. The amount of minerals can determine physiochemical properties of foods; 0.51g of total ash was present in 100g of ivy gourd.

4.1.3. Fibre

Dietary fibres are the edible parts of plant or analogous carbohydrates that are resistant to digestion and absorption of human small intestine with complete or partial fermentation in the large intestine. Dietary fibre includes polysaccharides, oligosaccharides, lignin and associated plant substances (Devries, 2001). Fibre can act by altering the nature of the content of gastrointestinal tract and by changing the rate of absorption of nutrients and chemicals. From the table (1), it can be observed that about 1.98g of crude fibre was present in 100g of ivy gourd

4.1.4. Carbohydrates

Carbohydrates are intricate biochemical structures that serve the major source of calorie after fat. They help fuel brain, kidneys, heart, muscles and central nervous system. It spares the use of proteins for energy and also helps in the breakdown of fatty acid to prevent ketosis. The carbohydrate content of ivy gourd was depicted in Table, (15) it can be seen that 3.79g was present in 100g of ivy gourd.

4.1.5. Calcium

Calcium is a mineral found in many foods. The body needs calcium to maintain strong bones and to carry out many important functions. The body also needs calcium for muscles to move and for nerves to carry messages between the brain and every body part. In addition, calcium is used to helps move blood throughout the body and to help release hormones and enzymes that affect almost every function in the human body. Based on analysis of ivy gourd 45.25mg calcium was present in 100g of sample.

4.1.6. Iron

Iron is one of the important elements necessary for the metabolism of the human body. Iron is an essential element for almost all living organisms as it participates in a wide variety of metabolic processes, including oxygen transport, deoxyribonucleic acid (DNA) synthesis, and electron transport. The quantity of iron in fresh ivy gourd is reported to be 0.90mg in 100g.

4.1.7. β-carotene

Beta carotene, a strong antioxidant can neutralize free radicals and reactive oxygen molecules which may lead to the development of cardiovascular diseases and cancer. From the table, (1) it was observed that about 0.78μg of β-carotene was present in 100g of ivy gourd.

4.1.8. Vitamin C

The antioxidant properties of vitamin C (ascorbic acid) and its role in collagen synthesis makes vitamin C a vital molecule for skin health and protect the body from ill effects of free radicals. Vitamin C content of ivy gourd under the study was estimated to 14.55mg/100g.

4.1.9. Sodium

Sodium is an element that the body needs for immune functions. Sodium occurs naturally in most foods. The body uses sodium to control blood pressure and blood volume. It regulates the total amount of water in the body and also plays a role in critical body functions. Sodium content of fresh ivy gourd was 1.83mg.

4.1.10. Potassium

Potassium is one of the most important electrolytes in the human body, and this helps to maintain a healthy balance of fluids in the body. It also helps to transmit electrical pulses to allow for proper nerve and muscle function. Potassium is also important for muscle contraction and in the transforming of nerve impulses in animals through action potential. The potassium content of ivy gourd was estimated as 2.10mg.

Table15. Nutrient profile of ivy gourd

Nutrients	**Values (per 100g)**
Protein	2.13g
Total minerals	0.51 g
Fiber	1.98 g
Carbohydrates	3.79 g
Calcium	45.25 mg
Iron	0.90 mg
β-Carotene	145 µg
Vitamin C	14.55 mg
Sodium	1.83 mg
Potassium	2.10mg

4.1.2. Determination of antioxidant activity

The total antioxidant activity of ivy gourd was studied by phosphomolibidinum method and antioxidant activity was expressed in terms of µg of ascorbic acid equivalents per gram of solvents used for the extraction of ivy gourd varieties. The antioxidant capacity of ivy gourd is presented in table (16). It was revealed that antioxidant activity was higher for petroleum ether extract followed by methanol extract and aqueous extract. The antioxidant activity of ivy gourd was 58.01µg/ml, 59.53µg/ml and 61.21µg/ml in petroleum ether, methanol and aqueous extract respectively.

Table 16. Total antioxidant activity of ivy gourd

Particulars	**IC_{50} Value (µg/ml)**
Petrolium ether	58.01
Methanol	59.53
Aqueous extract	61.21

4.1.2.1. Total Poly phenols

Phenols are secondary metabolites in plants. Which act as defence mechanisms against pathogens and predators. Phenols contribute the colour to the plants. In addition to their roles in plants, phenolic compounds in our diet may make available health benefits linked with reduced risk of chronic diseases (Boyer and Rui, 2004). Ivy gourd was observed contain 2.85mg of phenols.

4.1.2.2. Tannins

Tannins are water soluble poly phenols present in plants. Interactions between tannins and proteins lead to astringency (Cieslik *et al.*,2004). Ivy gourd was observed contain 10.71mg of tannins.

4.1.3. GLYCEMIC INDEX

The Glycemic Index (GI) is a relative ranking of carbohydrate in foods according to how they affect blood glucose levels. Carbohydrates with a low GI value are more slowly digested, absorbed and metabolised and cause a lower and slower rise in blood glucose and, therefore insulin levels. The GI is therefore, an index of ranking of the postprandial glycemic response to different sources of carbohydrate in comparison with a reference carbohydrate (Wolever, 1990).

To find out the glycemic index of ivy gourd, five subjects were selected from the College of Agriculture Vellayani. The subjects were in the age between 20- 25 years and having body weights between 40-60 kg and height between 150-170cm. Among the selected subjects, four of them were vegetarians and remaining were non-vegetarians.

All selected subjects were administered with 50g glucose and the blood sugar levels were monitored after 0,30,60,90,120 min. on the next day the subjects were given ivy gourd whose carbohydrate content was equivalent to 50g of glucose. Blood sugar levels were monitored. The results are depicted in table (17).

Table17. Glyceamic index of ivy gourd

Subjects	GI
SUBJECT 1	50.15
SUBJECT 2	51.68
SUBJECT 3	48.59
SUBJECT 4	47.62
SUBJECT 5	55.02
MEAN	**50.61**

The above table, (17) revealed that the glycemic index of ivy gourd was noticed 50.61.

4.2. Assessment of changes in nutrients and antioxidants with processing

As pointed out by Salunkhe *et al.,* (1981) in their account of assessment of nutritive value, quality, and stability of cruciferous vegetables during storage and subsequent processing, today's world is faced with an acute need to provide enough nutritive food for all people. Increased consciousness about nutrition, food, and health has significantly influenced our modem agriculture and food industry. If food processing is defined as including all treatments of foodstuffs from harvest to consumption, then more than 95% of our food may be considered as processed. In most cases, food processing and storage cause some reduction in the nutritional value of foods. Advances in food science and food technology have resulted in an increase in nutrient retention after processing. The challenge to the food processing industry is to minimize the loss of nutrients during processing while providing an adequate process to ensure an extended storage life. In addition, today's consumer better understands how to avoid excessive nutrient losses during food preparation.

4.2.1. Processing methods

Blanching (T_1), boiling (T_2) and drying (T3) were the processing methods applied to ivy gourd.

T1 : Blanching

Treatments of fruits and vegetables with boiling water or steam for a short period followed by cooling prior to processing is known as blanching (Siddappa *et al.*, 1998). Blanching is a heat process frequently applied to tissue systems prior to freezing, drying, or canning. The objective of the blanching process depends on the subsequent treatment of the foodstuffs. For example, blanching prior to freezing or drying is used primarily to inactivate enzymes which would contribute to undesirable changes in colour, flavour, or nutritive value during storage. Ivy gourd was washed and steamed in 100°C at 3 minutes and subsequently dipped in cold water. The method of Scow *et al.*, (1991) of using the minimum temperature and time for a better effect was administered in the present study.

T3: Drying

Vegetables were washed with tap water after removing manually inedible parts with a sharp knife and cutting into similar sizes and dried at 55°C.

T2: Boiling

Ivy gourd was boiled in distilled water (100°C) for 5 minutes. After boiling the water was drained off and analysed for nutrient changes. Table (4), depicts the chemical and nutritional characteristics of blanched (T1), boiled (T2), and dried (T3) ivy gourd along with control (T0). To assess the changes in nutrients and antioxidants with processing, the level of Such as protein, total minerals, fiber, carbohydrates, calcium, iron, β-carotene, sodium and potassium were determined.

Analysis of chemical and nutritional characteristics of the processed ivy gourd indicated that the protein levels ranged from 1.42 to 6.20 (g) and total minerals content ranged from 0.12 to 0.72 (g), fibre 1.98 to 0.95 (g), carbohydrate

Table18. Nutrient analysis of fresh and processed ivy gourd

Treatments	Protein (g/100g)	Total minerls (g/100g)	Fiber (%)	CHO (g/100 g)	Calcium (mg/100 g)	Iron (mg/ 100g)	β-Carotene (µg/100g)	Vitamn C (mg)	Sodium (mg/100g)	Potassium (mg/100g)
T1 (plain)	2.13	0.51	1.98	3.79	45.27	0.90	145	14.55	1.83	2.10
T2 (boiling)	1.42	0.12	1.35	2.13	42.13	0.16	120	7.69	0.99	1.97
T3 (Blanching)	1.68	0.13	1.69	2.73	43.70	0.34	128	7.79	1.00	1.98
T4 (Drying)	6.20	0.72	0.95	7.73	67.80	1.03	0.21	0.98	2.54	5.32
CD (0.05)	0.08	0.005	0.47	0.13	0.29	0.006	0.006	0.01	0.05	0.05

7.73 to 2.13 (g), calcium 67.80 to 42.13 (mg), iron 1.03 to 0.16 (mg), β carotene 145 to 0.21 (µg), vitamin C 14.55 to 0.98 (mg), sodium 0.99 to 2.54 (mg) and potassium 5.32 to 1.97(mg). Comparative analysis of data revealed that most nutrients were higher in dried ivy gourd samples except for fiber, vitamin C and β carotene. Fiber, vitamin C and β carotene was recorded to be higher in the fresh sample of ivy gourd followed by blanched sample of ivy gourd. While lowest nutrient content was observed in boiled sample of ivy gourd.

As inferred from CD values, it is clear that all the nutritional characteristics analysed in the processed ivy gourd namely protein, total minerals, fiber, carbohydrates, calcium, iron, vitamin C, β carotene, sodium and potassium were found to vary significantly with each other.

4.2. Total antioxidant activity

Total antioxidant activities of ivy gourd after different processing methods are presented in table. It was revealed that antioxidant activity was higher in petroleum ether followed by methanol and aqueous extract. The percentage of antioxidant activity of ivy gourd in petroleum ether ranged between 57.51 to 67.66 (µg/ml) in the case of methanolic extraction, it ranged between 58.76 to 68.25(µg/ml). Where as in the case of aqueous extraction, it ranges between 60.60 to 69.06(µg/ml). Highest antioxidant activity (IC_{50} value) was reported in fresh sample of ivy gourd, 57.51 (µg/ml), 60.60 (µg/ml) and 58.76 (µg/ml) petroleum ether, aqueous medium and methanol respectively.

The total antioxidant activity of ivy gourd with different processing methods is presented in Table (19).

Table19. Changes in total antioxidant activity of fresh and processed ivy gourd

Samples	IC_{50} value		
	Petroleum ether	Methanol	Aqueous extract
T1 (Fresh)	57.52	58.76	60.60
T2 (Boiled)	64.66	66.26	67.57
T3(Blanched)	61.67	63.11	67.56
T4 (Dried)	67.66	68.25	69.06
CD value (0.05%)	2.57	3.65	2.86

The concentration of sample that could scavenge 50 percent free radicals (IC_{50}) was used to determine antioxidant capacity of the sample compared to standard. The samples having lowest IC_{50} value had the highest antioxidant capacity. According to Blois (1992), "samples that had $IC_{50} < 50$ ppm, was considered as very strong antioxidant, 50-100 ppm strong antioxidant, 101-150 ppm as medium antioxidants, while weak antioxidant had $IC_{50} > 150$ ppm."

4.2.1. Phenol and Tannin content of treatments

Secondary metabolites from plants have important biological and pharmacological activities, such as anti-oxidative, anti-allergic, antibiotic, hypoglycemic and anti-carcinogenic (Borneo *et al.,* 2008; Katalinic *et al.,* 2004; Mulabagal and Tsay, 2004). Phenols are secondary metabolites in plants which act as defence mechanisms against pathogens , parasites and predator. It also provides many health benefits and reduces the risk of chronic diseases (Boyer and Rui, 2004)

The name 'tannin' is derived from the French word 'tanin' (tanning substance) and is used for a range of natural polyphenols (Ashok and Upadhyaya 2012). Tannins are water soluble polyphenols present in plant foods, responsible

for reduced feed intake, growth rate and protein digestibility in experimental animals (Jackson, 1973)

The present study, fresh sample of ivy gourd showed maximum tannin content (10 mg/100g) and it was significantly different from the other samples. The tannin content was found to be minimum for dried ivy gourd powder 0.75(mg/100g) followed by boiled 1.40 (mg/100g) and blanched 1.89 (mg/100g) samples of ivy gourd.

In the case of phenols content of samples, the total phenol content of samples were found to be ranged between 0.20 – 2.62 mg/100g. Phenol content was found to be more in fresh ivy gourd sample (2.62mg/100g). When the data was statistically analyzed, it was found that significant differences existed between the various processed treatments.

Table20. Phenols and tannin contents of fresh and processed ivy gourd

Samples	Phenols (mg/100g)	Tannins (mg/100g)
T1 (Fresh sample)	2.62	10.00
T2 (Boiled)	0.63	1.89
T3(Blanched)	0.73	1.40
T4 (Dried)	0.20	0.75
CD value (0.05%)	0.57	1.40

4.3. Standardization and product development on ivy gourd.

Standardisation and product development play a key role in growth of food industries. According to Soharb, (2000) standardisation encapsulates technological results and becomes a vehicle for technology transfer while quality is the key for facilitating trade and satisfying consumers. According to Carson *et*

al., (2009), the standardization process can be summarized in three phases: product verification consist of viewing the product in detail, preparing it, verifying its yield, and recording changes. One of the fore most purposes of standardization is to facilitate the smooth movement of materials and products through all stages of production in any industrial activity, starting from the raw material to finished products, then the dealer and finally to the retailer and consumers (Poduval, 2002)

Food processing is the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption by humans or animals either at the home or by the food processing industry. The principal reason for the processing food is to make it microbiologically safe to eat. Processing food can transform unpalatable or unacceptable raw materials into attractive and desirable product.

4.3.1. Standardization of ivy gourd based salads (RTE)

Ready to eat foods are foods (RTE) that require no additional cooking before serving. These are economical convenient and flavoured foods, suitable for daily consumption by all age group (Manay and swamy, 2000). In these present study ivy gourd based salads was selected as ready to eat product. Salad is a term broadly applied to many food preparations that have mixture of chopped or sliced ingredients which may be mostly fruits and vegetables in their raw form. Raw fruits and vegetables are highly nutritious.

4.3.1.1. Preliminary processing

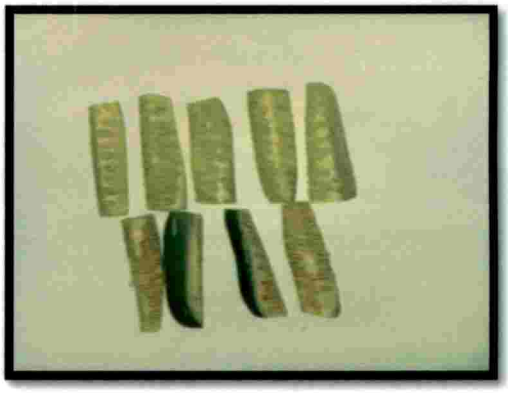
4.3.1.1.1. Standardization of dimensions of ivy gourd

Food presentation is just as essential to the success of a dish as its taste and flavour. The way the food looks on the plate is what tempts the eyes and makes a person want to taste it. The shape, size, gloss, and vibrant color of a fruit or vegetable attract us and entices us into picking it up by hand. So the shape of the cut vegetable is very important.

Cubic

Roll Cutting

Slicing



Batonet

Dice

Plate 2. Ivy gourd slices dimensions

The mean value of scores allotted by the panel for over all visual quality was worked out. Over all visual quality of dimensions of slices revealed that S3 (slicing) scored the highest value (42.69) for the preparation of salads. The lowest mean rank scores were obtained by S5 (12.20). The values of S4 and S5 were found to be on par (CD= 18.07 at 5% level of significance.) hence S3 was selected for further pre-treatments.

Table21. OVQ scores of dimensions of slices

Treatments	OVQ score
S1(Dice)	33.59
S2(Batonet)	23.78
S3 (Slicing)	42.7
S4(Roll cutting)	15.01
S5 (Cubic)	12.20
CD (0.05%)	18.07

(OVQ scores indicate mean rank values)

4.3.1.1.2. Standardization of pre-treatment media

In order to control the slimy nature of ivy gourd pre-treatment is essential. The pretreatment media comprised of different proportions of (2 to 3 percentage) salt and vinegar.

On the analysis of OVQ scores, the treatment T8 with 3% salt and 3% vinegar was observed to have the highest mean rank score (67.85) from among 9 treatments. This was followed by T9 and T7 (3% salt and 1% vinegar and 3% salt and 2% vinegar respectively). T3 scored lowest value among 9 treatments. These differences in values among treatments were found to be statistically significant too.

Table22. OVQ scores of pre-treatment media

SL. NO.	Treatments (Salt %+ vinegar %)	OVQ scores
1	T1 (1-1)	36.65
2	T2 (1- 2)	33.20
3	T3 (1-3)	30.50
4	T4 (2-1)	44.00
5	T5 (2-2)	49.80
6	T6 (2-3)	38.45
7	T7 (3-2)	54.50
8	T8 (3-3)	67.85
9	T9 (3-1)	54.55
	CD (0.05%) 15.50	

(OVQ scores indicate mean rank values)

4.3.1.1.3. Standardization of immersion time

In the view of Firuerora *et al.,* (2000) dipping in salt water solution will help to create appropriate conditions for the growth of micro-organisams that form acids, which will in turn preserve the produce and also improve the colour, odour and taste.

The immersion time of raw materials in pre-treatment media was set at different time durations such as 10 min, 15 min, 20 min,30 min,45 min, and 60 min. on the evaluation of OVQ scores T1 scored the highest mean rank value (52.01) and T_6 scored the lowest mean rank value (14.21). Thus T1 was selected as best immersion time for raw material. T_5 and T_6 were found to be on par as revealed by the CD values.

Table23. OVQ scores of immersion time

Sl no	Treatments	OVQ scores
1	T1 (10)	52.01
2	T2 (15)	44.09
3	T3 (20)	32.2
4	T4 (30)	22.5
5	T5 (45)	17.32
6	T6 (60)	14.21
	CD (0.05%)	22.02

(OVQ scores indicated mean rank values)

4.3.2. Formulations of Ready to Eat Products from ivy gourd (Salads)

Changing lifestyles have influenced majority of people to consume products that comes under ready to eat (RTE) category. A "ready-to-eat" food product may be defined as any food product which does not require any elaborate processing procedures before being eaten.

In the present study different combinations of ingredients were formulated keeping ivy gourd as the major ingredient. A sensory panel evaluated the various formulations with respect to the five parameters namely, appearance, colour, texture, flavour, taste and overall acceptability. The analysed data is presented in Table (23).

Appearance

First impression of food depends on its appearance. The mean rank values for appearance of six formulations of salads ranged from 22.80- 46.90. The highest mean rank value (46.90) for appearance was observed for SD6 which was combination of salad dressing with mayonnaise. Analysis of score revealed that the formulation of SD6 was significantly superior in appearance than other formulations.

Colour

Color is one of the major attributes which affects the consumer perception of quality (Hutchings, 1999), holds a prominent position in food acceptance, and can be a predictor of non sensory attributes like moisture content, over-processing, and pigment content (Andress *et al.,* 2006). Among the formulations SD6 was noted to get the highest mean rank value (38.50) while SD2 recorded the least mean rank value (22.80) for this parameter. There was no significant difference in these score of formulations.

Texture

Texture is an overall assessment of the sensations of the mouth and hand. The highest mean rank value (35.65) in texture was obtained for the formulation SD3. The formulations SD3 with curd as salad dressing got the least mean rank value (26.30) among the treatments.

Flavour

The flavour of a food product is referred as aroma. It is due to volatile compounds such as alcohols, esters, aldehydes, and carbonyl compounds. As per the flavour evaluation, the mean rank value obtained for the parameter flavour of the formulated salads is shown in table. The kruskal values revealed that there was significant difference in the flavour of the salads. SD1 obtained the highest mean rank value (42.65) and SD2 got the lowest mean rank value (22.45).

Taste

Taste is the major attribute which determine the acceptability of a food. The difference in the score were found to be significant. It ranged from 43.30-22.85. maximum mean rank value was noticed for the formulation of SD6. SD4 obtained least mean rank value (22.85).

Overall acceptability

The overall acceptability of the formulated ivy gourd based salads depends on the sum total of the scores obtained for the various parameters viz performance of the ivy gourd based salads on the whole, considering the judges perception on different sensory attributes.

The overall mean rank value for different formulations of ivy gourd salads ranged from 21.65- 41.20. Among the six formulations, maximum mean rank score secured by SD6 (salad dressing with mayonnaise) (41.20), followed by SD5 (salad dressing with pepper) (39.30) and SD1 (lime) (32.80). Least preference for overall acceptability was obtained by SD2 (21.85) and SD4 (21.65).

Table24. Sensory evaluation of salads formulations

Formulations	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
SD_1 (Lime)	32.30	31.70	31.85	42.65	26.10	32.80
SD_2 (Curd)	22.80	22.80	26.30	22.45	27.25	21.85
SD_3(commercial salad dressings)	26.15	29.65	27.75	26.70	23.75	26.20
SD_4(Salad dressings with olive oil)	27.05	28.45	26.50	24.20	22.85	21.65
SD_5 (Salad dressing with pepper)	27.80	31.90	35.40	39.20	39.75	39.30
SD_6 (Salad dressing with mayonnaise)	46.90	38.50	35.65	27.80	43.30	41.20
K value	13.43	4.89	3.60	11.92	13.30	12.23
$X^2(0.05)$	11.070					

(Scores indicate mean rank values)

4.3.3. Evaluation of freshness of RTE (salad) product.

The sensory evaluation of ivy gourd based salads was done to find the freshness of salads after four hours and the data is depicted in table (25).

Table25. Sensory evaluation of salads after four hours of preparation

Formulations	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
SD_1 (Lime)	31.10	30.70	27.22	32.90	31.70	33.20
SD_2 (Curd)	28.90	28.55	24.77	27.70	25.30	23.25
SD_3(commercial salad dressings)	27.05	27.25	22.33	23.10	27.70	20.40
SD_4(Salad dressings with olive oil)	28.55	26.75	20.27	21.10	20.90	18.55
SD_5 (Salad dressing with pepper)	32.60	34.30	33.77	37.50	36.50	42.30
SD_6 (Salad dressing with mayonnaise)	34.80	35.45	36.61	40.70	40.90	45.30
K value	1.54	2.16	9.09	12.55	10.47	22.29
$X^2(0.05)$	11.070					

(Scores indicate mean rank values)

Appearance

The score obtained for the parameter of appearance for the six types of ivy gourd based salads was analysed.,SD6 comprising of commercial salad dressing with mayonnaise got the maximum score of (34.80) followed by SD5 (32.60) and SD1 (31.10). There was no significant difference at 5 percent level for six combinations of ivy gourd salads.

Colour

Among the samples, SD6 got the highest score (35.35) followed by SD5 (30.70). SD4 (26.75) recorded the least mean score for this attribute. There was no significant difference noted in this parameter among the treatments.

Flavor

Flavor evaluation of samples was assessed and the mean score obtained was seen its range from 20.77- 36.61. The highest mean score was recorded by SD6 (36.61). The least mean score value was secured by SD4 (20.77). the statistical data showed that there was no significant difference in mean rank values for flavor of the formulated RTE salads after four hours.

Texture

Table(10) depicts that the mean rank values obtained for freshness of texture for the formulated salads. Statistical analysis of data showed that, there was significant difference in the scores. It ranged from 21.10-40.70. SD6 received the highest mean rank value (40.70) in this attributes, followed by SD5 (37.50). SD1 received least mean rank value (21.10).

Taste

The obtained mean rank value for taste of ivy gourd salads after four hours ranged from 20.90- 40.90. SD6 gained the highest mean rank value (40.90) and SD4 got the lowest mean rank value (20.90) for this attribute.

Overall acceptability

Table (25) reveals the overall acceptability of the different formulations of salads from ivy gourd. The kruskal values revealed that there was significant difference in the mean rank values obtained, it ranged from 20.40- 45.30. SD 6 scored maximum mean rank value (45.30), followed by SD5 with mean rank value (42.30) and SD1 (32.30). SD4 (18.55) and SD3 (20.40) got the least mean score.

On the basis of kruskal values SD6, SD5 and SD1 were fresh after four hours and selected as the best combinations of ivy gourd salads.

4.4. Quality analysis of Ivy gourd based dehydrated products

Ivy gourd should be used for consumption immediately after harvest. The availability of ivy gourd could be extended by dehydration. The demand for dehydrated vegetable is increasing rapidly both in the domestic and international markets. Ratti (2001) reported that drying process is related to identification of the operating conditions. This more popular due to its low cost and high quality of dried foods in terms of fast rehydration capacity, little shrinkage and attractive colour.

The purpose of this part of present investigation was to evaluate the effect of pre-treatments on the quality characteristics of dehydrated ivy gourd slices and its storage stability.

4.4.1. Physical characteristics of dehydrated ivy gourd

Physical characteristics are associated with the overall quality of the developed food product. Understanding the physical properties of foods is important as they are used in process design, product and process optimization, product development, food quality control and food process modelling. Physical characteristics ultimately determine their perceived quality, sensory attributes and behaviour during production, storage and consumption. It describes the unique, characteristic way a food material responds to physical treatments involving mechanical, thermal, electrical, optical, sonic, and electromagnetic processes. A better understanding of the way food materials respond to physical and chemical treatments allows for optimum design of food equipment and processes to insure food quality and safety. Knowledge of a food's physical properties is necessary for defining and quantifying a description of the food material, providing basic data for food engineering and unit operations, and predicting behaviour of new food materials (Almanza *et al.,* 2015).

Drying after blanching

Plain drying

Drying after blanching
and smearing with spices

Drying after blanching and
treated with 0.2%KM

Plate 3. Ivy gourd based dehydrated products

4.4.1.1. Moisture loss

Foods are composed of nothing in greater amount than water. The amount of water in a food is denoted by its moisture content. A food's storability is directly related to moisture content, along with temperature and oxygen availability. High amounts of available moisture lead to mold growth and microbial activity. Moisture in the air affects the food's physical properties and determines the potential for the air to be used in drying operations.

The moisture loss of dehydrated ivy gourd ranged from 94.32-95.80 per cent. The ANOVA table indicated that there was significant difference in moisture content of ivy gourd dehydrated treatments. However these values were in the safe range with respect to shelf life.

The highest moisture loss was noted for drying after blanching and treated with 0.2% KMS (95.80%) and the lowest moisture loss was observed for drying in plain drying (94.32).

4.4.1.2. Drying time

Drying time of dehydrated ivy gourd ranged from 9 – 9.45 Hrs. there was significant difference in dying time of treatments. More drying time was secured for plain drying (9.30 hrs). The drying time of drying after blanching and smearing with spices was 9.15 hrs. While drying after blanching and treated with 0.2% KMS and drying after blanching were on par.

4.4.1.3. Dehydration ratio

Drying brings about a substantial reduction in weight and volume there by making it suitable for packaging, storage and transportation and also enables storability of the product under ambient temperature (Senadeera *et al.,* 2005) dehydration ratio ranged from 0.30 – 0.58. The dehydration ratio of drying after blanching and smearing with spices found to be higher (0.58). While lowest dehydration ratio found in drying after blanching and treated with 0.2% KMS (0.30).

Table26. Physical properties of dehydrated ivy gourd

Treatments	Moisture loss (%)	Drying time (Hrs)	Dehydration ratio
D1 (plain drying)	94.32	9.30	0.42
D2 (Drying after blanching)	95.77	9.00	0.34
D3 (Drying after blanching and treated with 0.2% KMS.)	95.80	9.00	0.30
D4 (Drying after blanching and smearing with spices.)	95.52	9.15	0.58
CD (0.05)	0.93	0.05	0.01

4.4.2. Shelf stability

Shelf life is the recommendation of time that product can be stored, during which the defined quality of a specified proportion of goods remains acceptable under expected condition of distribution, storage and display (Azanha and Faria, 2005). Shelf stability of dehydrated ivy gourd were analysed by assessing moisture and microbial profile for three months at monthly intervals.

4.4.2.1. Moisture content of stored product

Moisture content is one of the most commonly measured properties of food materials. The moisture content of dehydrated ivy gourd packed in poly propylene covers was analysed. Initial moisture content of plain dried ivy gourd samples was 5.20 per cent. At the end of first month plain samples did not show any increase in moisture content, it remained constant. At the end of second month of storage it was 5.50 percent. The data reveals that there was slight increase in the moisture content of plain ivy gourd samples during storage.

As for drying after blanching , initial moisture content was 5.05 percent and at the end of first month moisture content of blanched ivy gourd showed little increase

in the moisture content at the end of third month ie 5.43. in the case of drying after blanching and treated with 0.2% KMS moisture content after the first and second month remained constant (5.05 percent). After the third month of storage it increased into 5.12 percent.

As for drying after blanching and smearing with spices initial moisture content was 5.56 percent. At the end of first month it increased to 5.61 percent and at the end of second month it again increased in to 5.72 percent. By the end of third month the moisture content remained constant. Among the 4 treatments the moisture content was comparatively low in drying after blanching and treating with 0.2% KMS.

Table27. Moisture content of stored dehydrated ivy gourd (%).

Storage periods	**D1 (plain drying)**	**D2 (Drying after blanching)**	**D3 (Drying after blanching and treated with 0.2% KMS.)**	**D4 (Drying after blanching and smearing with spices.)**
Initial month	5.20	5.05	5.01	5.56
After first month	5.20	5.06	5.05	5.61
After second Month	5.50	5.36	5.05	5.72
After third month	5.55	5.43	5.12	5.72
CD (0.05)	0.017	0.018	0.008	0.018

(Values indicated are mean of 3 replications)

4.4.2.2. Microbial profile of the developed product

Microbial population in the processed food is an important factor, which determines the quality and safety of the products. The various forms of microbiological spoilage could be avoided to a large degree by a wide range of preservation techniques, most of which act by preventing or inhibiting microbial growth (Gould, 1996). Microbial analyses of stored ivy gourd based dehydrated

products were done in order to ascertain the shelf stability of these products. Processing methods and addition of additives were assumed to reduce the microbial load, which would enhance the keeping quality of the product. The population of bacteria, fungi, actinomycetes and coliforms were determined using Nutrient agar (NA), Potato Dextrose Agar with Rose Bengal (PDARB), Ken Knight Agar (KEN) and Eosin Methylene Blue (EMB) respectively. This was done by serial dilution of the samples followed by pour plating technique suggested by Johnson and Curl (1972).

During the storage period no coliforms and actinomycete colonies were found to appear in the dehydrated ivy gourd products. After the first month of storage there were no microbial colonies. During second and third month of storage bacterial and fungal colonies were present. Microbial load showed an increasing trend when analysed at two months of storage. However, microbial load were found to be within the permissible limit.

The data on bacterial colonies of ivy gourd based dehydrated products revealed that the mean score of microbial count differed among the products and the score was having highest in plain dried ivy gourd. Lowest fungal colonies were present in drying after blanching and treating with 0.2% KMS which ranged from 2.66-5 CFU/g^3 during storage. In plain dried ivy gourd samples the count ranged from $10.66\text{-}16.33\times10^3$ CFU/g^{-1}during storage. Drying after blanching and treating with 0.2%KMS recorded lowest bacterial load ranging from 8.66-12.66 CFU/g^{-1}. The storage study of ivy gourd dehydrated product revealed that all the four treatments were microbiologically safe and acceptable up to three months of storage and drying after blanching and treated with 0.2%KMS selected was the best treatment which exhibited highest acceptability during storage.

Table28. Microbial count of dehydrated ivy gourd

	Fungi (CFU×10 $^{-2}$/g)			Bacteria (CFU×10 $^{-3}$/g)		
Treatment	**M1**	**M2**	**M3**	**M1**	**M2**	**M3**
P1(Plain drying)	0	4.33	6.33	0	10.66	16.33
P2 (Drying after blanching)	0	1.00	2.33	0	6.33	8.33
P3(drying after blanching & treated with 0.2% KMS)	0	0.33	1.00	0	3.33	5.66
P4 (Drying after blanching & smearing with spices)	0	2.66	5.00	0	8.66	12.66
Mean A	0	2.08	3.66	0	7.24	10.74
CD (0.05)		NS	2.81		4.61	4.90

4.5. Standardisation of ivy gourd based RTC olath mix.

Ready To Cook products are primarily the target for persons with busy life styles, convenient seekers and also working women. The newly emerging era of fast foods, convenient foods and instant foods are becoming increasingly popular among Indian house holding, in the present study one such Ready to Cook product was formulated that is 'Olath mix', keeping the ivy gourd slices as the major ingredients and varying the amount and proportions of adjuncts used.

4.5.1. Preliminary processing

4.5.1.1. Standardization of size and thickness of slices

Size and shape may be influenced by cultivar, maturity, production inputs, and the growing environment. It is important for fruits and vegetables to be of uniform size and characteristic shape (Mitcham *et al.,* 1996).The mean rank

values of scores allotted by the panel members for overall visual quality was worked out. Over all visual quality (OVQ) of ivy gourd slices revealed that T2 with ivy gourd longitudinally cut into 1/4 scored the highest value (62.30) for the preparation of ivy gourd based Olath mix. The values were found to be on par.

Table29. OVQ score of ivy gourd slices dimensions

TREATMENTS	OVQ scores
T1 (longitudinal 1/8)	45.45
T2 (longitudinal ¼)	62.30
T3 (longitudinal 1/2)	44.00
T4 (longitudinal 1/16)	27.35
T5 (longitudinal 1/14)	26.05
T6 (rounded ¼)	37.50
T7 (rounded 1/8)	34.80
T8 (rounded 1/16)	46.55
CD (0.05)	32.22

4.5.1.2. Standardization of pre-treatment media

Pre-treatment media comprising of salt (0.5%), KMS (0.2%), citric acid (0.1%) and there combinations were used. On the analysis of OVQ scores, the treatment T4 with salt (0.5%) and KMS (0.2%) was observed to have highest score (40.75) the treatment T5 (Citric acid 0.2%) and T3 (KMS(0.2%) and citric acid(0.2%) showed the lowest score. Hence T4 was selected among five treatments as best pre-treatment media for ivy gourd slices.

Table30. OVQ scores of pre-treated ivy gourd slices

Treatments	OVQ scores
T1 (salt 0.5%)	32.50
T2 (KMS 0.2%)	21.00
T3 (KMS 0.2% + citric acid 0.2%)	18.75
T5 (citric acid 0.2%)	16.75
T4 (salt 0.5%+ KMS 0.2%)	40.75
CD (0.05)	18.07

4.5.1.3. Standardization of immersion time

Immersion time of ivy gourd slices in pre-treated media were set in different time duration such as 10 min, 15min, 20min, 30min, 45min and 60min. Analysis of OVQ treatment T1 (10min) gave the highest score for immersion time of ivy gourd slices. While T4 (45min) was recorded lower score than other treatments.

Table31. OVQ evaluation of Immersion time

Treatments	OVQ scores
T1 (10 min)	44.45
T2 (15min)	30.70
T3 (20 min)	32.85
T4 (30 min)	25.50
T5 (45 min)	21.45
T6 (60 min)	28.05
CD (0.05)	22.02

4.5.2. Formulation of Ready to Cook dehydrated product from ivy gourd

According to Solanki, (2000) there is an urgent need to develop low cost ready to cook mix to improve the nutritional status of our population along with saving time.

In the present study, different combinations of dehydrated RTC products were formulated keeping the ivy gourd slices as the major ingredient and varying the amount of adjuncts used. A sensory panel comprising of 10 judges evaluated the various formulations with respect to the five parameters namely appearance, colour, texture, flavour, taste and overall acceptability.

Five combinations were formulated for RTC Olath mix. The sensory evaluation of formulated RTC mixes were done by panel of 10 judges and the data is presented in the table (17).

Appearance

The mean rank values for appearance of five formulations of Olath mix ranged from 16.70-34.25. The highest mean rank value (34.25) for appearance was observed in RT1 which was the combination of Ivy gourd, crushed red chilly, garlic, turmeric powder and curry leaves. Analysis of scores revealed that the formulation RT1 was significantly superior in appearance than many of the formulations.

Colour

Colour is an important parameter for consumer acceptance of any food product. It is one of the important visual attributes that has been used to judge the overall quality of foods for a very long time. Among the formulations RT3 was noted to get highest mean rank value (31.25). Which comprised of Ivy gourd, chilli powder, onion, garlic, turmeric powder and curry leaves. While RT4 was recorded least mean rank value (17.40) for this parameter. There was no significant difference in these parameters.

Texture

Texture includes the physical property of food stuffs as evaluated by the eye, skin and muscle senses located in the mouth. The highest mean rank value (35.10) in texture was obtained for the formulation RT1. The formulations RT5 with constituents Ivy gourd ,pepper, green chilli, onion, garlic, turmeric powder, curry leaves and big jeera got the least mean rank value (19.70) among the treatments.

Flavour

Odour preference is generated by stimulation of sensory cells by specific volatile compounds present in food. The flavour of different formulations of Olath mix ranged from 15.95-32.75. The highest mean rank value was recorded by RT1 (32.75) and the least mean rank value scored in RT4 (15.95). The differences in values were statistically significant too.

Taste

Taste is the major attributes which determines the acceptability of a food. It is the sensation produced when a substance in the mouth reacts chemically with receptors of the taste buds. Superior taste was found for RT1 with the highest mean rank score of 38.00 and the least was noted in RT4 (13.40). The difference in these score were also found to be significant.

Overall acceptability

Overall acceptability also clearly depicts that among the five formulations RT1 obtained maximum mean rank value (38.45) and therefore highest preference. Least mean rank value and less preference were recorded for RT4 (14.00). The result indicates that there was significant difference in the rank scores obtained for the parameters of the formulations except RT3. On the basis of analysis of scores RT1 was selected as best combination.

Table32. Sensory evaluation of RTC mixes

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
RT1	34.25	30.55	35.10	32.75	38.00	38.45
RT2	18.85	23.80	23.40	20.85	19.50	18.40
RT3	28.50	31.25	28.90	27.45	30.95	30.85
RT4	16.70	17.40	20.40	15.95	13.40	14.00
RT5	29.20	24.50	19.70	30.50	25.65	25.80
K value	12.46	7.67	10.50	11.48	20.03	18.15
$\chi^2_{(0.05)}$	9.49					

4.5.3. Standardization of cooking methods of ready to cook Olath mix

The cooking procedure and reconstitution time were standardized systematically to suit consumer requirement.

4.5.3.1. Optimization of reconstitution time of RTC products

Foods are dried in order to preserve them for longer periods of time. Prior to consumption preserved dried pieces of food generally require as much of there original moisture to be restored, so that soluble constituents of cells are returned to their original state. According to Boyer, (2009) dried fruits and vegetables may be reconstituted by soaking the food in water. Time for reconstituting will depend on the size and shape of the food. Most dried fruits can be reconstituted within 8 hours, whereas most dried vegetables take only 2 hours. One cup of dried vegetable will yield approximately 2 cups of reconstituted vegetable. Rehydration can be considered as a remedy to the injury in the material caused by drying and treatments proceeding dehydration (Minn and Magee, 2003).

The formulated Ready To Cook mixes was reconstituted by various treatments. Initially the measured quantities of mixes were soaked in plain cold water for 10 min, 15min, 20min, 30min and 45 min. The reconstitution time was evaluated

with respect to OVQ scores of the product for appearance. When the OVQ scores were analysed, treatment T4 was found to be get the highest mean rank value (45.20) and T1 got lowest mean rank score (18.90). The score ranged from 18.90-45.20. There for 30 min reconstitution selected as optimum time duration for Olath mix.

Table (18) presents the data of OVQ evaluation of reconstitution time of formulated Olath mix.

Table33. OVQ scores of reconstitution time

Sl.no	Treatments	OVQ scores
1	T1(10)	18.90
2	T2 (15)	20.75
3	T3 (20)	27.15
4	T4 (30)	45.20
5	T5 (45)	32.60
	CD (0.05)	4.62

4.5.3.2 Optimization of cooking procedure

The time required for the preparation of the product was observed in order to determine the ease of preparation. Products which can be cooked using less energy will have a large potential (Nagarajan, 2000). Direction regarding using a packed commodity is needed at the consumer level. Optimizations of cooking procedures of dehydrated mixes were conducted after various treatments. Treatments were evaluated on the basis of organolaptic evaluation by panel of 10 members.

Table (34), presents the evaluation of cooking procedure viz., cooking in plain hot water (RC1), Cooking in strained hot water (RC2), Cooking in plain cold water (RC3) and Cooking in strained cold water (RC4).

Table34. Sensory evaluation of cooking procedures

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
RC1	19.00	20.55	22.25	24.50	24.10	22.65
RC2	29.35	23.75	23.25	27.90	27.15	27.90
RC3	17.60	17.60	19.80	15.65	17.25	13.77
RC4	16.05	20.10	16.70	13.95	13.50	12.38
K value	9.11	1.47	2.00	10.59	9.25	12.69
$\chi^2_{(0.05)}$	7.82					

Appearance

When the kruskal values for appearance was analysed RC2 (cooking in strained hot water) obtained significantly higher mean rank value (29.35).as compared to other formulations and RC4 (Cooking in strained cold water) got the least mean rank value.

Colour

The mean rank value of colour ranged from 17.60-23.75. Among the four treatments RC2 secured the highest mean rank value (23.75) and the least mean rank value was obtained by RC3 *i.e.* Cooking in plain cold water (17.60). The data on the mean scores revealed that there was no significant difference obtained for colour of different treatments.

Flavour

Flavour is unitary the experience which includes sensations of taste, smell, and pressure, and often cutaneous sensations. The difference in the scores obtained for this attribute was found to be significant. Maximum mean score

value was noticed for RC2 (27.90), followed by RC1 (Cooking in plain hot water) with mean rank value of 24.50 and least mean rank value obtained by RC4 (13.95)

Texture

Analysis of data showed that, there was no significant difference among the scores. It ranged from 16.70-23.25. RC2 received the highest mean rank value (23.25) for this parameter followed by RC1 with the mean rank value 22.25. RC4 obtained the least mean rank value 16.70.

Taste

The differences in the scores of taste were found to be significant among most of the cooking methods. It ranged from 13.50-27.15. Maximum mean rank value was noticed forRC2 (27.15). RC4 obtained least mean rank value (13.50), which was significant difference with RC1 and RC2

Overall acceptability

Table (34) explains the overall acceptability of Olath mix after the four cooking procedures. RC2 was ranked first with maximum mean rank value (27.90), RC1 placed second with the mean rank value 22.65 and RC4 got the least mean rank values 12.38.

On the basis of kruskal values RC2 (cooking in strained hot water) was selected as the best cooking procedure for Olath mix.

4.5.4. Cooking characteristics

4.5.4.1. Optimization of cooking time of dehydrated RTC mix.

Optimization of cooking time of dehydrated mix is also an important information to be conveyed at the consumer level. Formulation 1 comprising of Ivy gourd, crushed red chilli, onion, garlic, turmeric powder and curry leaves were cooked at various time duration 6-15 min. The product was evaluated on the basis of organolaptic evaluation judged by 10 panel members. The results of sensory evaluation are presented in table (35).

Table35. Sensory scores of cooking time dehydrated RTC mix.

Formulations	Mean rank values					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
R1 (6min)	10.75	19.80	15.45	9.50	14.45	9.15
R2 (8min)	11.90	16.05	19.15	13.00	15.00	12.55
R3 (10min)	26.15	23.85	21.65	27.75	22.60	27.10
R4 (15min)	33.20	22.30	25.70	31.75	29.95	33.20
K value	28.03	2.91	4.65	27.11	12.84	29.19
$\chi^2_{(0.05)}$	7.82					

Appearance

The mean rank score obtained for appearance of the formulated RTC mix ranged from 10.75-33.20. Statistical analysis showed that there was significant difference in the mean rank values of appearance of Olath mix (between R1 and R4). R4 (15min cooking time) was found to be give the highest mean rank value (33.20) and R1 got the least score (10.75).

Colour

The mean rank values obtained for colour parameter ranged from 16.05-23.85. Statistical analysis depicts that treatment R3 received the maximum mean rank value (23.85) and the least mean rank value obtained for R2 (16.05).

Flavor

The mean rank value of flavour for different treatments were evaluated and the mean rank values ranged from 9.50-31.75 The highest mean rank value was recorded by R4 and least mean rank scored by R1 (9.50) . However there was no significant difference between flavours of the four different treatments.

Texture

The texture indicates whether a food is thick or thin, free flowing or dense. The scores for texture of treatments revealed that highest mean rank score was obtained for S R4 (25.70) and least for R1 (9.50). The data revealed that the values were no significant different.

Taste

The taste of the four different treatments ranged from 14.45 to 29.95. The highest mean rank value was obtained by S R4 having a mean rank value of 29.95 and least mean rank value was scored by R1. The differences in the scores were found to be significant.

Overall acceptability

Among the five formulations R4 obtained highest mean rank value (33.20) and least mean rank value was obtained by R1 (9.15) for overall acceptability. However, the results indicate that there was significant difference in overall acceptability. On the basis of analysis of scores R4 was selected as optimum cooking time for RTC mix.

4.5.4.2. Cooked weight of RTC olath mix

30g of dry RTC dry olath mix when cooked with 500 ml of water yielded 70g of product.

4.5.5. Optimization of additional ingredients to be added

4.5.5.1. Addition of coconut into RTC mix

To give useful hints to the consumers as to the additional perishable ingredients to be added before serving, the amount of coconut to be added was standardized. It was standardized after trials in different level. The amount ranged from 10-50g per 50g of dry RTC mixes. Five variations were tried and evaluated by a sensory panel.

Table36. Sensory evaluations on RTC mix with addition of coconut

Treatments	Sensory scores on RTC mix adding coconut					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
	Mean rank	Mean rank	Mean rank	Mean rank	Mean rank	Mean rank
C1 (10g)	11.25	12.60	9.20	10.95	9.35	7.05
C2 (20g)	30.65	33.75	31.55	34.60	34.70	34.70
C3 (30g)	40.60	38.55	39.90	38.70	40.20	42.95
C4 (40g)	28.95	22.65	28.40	30.50	26.60	28.15
C5 (50g)	16.05	19.95	18.45	12.75	16.65	14.65
K value	27.53	21.94	28.06	32.83	32.18	40.33
$\chi^2_{(0.05)}$						9.49

Appearance

The appearance parameter increases the appeal of a product. In Olath mix, the treatment C3 (30g) obtained the highest mean rank value (40.60) for appearance compared to the other 5 formulations. The treatment C1 with 10g of coconut obtained the lowest mean rank value. The differences among the scores were found to be significant.

Colour

The mean rank value of colour ranged between 12.60-38.55. Among the five formulations, C3 obtained highest mean rank value (38.55). T2 ranked second with the mean rank value (33.75). While T1 scored the least mean rank value (12.60).

Flavor

As revealed in table maximum mean rank value (39.90) was secured by C3, followed by C2 (31.55) and C1 obtained the minimum mean rank value (9.20). Statistical analysis revealed that values were significantly different.

Texture

The result points out that, the mean rank values for texture ranged from 10.95-38.70. From the table it was found that, highest mean rank value was recorded by C3 (38.70), C2 ranked second with the mean value (34.60) and C1 scored the least mean rank value (9.35).

Taste

As for this parameter mean values revealed that there was significant difference in the taste of treatments. The mean rank value ranged from 9.35- 40. Among the four treatments, C3 was observed to get highest mean rank value (40) C2 was placed second with the mean rank value (34.70) and least mean rank value was scored by C1 (10g) with the score (9.35)

Overall acceptability

The score depicted in table revealed that C3(addition of 30g coconut) obtained the highest mean rank value (42.95), followed by C2 with mean rank value (34.70) and the least mean rank value (7.05) was obtained for treatment C1.

The result shown in table on sensory evaluation indicated that, the scores received for various parameters such as appearance, colour, flavor, texture taste and overall acceptability were significantly different. The statistical data noted that C3 (30g) secured the highest mean rank value for all parameters, followed by C2 (20g). it was thus concluded that C3 (30g) was the best treatment to get superior qualities during cooking of Olath mix.

4.5.5.2. Addition of coconut oil into Olath mix

Like coconut scrapings, coconut oil too was added to enhance the taste and flavor of dishes. The amount of oil added into Olath mix was ranged 1.5ml-5.0ml in five different treatments for 50g of dry mix. The results of sensory evaluation are discussed herewith.

Table37. Sensory evaluation of RTC with addition of Oil

Treatments	**Sensory scores on RTC mix adding Oil**					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
	Mean rank	Mean rank	Mean rank	Mean rank	Mean rank	Mean rank
T1 (1.5 ml)	20.95	19.45	18.20	15.90	17.75	12.10
T2 (2.5 ml)	21.60	21.10	27.00	21.60	25.90	21.70
T3 (3.5ml)	36.70	30.75	32.35	40.30	36.10	43.00
T4 (4.5ml)	25.30	29.10	28.90	30.45	26.90	31.90
T5 (5.0ml)	22.95	27.10	21.05	19.25	20.85	18.80
K value	8.74	5.38	7.16	19.47	10.52	27.92
$\chi^2_{(0.05)}$	9.49					

Appearance

The mean rank value of appearance ranged from 20.95-36.70. the highest mean rank value (36.70) of appearance was obtained for T3 (3.5ml). T1was found to be give the least mean rank value (20.95). Statistical analysis revealed that the differences among these scores were found to be not significant.

Colour

Colour is one of the important visual attributes that has been used to judge the overall quality of foods. Among the five formulations T3 had obtained the

highest mean rank value (30.75) while T1 observed the least mean rank value (19.45) for this parameter. It was found that there was no significant difference between these treatments for this parameter.

Flavour

The odour preference is generated by stimulations of sensory cells by specific volatile compounds present in foods. It was observed that the highest mean rank value was obtained for T3 (32.35) and least was reported by T1 (18.20). There was no significant difference in these scores of the formulations.

Texture

Texture includes the physical property of food stuffs as evaluated by the eye, skin and muscle senses located in the mouth. The highest mean rank value (40.30) in texture was obtained for the treatments of T 3 and T1 obtained the least mean rank value (15.90) among the five different treatments.

Taste

Table shows the mean rank value obtained for the parameter taste, it was found to be ranged from 17.75-36.10. It was observed that T3 (3.5ml) got the highest mean rank value (36.10), T4 (4.5ml) placed second with a mean rank value of (26.90) and T1 (1.5ml) received the least mean rank value (17.75)

Overall acceptability

The scores depicted that in the table reveals that T3 with addition of 3.5ml of oil into the Olath mix obtained highest mean rank value (43.00), followed by T4 with the mean rank value (31.90) and T1 has scored least mean rank value (12.10).

The result of sensory evaluation are depicted as scores for various parameters such as appearance, colour, texture, flavor, taste and overall acceptability as shown in table. The statistical data reveals that T3 (3.5ml) secured the highest mean rank values for all the sensory parameters, followed by T4 (4.5ml). it can

thus concluded that T3 (3.5ml) was the best treatment to get superior qualities during cooking of Olath mix. So, T3 (addition of 3.5ml) was assessed as best treatment for further study.

4.6. Packaging and storage

Packaging plays a vital role in preserving food throughout the distribution chain. Directly related, and interlinked, with food packaging is the concept of shelf life- the length of time foods, beverages, pharmaceutical drugs, chemicals and many other perishable items take before they are considered unsuitable for sale, use or consumption (langowski and wani, 2013)

The standardized RTC olath mix was packed in laminated pouches and stored in ambient conditions for studying their shelf life at monthly intervels up to three months.

4.7. Quality analysis of dehydrated Ready To Cook mix

Quality is a very important parameter for judging the edible nature of any food product (Sharma, 2006). Food quality is the quality characteristic of food that is acceptable to consumers. Quality is a very important parameter for judging the edible nature of any food product. The quality of the developed products were ascertained with special reference to physical properties, chemical composition, shelf life and consumer acceptability.

4.7.1. Physical characteristics of RTC mix

The physical characteristics are important criteria for product acceptance. It helps in the quality assessment and acceptability of any food product. The Physical characteristics of the Olath mix namely yield, dehydration ratio, bulk density and water absorption index were studied.

4.7.1.1. Yield

Drying removes moisture and as a result the food shrinks and decreases in size and weight, thus requiring less space for storage. Yield of a dried product is

directly related to how much water is in the original product. It was noted that when 100g of sliced pre-treated ivy gourd mixes were dried, the yield of Olath mix was 38.46 percent.

4.7.1.2. Rehydration ratio

Rehydration increases the shelf life and the space for storage is reduced along with easy transportation. Dehydration reduces the weight and space required to store and transport products to remain stable in ordinary storage conditions. Rehydration ratio is the weight of dehydrated sample to drained weight of rehydrated sample. Rehydration ratio of the developed Ready To Cook mix were presented in table Rehydration ratio of RTC mix was 0.54%.

4.7.1.3. Bulk density

Bulk density is one of the most common simple measurements in food analysis; it is the ratio of the sample to the weight of equal volume of water. It is defined as the mass particle of the material divided by total volume they occupy. Bulk density is used as an index for comparing the value of different foods. Bulk density of RTC mix was calculated and the results depicted in table. The bulk density of RTC mix was 0.18.

4.7.1.4. Water absorption index

Water absorption index of ivy gourd based Ready To Cook mix was calculated. Water absorption index of RTC mix was 4.5 per g.

Table38. Physical properties of RTC mix

Physical properties	values
Yield	38.46
Dehydration ratio	0.54
Bulk density	0.18
Water absorption index	4.5

4.7.2. Chemical composition of developed product

According to Potter, (1998) the knowledge of the constituents of foods their properties is the baisis of understanding the quality of products. Chemical characteristics like moisture, total acidity, reducing sugar, TSS and pH of developed RTC mix was analysed. The methods followed are detailed in table.

Table39. Chemical composition of RTC mix

Parameters	values
Ph	4.84
TSS °(brix)	20
Reducing sugar (g%)	0.24
Acidity (%)	0.87
Moisture (%)	5.32

4.7.2.1. pH

pH determines the acidity or alkalinity of a solution. pH of the Ready To Cook mix was observed to be 4.84. The result indicated that the developed RTC product was acidic in nature.

4.7.2.2. TSS

Sugar content of fruit is measured as total soluble sugar content. It is partially influenced by fruit maturity. TSS content of RTC was found to be 20.

4.7.2.3. Reducing sugar

Reducing sugar is expressed in terms of glucose since glucose is the most predominant reducing sugar present in fruits. The value indicated that reducing sugar content of RTC olath mix was low i.e., 0.24 percent.

4.7.2.4. Acidity

According to Ashurst, (1986) acidity gives flavor and offers antimicrobial activity. Acidity is one of the prime chemical constituents which indicates the deteriorative changes in the product. As indicated in the table acidity of RTC mix was 0.87 per cent.

4.7.2.5. Moisture

Moisture content is one of the vital parameters which interfere with the quality of the ivy gourd based dehydrated product during storage. As indicated in the table the moisture content of RTC mix was 5.32 percent.

4.7.3. Shelf life stability

Food safety and consistent quality that meets customer expectations are the two main aspects of an acceptable shelf life. Shelf life is the period of time, established under intended conditions of distribution, storage, retail and use, that the food would remain safe and suitable. A food is considered spoiled when it is no longer acceptable to the consumer. The time it takes for a food product to reach one of these spoilage conditions is generally termed the product's shelf-life (Steele, 2004)

The factors like raw material quality, storage containers, procedures employed and environment in which it is processed affects the shelf life quality (Shankar, 1993).

The shelf life quality of the developed RTC mix was analysed by assessing the sensory parameters, moisture content and microbial profile for three months at monthly intervals.

4.7.3.1. Sensory evaluation of dehydrated RTC mix

Sensory evaluation plays an important role in determining the acceptability and shelf stability of food products. Table shows the sensory evaluation of

Plate 4. Finalised RTC (olath mix)

developed RTC olath mix before packaging and at monthly intervals for three months.

Table40. Sensory evaluation on RTC mix during storage

Treatments	Sensory scores on RTC mix during storage					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Initial period	29.7	28.4	29.8	29.6	29.0	27.9
First month	27.8	26.5	26.2	27.7	27.6	25.3
Second month	25.9	25.0	25.5	25.4	26.4	24.5
Third month	24.7	24.4	23.5	24.2	20.9	23.3
K value	15.60	13.17	17.60	14.25	16.12	14.92
CD (0.05)	13.79					

Appearance

Appearance of the product usually determines whether a product is accepted or rejected; therefore this is one of the most critical quality attributes. The highest mean rank score in appearance was obtained in initial period (29.7), which gradually decreased in later months. The lowest mean rank value noted in third month of storage. Statistical analysis revealed that mean rank scores were found to be significantly different between initial stage and final stage.

Colour

Color perception interacts with other sensory attributes such as sweetness, creaminess, flavor, and overall acceptance (Hutchings, 1999), which makes sensory analysis an important tool in food characterization. The result of mean rank values for colour was higher in initial month of storage (28.4). However the result indicates that after three month of storage only a slight decrease in score

was observed in colour. The mean rank value found to be on par during the period of storage.

Flavour

The flavour of foods is usually defined as a combination of aroma and taste. While comparing mean values of flavor highest mean rank score was found in the initial month. After first and second month of storage slight variation in rank scores (26.2 and 25.5) was observed. Score further reduced by third month (23.5). the scores were found to be significant too.

Texture

Textural parameters are perceived with the sense of touch. The highest mean rank value of texture obtained in fresh product (29.6) and the lowest mean score was noted in third month of storage (24.2). Mean rank value of second and third months of storage were on par.

Taste

Change in score of taste throughout the storage period was noticed at monthly intervals. The highest taste rank score was found in the fresh product (29.0) and the lowest mean score was noted in third month of storage (20.9). The first and second months of scores were on par. However the result revealed that there was significant difference in taste at monthly intervals.

Overall acceptability

As the major parameters namely overall acceptability, the mean score values revealed that the highest mean score was found in fresh sample (27.9) followed by first and second month (25.3 and 24.5). the score further decreased in third month of storage (23.3).

From the above observation it may be concluded that the change in sensory attributes namely appearance, colour, texture, and taste of RTC mix were negligible over three months of storage.

4.7.3.2. Moisture content of stored product

Many manufactured food products are adversely affected by moisture changes which directly impart there shelf life and quality. These foods will lose desirable texture characteristics if allowed lose or gain too much moisture. According to Steele, (2004) if the moisture level is elevated enzyme mediated hydrolysis rates are increased significantly and maillard type of non enzymatic browning is enhanced. Moisture content of developed product was analysed. The data reveals that moisture content increased from 5.16-5.81 per cent. Initial moisture content was 5.16 percent. At the end of first month it was 5.50 per cent., at the end of second month moisture content slightly increased (5.60 per cent.). By the end of third month the moisture content again increased (5.81 per cent.).

Table41. Moisture content of stored product

Sl No	Storage period	Moisture content (%)
1	Initial	5.16
2	First month	5.50
3	Second month	5.60
4	Third month	5.81
CD (0.005)		0.304

4.7.3.3. Microbial profile of developed products

Analysis of microbial population in the developed food product is important as it determines the quality and safety of food product. Management of microbiological food safety is largely based on good design of processes, products and procedures. Microbial analysis of stored product was done to ascertain shelf life of products. The product was stored in ambient condition for three months.

The microbial evaluation was done initially and at 30 days intervals up to 3 months. The population of bacteria, fungi, actinomycetes and coliforms were determine using Nutrient agar (NA), Potato Dextrose Agar with Rose Bengal (PDARB), Ken Knight Agar (KEN) and Eosin Methylene Blue (EMB) respectively. This was done by serial dilution of the samples followed by pour plating technique suggested by Johnson and Curl, (1972).

During the storage period no bacterial colonies were found to appear in developed RTC product packed in laminated pouches. But 6 fungal colonies were seen in 10^2 dilution during third month of storage. However this was within permissible limits. No other pathogenic organisms could be detected in the developed product.

4.8. Cost of the developed product

According to Singh *et al.*, (2001) dehydration has usually been more costly than sun drying, but the superior cooking quality of the dehydrated products will cause them to command a sufficiently higher price which will counter balance the slightly cost of production. In order to realize the economic feasibility of the developed RTC product the cost was worked out by taking individual cost of the ingredients used and adding 10 percent over head charge. The cost of 1kg packets of product worked out Rs 350/-.

4.9. Consumer acceptability of Salad (RTE) and Olath mix (RTC)

The hedonic rating was used to measure the consumer acceptability of food products (Srilakhmi, 2003). Hedonic rating was carried out for the developed RTE and RTC products on nine point scale from "like extremely to dislike extremely". The scores was obtained by hedonic rating is presented in the table

As indicated in table (42), 20 percent of the respondents liked RTC olath mix extremely, while 18 percent liked the RTE salad. Hence ivy gourd based Ready To Cook products was more acceptable to the judging panel.

Table42. Consumer acceptability of Salad (RTE) and Olath mix (RTC)

Rating scale	**Scores**	**Scores of the salad and RTC mix (N = 50)**	
		V1 (RTC)	V2 (RTE)
Like extremely	9	40(20)	36(18)
Like very much	8	38(19)	32(16)
Like moderately	7	14(7)	16(8)
Like slightly	6	4(2)	12(6)
Neither like or dislike	5	4(2)	4(2)
Dislike slightly	4	-	-
Dislike moderately	3	-	-
Dislike very much	2	-	-
Dislike extremely	1	-	-

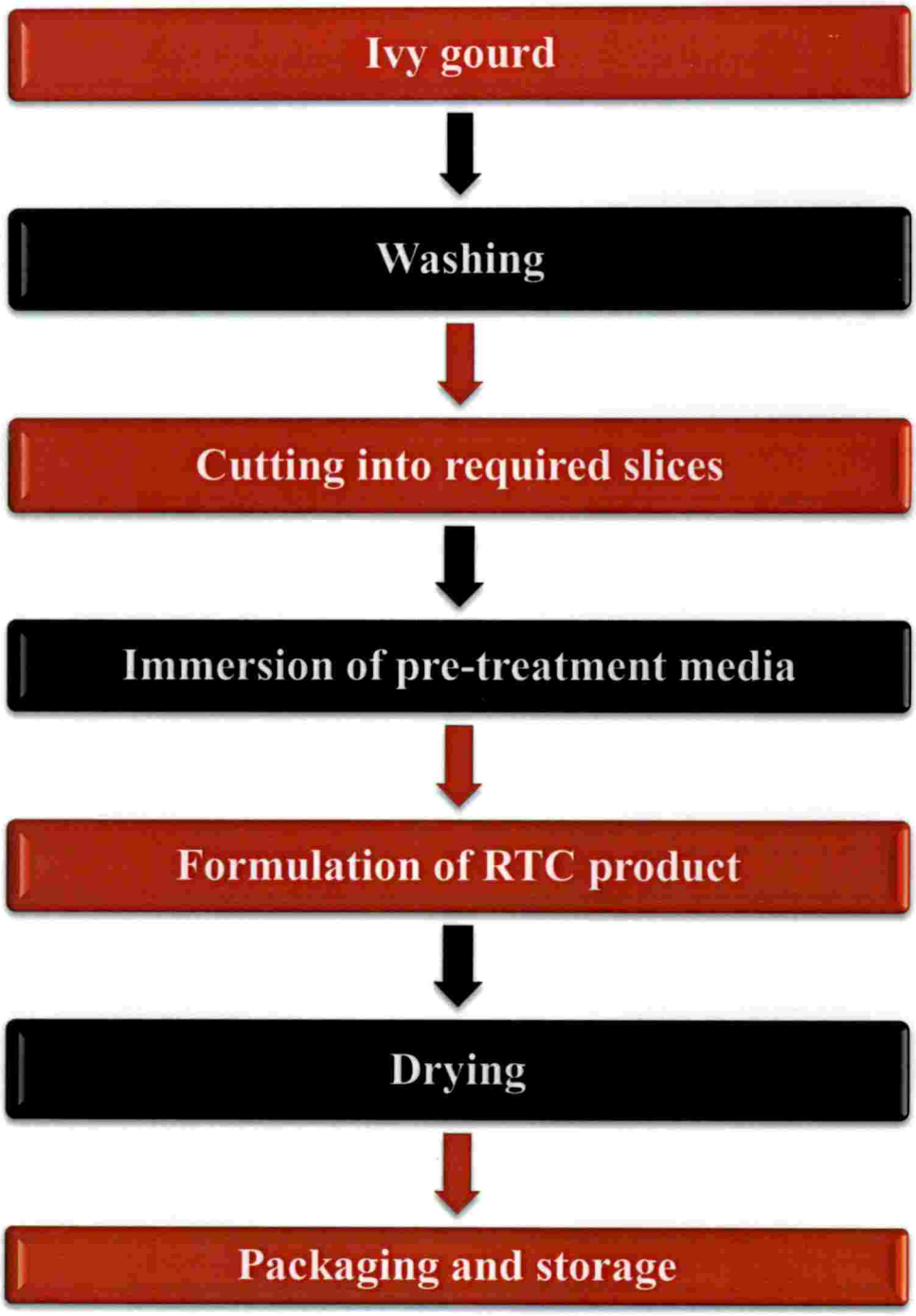
RTE (Salad)

RTC (olath mix)

Plate5. Standardized RTE and RTC products

Fig.1

Processing of ivy gourd based RTC mix



DISCUSSION

Discussion

The results of the present investigation entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica* L.)." are discussed below.

5.1 Quality evaluation of Ivy gourd

5.2 Assessment of changes in nutrients and antioxidants with processing

5.3 Standardization and product development on ivy gourd

5.4 Quality analysis of ivy gourd based dehydrated products

5.5 Standardisation of ivy gourd based RTC mix

5.6 Packaging and storage

5.7 Quality analysis of dehydrated RTC olath mix

5.8 Cost of the developed product

5.9 Consumer acceptability of RTE and RTC products

5.1. Quality evaluation of Ivy gourd

The quality evaluation of fresh sample of ivy gourd was assessed in terms of nutrient analysis, determination of antioxidants and glyceamic index.

5.1. Nutrient analysis

Kalia and Sood, (2000) defined nutritional quality as the combination of chemical that has significance in determining the degree of acceptability of the product to a user, based on its quality and sensory attributes. Srivastava *et al.,* (2014) pointed out that Ivy gourd is abundant source of beta-carotene and also it contains a good amount of complex carbohydrates, fibre and a vast array of vitamins B and minerals. It is also a valuable source of nutrients. Hence nutritional quality of fresh ivy gourd was carried out with respect to nutrients viz.

protein, total minerals, fiber, carbohydrates, calcium, iron, β-carotene, vitamin C, sodium and potassium.

Pugalanthal *et al.,* (2004), has revealed that protein is an essential component of diets that supply adequate amount of amino acid for nutrition. In this study, 2.13 g of protein was present in 100g of ivy gourd. Similar findings were also reported by Rubatzky and Yamaguchi (1997), that the protein content in ivy gourd was 1.3g.

The present study revealed that total mineral content of ivy gourd was 0.51g. Similar finding also reported by ICMR (2008), mineral content of ivy gourd was 0.5g/100g.

In this investigation fibre content of ivy gourd was 1.98 percent. This value was higher than the value (1.6 percent) reported by Guha and Sen (2007). This might due to when maturity increased the fibre content of the fruits. The increase in total fibre content in maturity may be due to the hardened seed coat of the fruits (Renjumol, 2006).

Carbohydrate plays a vital role in a healthy, balanced diet. They are primary source of energy, and yield about 4 calories per gram. The carbohydrate content of fresh ivy gourd ranged from 3.79g. The results are in tune with the findings of Gautam *et al.,* (2014), who had reported that carbohydrate content in fresh ivy gourd was 3.4g.

The findings of present study revealed that calcium content of ivy gourd was 45.25mg. Almost similar findings also reported by Rai *et al.*,(2004) according to the study calcium content ivy gourd was 40mg/100g. The range of calcium content in ivy gourd as reported by Raju and Peter (1995) was 32.7 mg/100g to 91 mg/100g. Renjumol (2006) observed that there was a significant variation in the calcium content of the ivy gourd genotypes in vegetable maturity. Ketsa and Chutichudet (1994), who observed that in okra pods the calcium content decreased during maturity. The reduction in calcium content may be due to the reduction in the pectin content during ripening. Calcium pectate in the cell wall

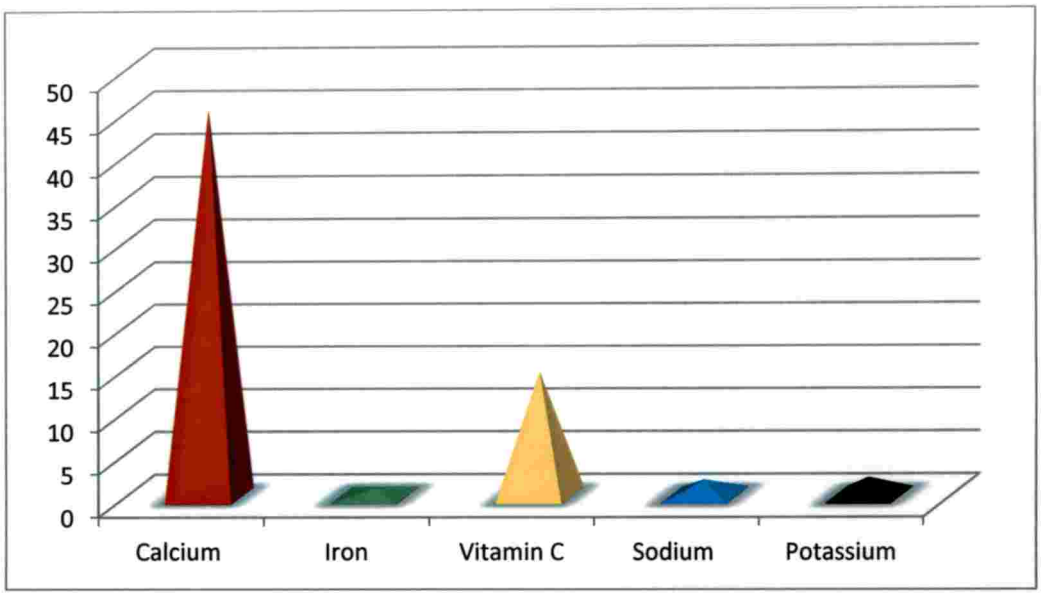


Fig. 2. Nutrient contents in fresh ivy gourd

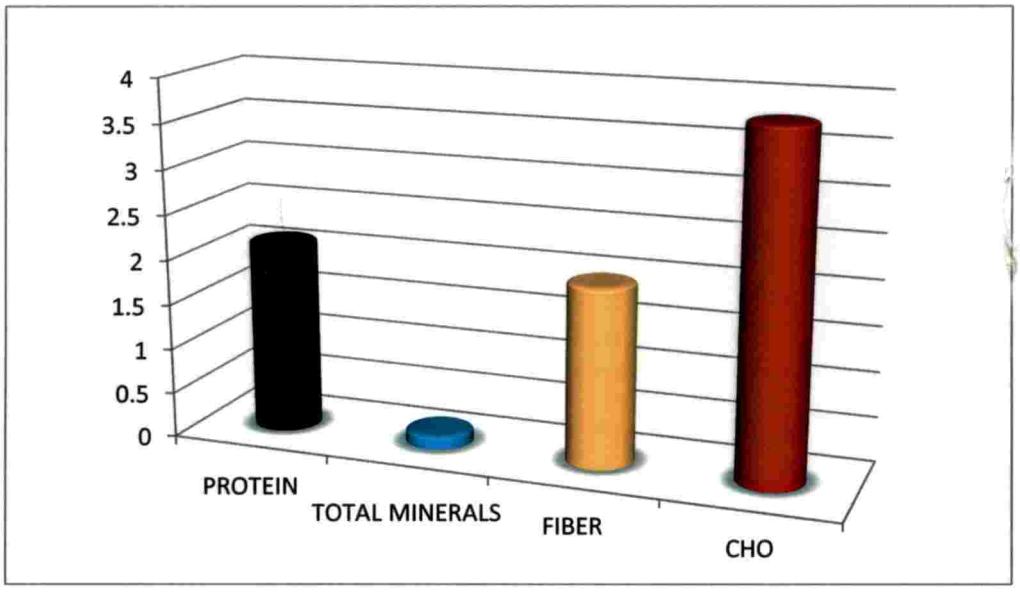


Fig. 3. Nutrient contents in fresh ivy gourd

will be hydrolysed to pectinic acid and leaching of calcium during ripening which contributes to less firmness of fruits during ripening.

In the present investigation iron content of ivy gourd was found to be 0.90mg. According to Rai *et al.*, (2004), iron content of four ivy gourd was (0.80 mg/100g). Renjumol, (2006), reported that iron content of ivy gourd was 0.97mg.

β-carotein content of ivy gourd was observed 145µg. The observed value for β-Carotene was low when compared to the value reported by ICMR (2008), β-carotein content of ivy gourd was 156 µg/100g. This might due to the maturity stage of ivy gourd. Renjumol (2006) reported that significant variation in the β-Carotene content of ivy gourd in their vegetable maturity stage. In over matured fruits, the β- Carotene content significantly increased with a mean value of 142.94 µg/100g. Thus, ivy gourd in over mature stage can be consumed for its β-Carotene content, which is considered to be a very powerful antioxidant.

According to Ronen *et al.*, (1999) the β-Carotene concentration of tomato increased dramatically during the ripening process and this can be attributed to the factor that during ripening of fruits, chlorophyll functions as a precursor for the synthesis of β-Carotene.

Vitamin C is one of the foremost water soluble vitamin. It is essential for carnitine, collagen and neurotransmitters biosynthesis (Naidu, 2003). In this study vitamin C content of fresh ivy gourd was found to be 14.55 mg. ICMR (2008), reported that ivy gourd contain 15g of vitamin C.

The present study revealed that potassium and sodium content of ivy gourd was 2.10mg and 1.83mg respectively. Renjumol (2006) reported that ivy gourd contain 2.78mg/ 100 g and potassium content was highest in variety Sulabha (2.65 mg/100g). Decreasing trend of potassium content with maturity was supported by the findings of Nerd *et al.*, (1999) who reported that, the amounts of minerals like potassium, iron and magnesium decreased during maturation of the cactus fruits. As in the case of the minerals in ivy gourd genotypes, calcium, phosphorus, iron, sodium and potassium showed a decreasing

trend with maturity in this study. The decreasing trend of minerals on maturity was also observed by Hodossi and Pankotai (1987) in okra pods.

5.1.2. Determination of antioxidant activity

The antioxidant activity of ivy gourd can be determined based on its capacity to inhibit lipids, peroxides, to scavenge free radicals, to reduce the transition metal or to chelate a ferrous iron.

In the present study antioxidant activity of ivy gourd was 61.21 µg/ml in aqueous extract, in petroleum ether was 58.01 µg/ml and in methanol 59.53 µg/ml. The scavenging effect of the fruit extract of *C. Indica* on the DPPH radical was 56.15% (Kumar *et al.,* 2016). Ashwini *et al.,* (2012) reported that ethanol and methanol extract of ivy gourd shows the antioxidant activity, solvent petroleum, chloroform and ethyl acetate shows antioxidant activity.

The free radical scavenging and antioxidant activities of ivy gourd might be attributed to the existence of phenolic and flavonoid compounds in the fractions (Bhadauria *et al.*, 2012).

Studies proved that various fractions of hydromethanol extract of ivy gourd revealed significant antioxidant activity in methanol-treated rats with oxidative stress (Umamaheswari and Chatterjee, 2008).

5.1.3. Phenols and tannin content of ivy gourd

In the present investigation total phenol content of ivy gourd was 2.85mg. According to Rejumol (2006), total phenol showed a decreasing trend with maturity and significantly low phenol content observed in ivy gourd variety Sulabha.

Tannin content of ivy gourd was found to be 10.71mg.

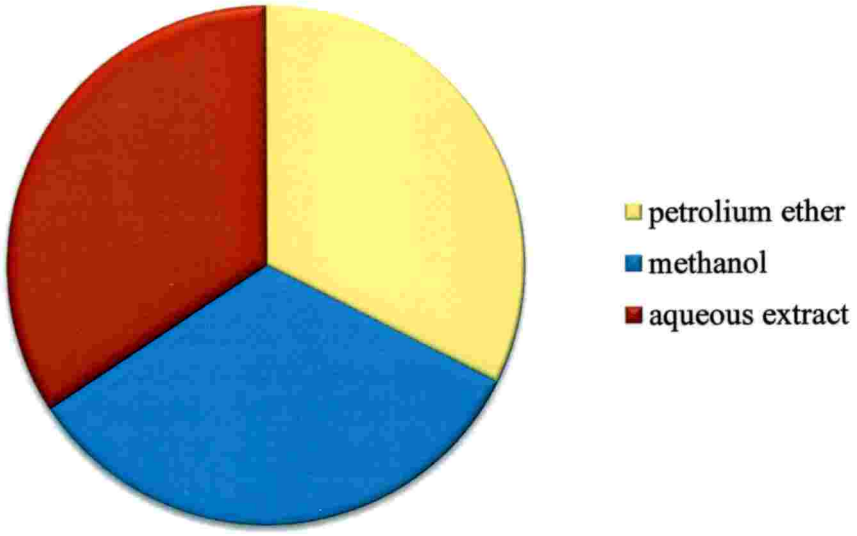


Fig. 4. Antioxidant activity of ivy gourd

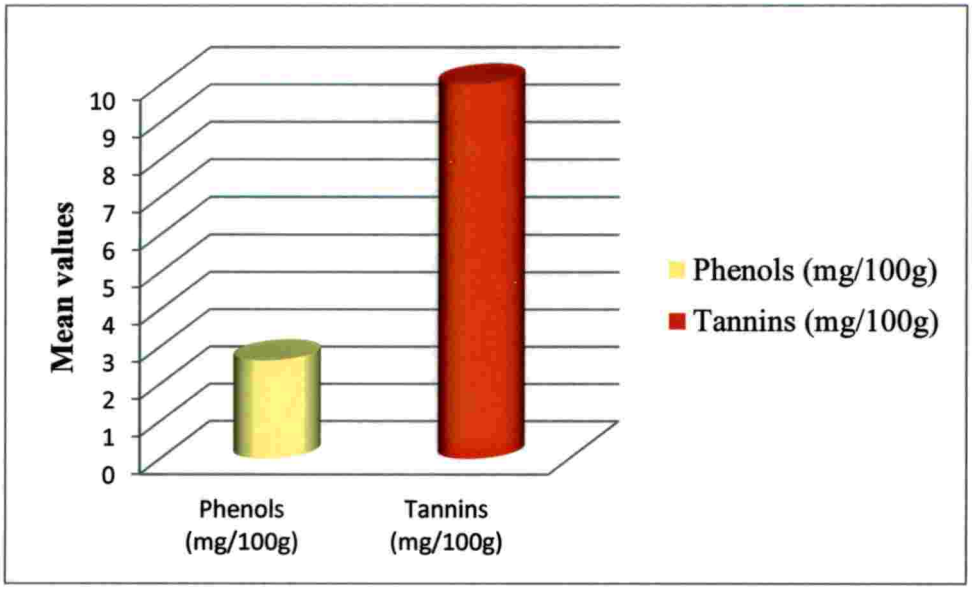


Fig. 5. Phenols and tannin content of ivy gourd

5.1.4. Glyceamic activity

Ivy gourd is rich in pectin, it also helps to inhibit gluconeogenesis and stimulate glucose oxidation (shibib *et al.,* 1993). The alcoholic extract of Coccinia indica was found to be more active in reducing blood glucose level (Singh *et al.,* 2007).

Rastogi *et al.,* (1993) revealed that daily oral administration of pectin isolated from the fruits of *Coccinia indica* (200mg / 100g body weight) exhibited a notable hypoglycaemic action in normal rats.

The study conducted by Gujan *et al.,* (2010) observed that chronic administration of ivy gourd fruit extract (200mg/kg) for 14 days reduced the blood glucose content of diabetic induced animal as compared to diabetic control group.

Another study showed that the ethanol extract of ivy gourd possessed significant hypoglycaemic, hypolipidemic and antioxidant effect (Eliza and Usha, 2010).

Kulkarni *et al*., (2010) in their study indicated that the ivy gourd extract had a potential hypoglycaemic action in mild diabetic patients. The fasting and postprandial blood glucose levels of the experimental group at day 90, significantly abated, by 16 percent and 18 percent respectively. In the present study glyceamic index of ivy gourd was found to be 50.61.

5.2. Assessment of changes in nutrients and antioxidants with processing

Dandago (2009) reported that processing foods is necessary to achieve desirable sensory and healthy attributes in the food product. The term processing cover an enormous field of widely different treatments carried out to render food safe, edible and palatable. The major methods of preservation cause some changes in the nutritional value of food but the loss is not significant. Because of their essential nature, the extent of destruction of vitamins during processing is often the main criterion by which judge the quality of processed foods.

According to Ihekoronye and Ngoddy, (1985) the skin of fruits and vegetables is richer in vitamins than other areas, trimming, peeling and washing of fruits and vegetables prior processing result in loss of vitamins and minerals. Losses may occur with vitamins labile to heat, light and air.

In order to determine best processing and preservation method that will have minimal nutrient loss of ivy gourd, the effect of blanching, boiling and drying on the nutritional and antioxidant compositions were studied.

Blanching is the first step for effective preservation of some fruits and vegetables and in many instances, blanching treatment is often combined with the use of chemicals in order to produce certain desirable qualities. Loss of vitamins and minerals during blanching can be significant and is a function of surface area per mass of product, degree of maturity of the product, blanching method, blanching time and method of cooling after blanching. Nutrients losses that occur during blanching are caused by leaching, oxidation of water soluble nutrients and thermal destruction (Walter and Espinel, 1998).

In this present study, most of the nutrients had significant variation among fresh and processed ivy gourd except for β carotene, vitamin C and fibre. All other nutrients were found to be highest in dried ivy gourd powder. β carotene, vitamin C and fibre was higher in fresh ivy gourd.

Protein is an essential component of human diet needed for the replacement of tissue and for the supply of energy and adequate amount of required amino acid. Protein deficiency cause growth retardation, muscle wasting, oedema, abnormal swelling of the body (Mounts, 2000).

In the present study protein content of fresh and processed ivy gourd was ranged from 1.42-6.20g. The protein content was observed low in boiling of ivy gourd (1.42g) followed by blanched ivy gourd (1.68g). Highest protein content observed in dried ivy gourd powder (6.20g). Boiling cause the highest reduction , this reductions may be due to the fact that during boiling cellular protein are denatured and the chlorophyll which are bound to protein released such free chlorophyll are highly unstable and are readily converted to pheophytin (Odoemena and Ekanem, 2006).

In this present study revealed total mineral content of fresh and processed ivy gourd was ranged from 0.72-0.51g. Highest total mineral content was observed in dried ivy gourd dried ivy gourd (0.72g) could be as a result of removal of moisture which tends to increase the concentration of nutrients (Morris *et al.*, 2004). Blanching (0.13g) and boiling (0.12g) of ivy gourd cause significant reduction in total mineral content. The decrease in the ash content of processed ivy gourd could be as a result of processing during which some of the inorganic salt in the vegetables might have leached off (Yaciuk and Sofose 1981).

The results are in tune with the findings of Kwarteng *et al.*, (2017), the total mineral content of red pepper significantly reduced the proceedure following blanching.

Wriya *et al.*, (2009) reported a loss of total minerals in boiled as compared with raw carrots.

Fibre content of fresh ivy gourd was 1.98g. In this study fibre content of fresh and processed ivy gourd was ranged from 1.98-0.95g. Lowest fibre content was observed in dried ivy gourd powder (0.95g) followed by boiling of ivy gourd (1.35g).

Similar findings also reported by Tatjana *et al.*, (2002), studied the modifications that happen during the thermal processing of kidney beans and reported that the solubilization of the polysaccharides resulted in decreased total fibre content mainly due to loss of soluble fibre. FAO (1997), reported that 40% loss of dietary fibre (mainly insoluble) with boiling.

Vidal *et al.*, (1992), pointed out that during boiling of lentils the quantity of fibre diminishes, fundamentally due to great decrease in hemicelluloses.

Carbohydrate content of fresh and processed ivy gourd ranged from 2.13-7.73g. Dried ivy gourd powder exhibited highest carbohydrate content followed by fresh sample. Blanching and boiling caused reduction in carbohydrate content. Highest loss was observed in boiling of ivy gourd (2.13g).

Leriei, (1998) reported that during wet heat treatment as in blanching and boiling; there is considerable loss of low molecular weight carbohydrates as well

as micronutrients into the processing water. These reactions are temperature dependent and most extensive at intermediate water activities.

According to Hurst *et al.,* (1993), drying does not cause major losses in vitamins provided the finished food are adequately protected from oxygen either by proper packaging or use of antioxidants.

The nutritive metals basically calcium, iron, Sodium and Potassium were determined in ivy gourd. All processing method cause reduction in the minerals analysed except for drying of ivy gourd which cause increase in concentration. Highest losses of minerals were observed in boiling of ivy gourd. The highest reduction in mineral content was observed for boiled ivy gourd. However, blanching resulted in the maximum retention of most of the minerals. Similar findings also reported by Ahmed and Rehab, (2013) in white cauliflower. Puupponen *et al*., (2003) reported that losses of minerals during cooking are not caused by destruction but only by leaching into the cooking water

Blanching and boiling of ivy gourd resulted in the reduction of potassium (1.98; 1.97mg), sodium (1.00; 0.99mg), and iron (0.34; 0.16mg), respectively. This might due to the behaviour of minerals during blanching is related to their solubility. Potassium, the most abundant mineral in vegetables, is extremely mobile and is easily lost by leaching during blanching because of its high solubility in water (Ahmed and Rehab 2013).

In the case of β carotene and vitamin C, β carotene content of fresh and processed ivy gourd was ranged from 0.21µg- 145µg and vitamin C content was ranged from 14.55-0.98mg. All processing method cause reduction in vitamin C and β carotene content of ivy gourd. Nutrient loss was high in dried ivy gourd. Observation which might due to their sensitivity to heat and leaching of these compounds in water (Sikora *et al.,* 2008).

Eswara and Ramakrishnarao, (2013) reported that during dehydration processes, changes in nutritional quality of heat sensitive vitamins and other nutrients occur.

According to Howard *et al.,* (1999) reported that significant losses in the content of vitamin C, minerals, and polyphenols in vegetables occur after

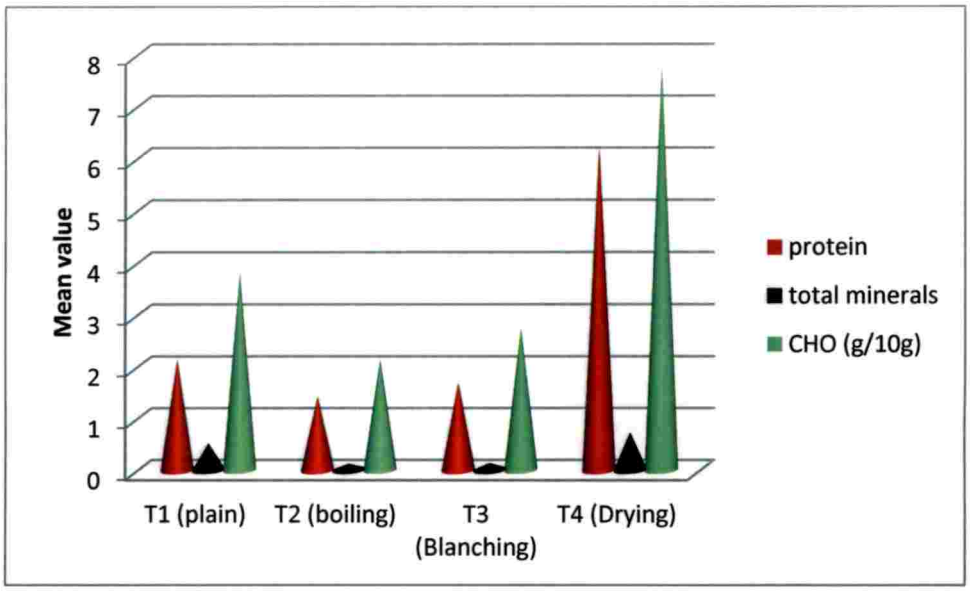


Fig.6. Nutrient content of fresh and processed ivy gourd

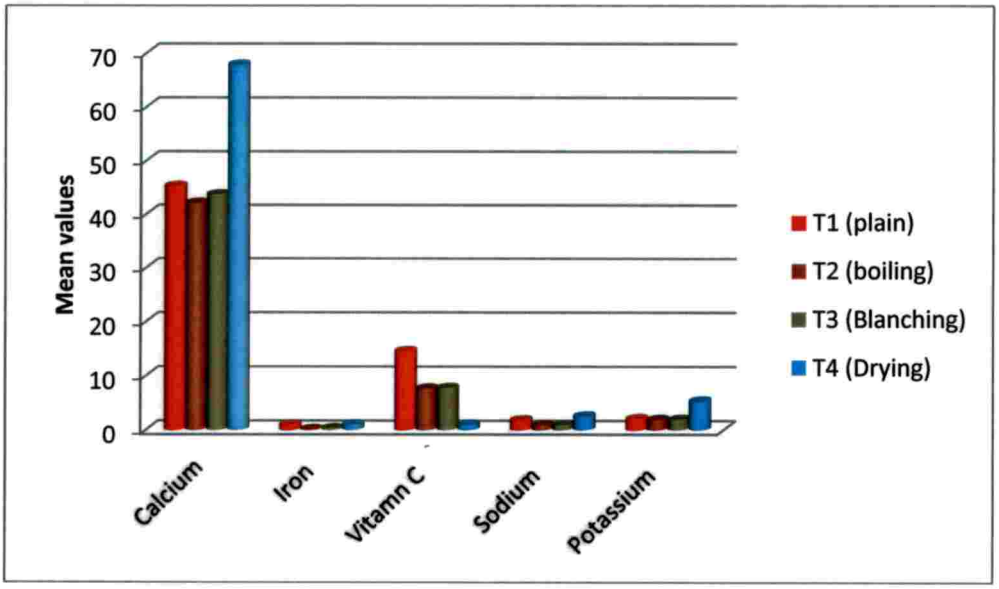


Fig.7. Nutrient content of fresh and processed ivy gourd

aquathermal blanching. According to Ihekoronye and Ngoddy (1985), the overall loss of water soluble vitamins is greater than that of fat soluble vitamins during cooking. Dandago (2009) reported that applications of heat during processing also lead to losses quantitatively and qualitatively and it was noticed that water soluble vitamins were worst affected. Nutrients may be lost during cooking in two ways. First, by degradation, which can occur by destruction or by other chemical changes such as oxidation, and secondly by leaching into the cooking medium (Miglio *et al.,* 2008).

5.2.1. Changes in total antioxidant activity of fresh and processed ivy gourd

Umamaheswari and Chatterjee (2008) pointed out that The free radical scavenging and antioxidant activities of *Coccinia cordifolia* may be attributed to the presence of flavonoids and phenolic compounds.

In this present study antioxidant activity of fresh and processed ivy gourd were analysed. Among the treatments fresh sample had highest antioxidant activity than processed ivy gourd while lowest antioxidant activity was observed in dried ivy gourd. After blanching and boiling ivy gourd resulted in a significant decrement in antioxidant capacity. Similar findings also reported by Preti *et al.,* (2016) in antioxidant capacity of green beans variety.

In the case of phenols and tannin content of fresh and processed ivy gourd, polyphenols are a large class of plant secondary metabolites important for the quality of plant based foods they are responsible for the colour foods and are also involved in flavor properties (Cheynier, 1991).

Polyphenol content of fresh and processed ivy gourd was ranged from 0.20-2.62mg and tannin content ranged from 0.75-10.00mg. Highest loss of tannin and poly phenol content was observed in dried ivy gourd followed by boiled ivy gourd.

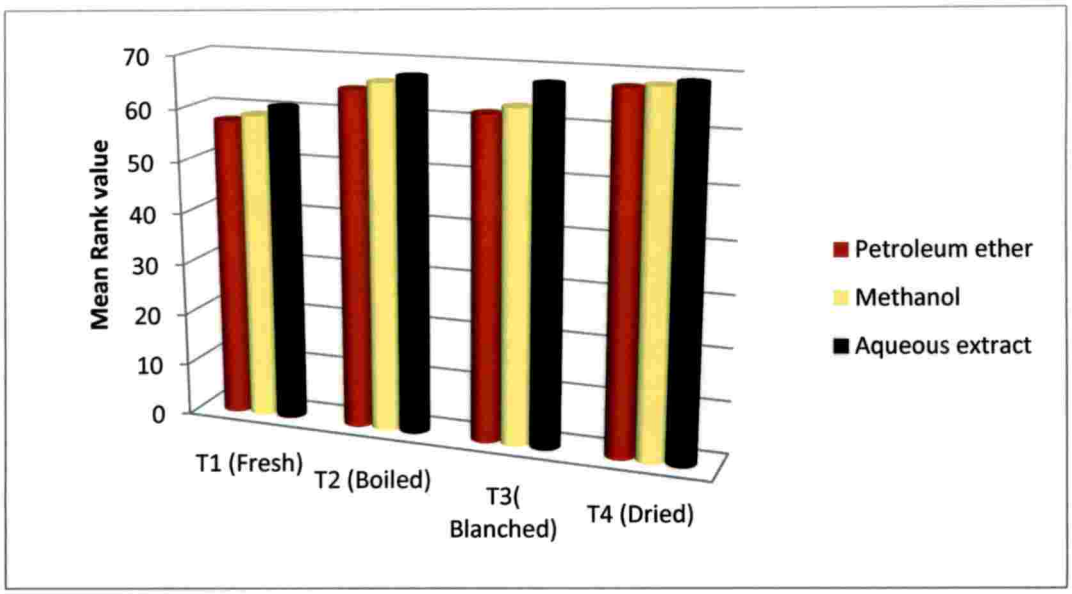


Fig. 8. Antioxidant activity of fresh and processed ivy gourd

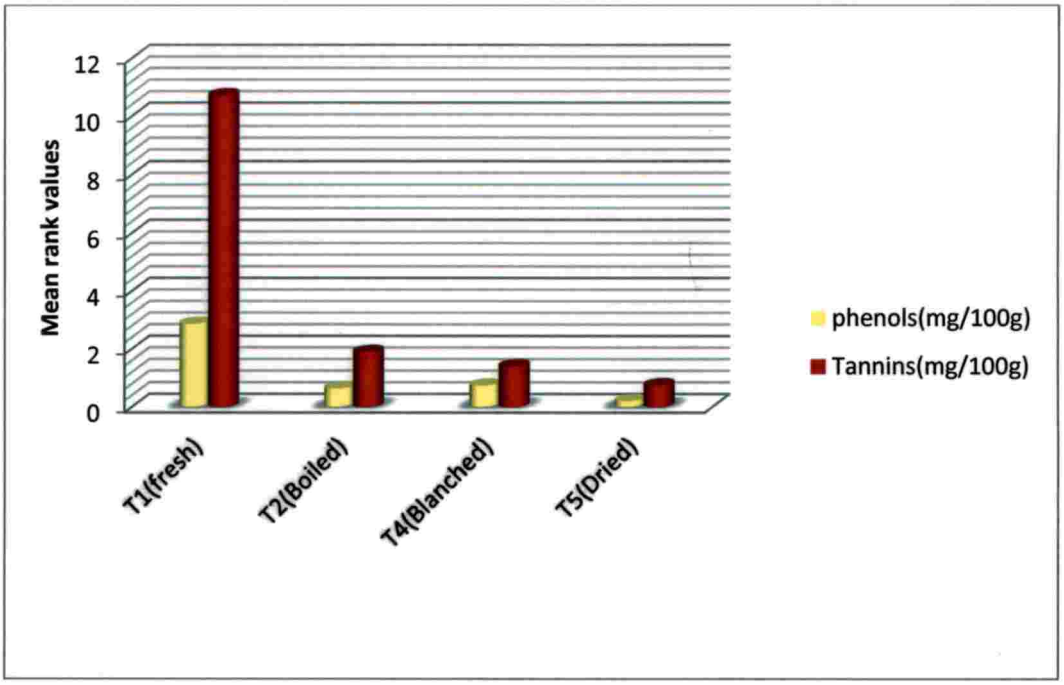


Fig.9. phenols and Tannin content of fresh and processed ivy gourd

The loss can be attributed to the water soluble compounds leaching into the cooking water as well as the breakdown of these compounds during cooking (Crozier *et al.*, 2000). Podsedek *et al.*, (2007) in fact reported the phenolic losses proportional to boiling time and to the amount of water.

5.3. Standardization and product development on ivy gourd

5.3.1. Standardization of ivy gourd based RTE (salad) product.

The tender fruits taste like cucumber and are used as salads or as a delicious vegetables in various curry preparations (Indira and Peter, 1988). Ivy gourd cut into different dimensions, among five different dimensions sliced ivy gourd was selected for further preparation.

Many factors contribute to the total perception of the appearance of a food product. This total perception is built up from all the visual sensations experienced when a product is viewed, as it is being prepared and when it is presented on the plate, and all three situations are extremely important to the consumer and hence to the processor (Hutchings, 1999). So the vegetables cut play an important role while making salads.

An appropriate pre-treatment method is required to overcome the slimy nature of ivy gourd. Ioannou and Ghoul, (2013) reported that appropriate chemical pre treatment can be adopted to preserve colour and inactivate enzymatic action. Different pre-treatment methods have been developed for fresh cut fruits and vegetables, along with lemon juice, salt solution, ascorbic acid and honey dip (Barret, 2010).

In this study 3 percent salt and 3 percent vinegar was selected as the best pre-treatment method for ivy gourd slices. Ivy gourd slices Immersed 10 min in selected pre-treatment media. It was inferred that the immersion increases the strength of the product (Zuniga *et al.,* 2004)

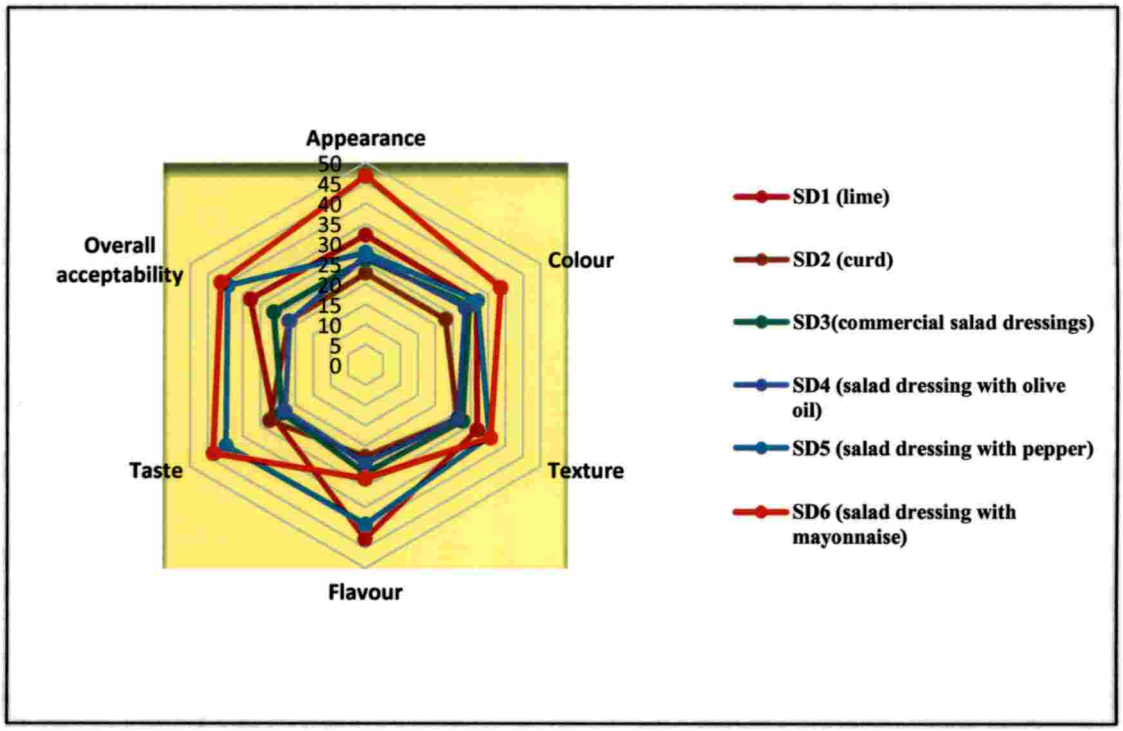


Fig. 10. Sensory evaluation of salad formulations

5.3.2. Formulation of RTE product form ivy gourd

Salad dressings enhance the taste of food and form the highest consumed category of food dressing worldwide (AAFC, 2013). In the present study different combinations of ivy gourd based salads were formulated keeping the ivy gourd as major ingredient. Salad dressings with mayonnaise selected as the best formulation of ivy gourd based salads. According to Rashed *et al.,* (2017) mayonnaise are good source of minerals, vitamins A and E, as well as linoleic acid and alpha-linolenic acids which are highly unique and of health importance. USDA (2014) reported that mayonnaise contains approximately 700 kcal /100 g of product, this makes mayonnaise a calorically dense food.

5.4. Quality analysis of ivy gourd based dehydrated product.

The information pertaining of the physical attributes of dehydrated ivy gourd was assessed in terms of moisture loss, drying time, dehydration ratio and shelf stability.

Moisture can adversely affect the quality of food sankar, (2002) reported that lower moisture content would give longer shelf stability. According to Pandey, (2004), most of stored product are considered to be safe when stored at particular moisture content

The moisture losses of dehydrated ivy gourd slices were ranged from 94.32-95.80 per cent. The highest moisture loss was noted to drying after blanching and smearing with spices (95.52 percent.). The lowest moisture loss was observed in plain drying (94.32 percent.). Blanching, prior to drying has improved the drying rate, which might be due to rupturing of membrane and making ivy gourd tender, thus facilitating faster removal of moisture. Similar observations were also reported by Davoodi *et al.,* (2007).

Drying time of dehydrated ivy gourd ranged from 9- 9.30hrs. More drying time obtained for plain drying (9.30 hrs). While drying after blanching and treated with 0.2 percent KMS took less drying time when compared to other treatments.

Similar result Sharma *et al.*, (2007) observed that soaking of bell pepper shreds in KMS@ 0.20 % after blanching required minimum drying time compared to the control sample.

Rehydration is used to express the ability of dried materials to absorb water. In the present investigation lowest rehydration ratio was observed in drying after blanching and treated with 0.2 percent KMS. While higher rehydration ratio was observed for drying after blanching and smearing with spices (0.58 percent). Kulkarni (2013), observed that the dehydration ratio of ivy gourd slices varies from 1-1.8.

In the present study drying after blanching and treated with 0.2 percent KMS was selected as the best pre-treatment method for dehydration of ivy gourd slices. This might due to the blanching and treated with KMS prior to drying. Similar findings also reported by Mohmad and Hussain (1994) that KMS was added 0.1 percent level by mass of solution will help to retain the quality of dried sweet pepper.

Blanching is one of the most common pre-treatment methods, which can help preserve or improve the quality of food products in such terms as colour retention and texture modification. Blanching in hot water or in various chemical solutions, such as sodium chloride (Dutta *et al.,* 2006; Severini *et al.,* 2003; Negi and Roy, (2000), calcium chloride and magnesium carbonate (Maharaj and Sankat, 1996), has indeed been used widely for fruits and vegetables.

5.4.1 Shelf life of dehydrated ivy gourd

5.4.1.1. Microbial profile of RTC mix

Leela *et al.*, (2005) suggested that processed foods and other food materials provide ample scope for contamination with spoilage organism, thus necessitating biological quality assessment and as an integral part of processing. Several factors such as raw material quality, storage temperature, storage containers and process employed and the environment in which it is processed will have an effect on microbial quality of the processed food (Sankaran, 1993).

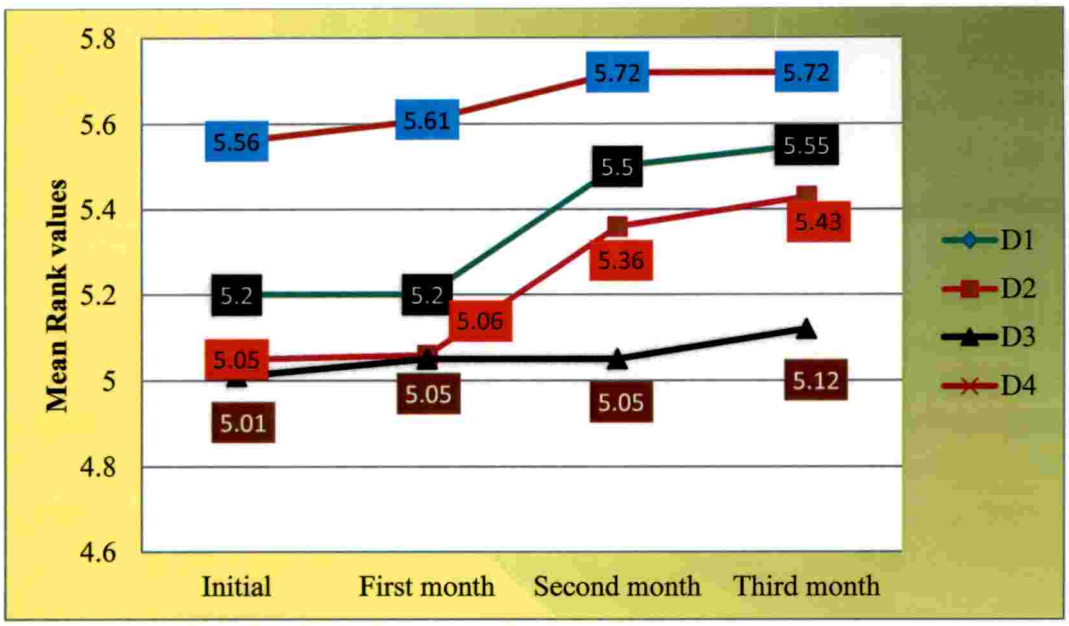


Fig. 11. Moisture content of stored dehydrated ivy gourd

Keeping quality of product very much depends upon the microbial contamination. Initially, microbial count was recorded nil in all the treatments. When comparing the pre-treatments of dehydrated ivy gourd microbial load was found more in plain dried ivy gourd ranged from 4.33-6.33 10^3 cfu/g for fungai colonies and 10.66-16.33 10^3 cfu/g for bacterial colonies. Lowest microbial colonies was found in the treatment drying after blanching and treated with 0.2 per cent KMS ranged from 0.33-1.00 10^3 cfu/g. for fungal colonies and 3.33-5.66 10^3 cfu/g for bacterial colonies.

Chellamal *et al.*, (1995) reported that product stored in polythene covers and steel containers had more fungal contamination than the product stored in glass and plastic containers. Nasheeda (2006) reported that the bacterial population of banana powder packed in poly propylene pouches ranged between 5.68-5.88 × 10^3 cfu/g. In the present investigation, microbial load was low. This may be due to low moisture content and absence of air in packs which inhibited the growth of micro organisms.

5.4.1.2. Moisture

Low moisture is highly important parameters which determine the shelf life quality of food product (Shankar, 1993). Amssong the different treatments higher moisture content was observed for drying after blanching and smearing with spices (5.72) after the end of third month. Lowest moisture content was observed in the treatment, drying after blanching and treated with 0.2 percent KMS (5.12) at the end of third month. However there was slight increase in moisture content during for all the treatments. Kumar and Srenarayanan, (2000) observed that increase of moisture content of onion flakes during storage.

5.5. Standardization of ivy gourd based RTC olath mix.

Developing a processed product with good sensory quality and prolonged shelf life would benefit consumers by its easier preparation. This will also serve in the broader aim of promotion of intake of vegetables. Its worldwide marketing will also be facilitated.

Pai, (2007) reported that there is a need to make new products from indigenous raw materials having nutritional value which open up new channels for domestic and export market. Hence research in this field should be focused to develop nutrient packed food products from locally available resources. Ray and Athwali, (2000) reported that more and more people were going in for processed food and its estimated that over 10 percent of the expenditure is being spent for processed foods. Instant food means simple convenient and fast food, which are easy and fast to prepare (Saha and Dankwal 2009). In this context RTE and RTC products from ivy gourd were developed.

In the present investigation fresh tender ivy gourd was collected and washed and sliced in varying size and thickness for standardization of olath mix. Longitudinally ($1/4^{th}$) sliced ivy gourd was selected as the best from different treatments. Abano and Samamoah, (2011) opinioned that size and shape of chips influences how fast it dries. The rate of drying time is also depends on temperature of drying air and thickness of slices. Thickness affect the drying time as thickness of the sample increases the drying time to achieve a desirable moisture ratio increases (Islam *et al.,* 2012).

Research studies have shown that processing with an acidic solution enhances the destruction of potentially harmful bacteria during drying. According to Devece et al., (1999), immersion of fruits and vegetable in a solution containing $3^{3/4}$ teaspoon of powdered ascorbic acid or ½ teaspoon of powdered citric acid in two cup water for 10 minutes helped to prevent enzymatic browning.

The sliced ivy gourd was pre treated with salt (0.5%) , citric acid (0.2%), KMS (0.2%) and in different combinations. The treatment done with KMS (0.2%) and salt(0.5%) for 10 minute was found to give a product with better appearance and acceptability. Study conducted by kulkarni (2013) reported that blanching of ivy gourd at 98°C water for 3 min followed by dip treatment in solution containing 2g of KMS per kg water gave low enzymatic browning and most acceptance. Mohamad and Husseain (1994) reported that added KMS at 0.1%

level by mass to the solution to help for retaining carotinoids in dried sweet pepper and increase storage life (Mizza, 1989).

Ivy gourd slices were immersed in selected pre-treatment media for 10 min, 15 min, 20 min, 30 min, 45 min and 60 min. Immersion time of 10 min was found to be optimum for giving a better product. Dipping sliced fruits and vegetable pieces in a mixture of citric acid and water or dipping directly in fruit juice for 3 to 5 minutes was found to prevent browning. (Andress *et al.*, 2006).

5.5.1. Formulation of RTC dehydrated products from ivy gourd.

Standardization and product development play a key role in the growth of food industries. One of the foremost purpose of standardization is to facilitate the movement of materials and products through all stage of production in any industrial activity starting from raw material to the finished products, then to the dealer and finally to the retailers and consumers (Poduval, 2002). The demand of Ready to Eat and Ready to Cook foods have captured a large amount of food retail market in India. There is a rise in the demand for foods based on traditional Indian recipes across different state and abroad because of its good quality, taste and continents (Rahman, 2013). In the present investigation RTC (olath mix) was formulated base on standard traditional recipe. Among the five different formulations sensory evaluation with a panel of 10 members identified the best one. Identified Olath mix comprised of Ivy gourd, crushed red chilli, garlic, turmeric powder and curry leaves (100: 2:10:5:1:5). Liji (2014) standardized a traditional RTC product namely olath mix from jack fruit . the recipe comprised of jack fruit bulbs and seeds, red chilli, turmeric powder, cumin and curry leaves (100:3:1:3:5). This product was found to be very much acceptable.

5.5.2. Standardization of cooking methods of RTC olath mix.

5.5.2.1. Optimization of reconstitution time of RTC mix

Dehydration is the process of removing moisture from food. Reconstitution is the replacement of that moisture to bring the food back to its

natural state. The optimum amount of water required for reconstitution depends largely on the product (pervin *et al.*, 2008). The dehydrated mix was reconstituted for 10 minutes, 15 minutes, 20 minutes, 30 minutes and 45 minutes. The treatment 30 minute of reconstitution time was found to give the most acceptable product. Pervin *et al.*, (2008) observed that pre-soaking of 50 minutes was found to be more acceptable for dried lablab bean without seed coat.

5.5.2.2. Optimization of cooking procedure

The reconstituted RTC mix was standardized for cooking procedures four different treatments. Cooking in plain cold water, cooking in strained cold water, cooking in plain hot water and cooking in strained hot water. Cooking in strained hot water was noted to the best cooking procedure to improve the quality of dehydrated mix before cooking. Rehydrated vegetables should be cooked in the water in which they were soaked to utilize the nutrients leached (Robert *et al.*, 2014). Thus it can be inferred that cooking in strained hot water is nutritious and tastier.

5.5.3. Cooking characteristics

5.5.3.1. Cooking time

Loss of nutrient increases as coking time increases. Cooking time depends on whether the vegetable is fresh frozen or canned. Vegetables are softened during the cooking process. Undercooking makes them too crisp while overcooking makes vegetables mushy (Robert and Cox, 2000).

The developed RTC mix was cooked at different timings such as 6 min, 8 min, 10 min and 15 min. It was found that 15min was enough for the preparation of the olath mix. According to Ghadge *et al.*, (2008) pre- soaking reduced the cooking time of products. Liji (2012) reported that 15 min cooking time was enough for jack fruit based RTC *Aviyal* mix and *Koottu* mix.

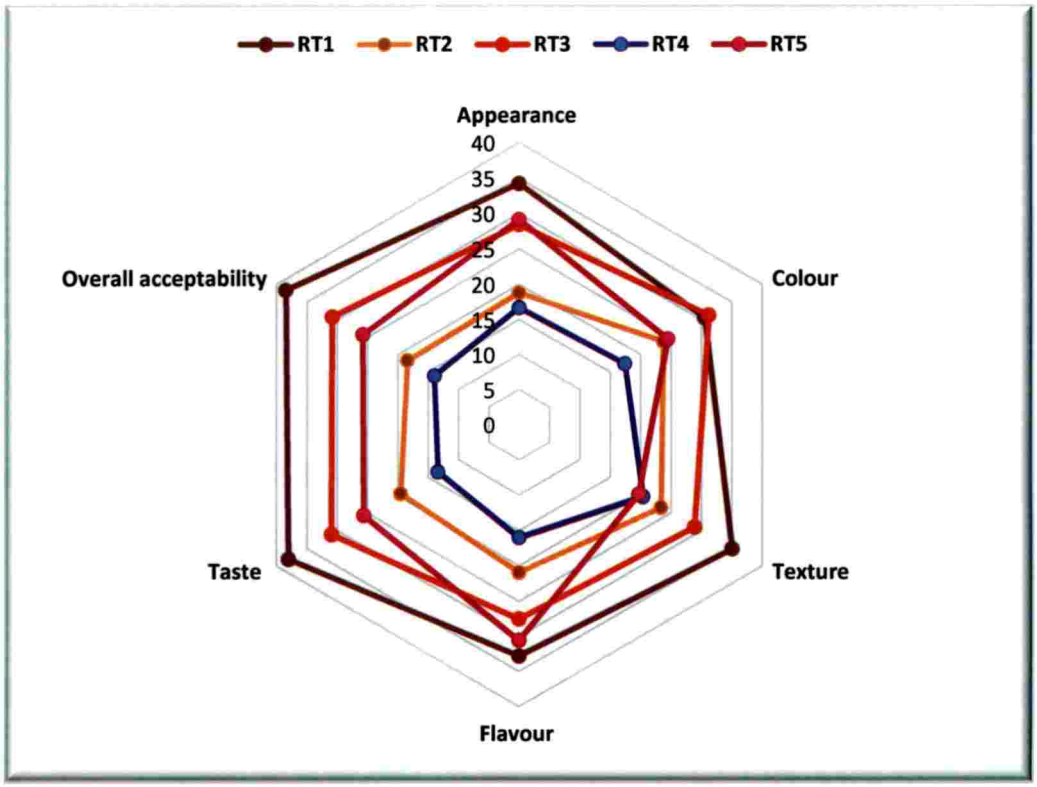


Fig.12. Sensory evaluation of RTC mix

5.5.3.2. Cooked weight

30g of dry RTC olath mix when cooked with 500 ml of water yielded 70g of product. Similar result also observed Megha (2015), reported that10g of RTC curry mix yielded 40g of product.

5.5.4. Optimization of additional ingredients to be added

Coconut forms one of the major ingredient of most Kerala cuisines due to its delicious taste and aroma Midhila, (2013). Coconut was added into Olath mix in various proportions of 10g, 20g, 30g, 40g and 50g. Among these 30g of coconut per 100g was selected as the best of treatment by the sensory panel.

Coconut oil has shelf life and contributes nutritional and functional benefits to value added food. It is necessary adjuncts for olath mix to impart the typical taste, flavour and appearance of the traditional recipes. Addition of 3.5ml of addition of oil was found to give a better product. Coconut and coconut oil impart characteristic flavour to food (FMRC, 2008).

5.6. Packaging and storage

To standardized mix was packed in laminated pouches and stored at ambient conditions to find out the shelf life of developed RTC mix. Bhattacharya and Bhole, (1999) reported that food packaging and storage are vital step to ensure product quality because it provides protection against deterioration and damage during storage, transportation and distribution.

In this present investigation laminated pouches found to be better packaging material for RTC olath mix. According to salve et al.,(2011), laminated polyethylene packages were found to be suitable in packaging supplementary foods and could be kept for 90 days.

Molla *et al.,* (2008) indicated that jack fruit chips packed in metalex foil pouches performed the best.

5.7. Quality evaluation of Olath mix

Quality is a term which denotes a degree of excellence, a high standard or value. Kramer and Twigg, (1970) stated that, quality of foods may be defined as the composite of those characteristics that differentiate individual units of a product, and have significance in determining the degree of acceptability of that unit to the user.

The quality of a food as a combination of attributes that determine the degree of acceptability of the product. These include nutritional value, microbiological safety, cost, convenience and organolaptic qualities (Sethi, 1993). In the present study product development from ivy gourd were assessed for physical properties, chemical compositions and shelf life stability.

5.7.1. Physical characteristics of RTC olath mix

Physical qualities help to qualitative assessment and acceptability of any new product. To assess physical qualities namely moisture, yield, weight loss, rehydration ratio and bulk density were ascertained.

The yield of developed RTC was 38.46 percent. The lower yield is due to the weight difference of initial raw material which is while bulk and the product which are thin in slices.

Rehydration ratio of developed RTC olath mix was 0.54. Davoodi *et al.,* (2007) reported that rehydration ratio of tomato treated with KMS was 0.82.

Indura *et al.,* (2009) reported that bulk density is one of the important quality parameter which indicate the quality of food product, higher bulk density lower the package volume. Bulk density indicates the weight of substance held in a unit volume and it is known to influence the packaging and transportation cost (Ranganna, 2001). In the present study bulk density of the developed RTC mix was 0.18.

Water absorption index of developed RTC mix was 4.5. Water absorption generally depends on starch, protein content and particle size. Fine particle size of the product were associated with higher water absorption than coarse particle size (Kulkarni *et al.,* (2013).

5.7.2. Chemical composition of developed product

Suitable laboratory techniques were followed to test the chemical constituents like moisture, acidity, reducing sugar, fibre, pH and TSS. Bose and Mitra (1990) reported that the chemical composition of fruits in general differs with cultivars and stage of maturity.

Moisture is important parameters in dehydrated products which directly influence the microbial activity, non enzymatic browning, solubility, bulk density, flow ability and hygroscopicity. Moisture can adversely affect the quality of food. Rathre *et al.*, (2007) point out that lower moisture content would give longer shelf stability. The moisture content of developed RTC mix was 5.32. Premakumari *et al.*, (2012) point out that moisture content of RTC Indian recipes such as dosa mixes vermicelli and kozhukattai incorporated with rice bran was 7.14-8.97 per cent. The study conducted by Kocheria *et al.*, (2013) on RTE extruded products made from flour blends the moisture content ranged from 1.80-2.44 percent. In the present study the lower moisture content of RTC mix due to the fact that this is a dehydrated product.

As reported by Mehta *et al.*, (2002) total soluble solid is an important criterion influencing the acceptability of the product. In the present study TSS content of RTC olath mix was observed to be 4.52 brix. Kulkarni, (2013) reported that the TSS content of ivy gourd pulp was 4.1 percent.

pH is an indirect measurement of sweetness or sourness of a product. It is of importance as a measure of acidity, which not only influence the flavour or palatability of a product but also affect the processing requirement of product (Mehta *et al.,* 2002). pH of developed RTC olath mix was found to be 4.84.

Similar trend of result reported on the pH of fresh ivy gourd was 4.65 (Kulkarni 2013). These results indicate that developed product was acidic in nature.

Reducing sugar is expressed in terms of glucose since glucose is the most predominant reducing sugar present n fruits. Reducing sugar content of developed RTC mix was 0.24.

The acidity is measured by the number of free hydrogen ions available in food and this causes a sour taste (Shi and Maguer, 2000). Acidity of developed RTC olath mix was found to be 0.87 per cent. Almost similar result was also reported Giraldo, (2009) acidity of guava fruit powder was 0.97 percent.

5.7.3. Shelf life studies

Livingstone *et al.*, (2000) reported that Assessment of shelf life quality is important since it determines the suitability of a particular ingredient of product development. According to Varsanay (2003), the mechanism and kinetics of the food deterioration can be controlled by storage techniques applied. Sankar, (2002) suggested that factors like material quality, storage temperature, storage containers, process employed and environment in which it is processed affects the shelf life quality.

In the present investigation, sensory evaluation, moisture and microbial profile were conducted predominantly up to a period of three months. The result revealed maintenance of quality through the storage period.

5.7.3.1. Moisture

Initial moisture content of RTC mix was 5.16 percent and the end of third month, moisture content of RTC mix rose to 5.81 percent. The data revealed that there was slight increase in the moisture content of RTC mix during storage. Similar observations reported about the increase in moisture content of dehydrated RTC curry mix from banana peel during storage (Megha 2015).

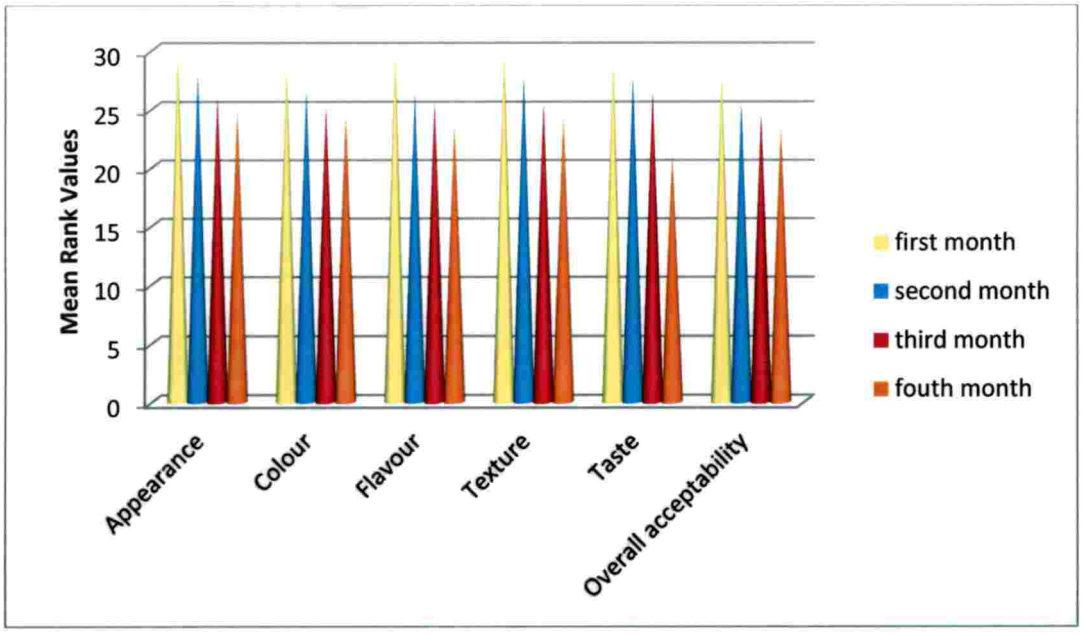


Fig. 13. Sensory of RTC mix during storage

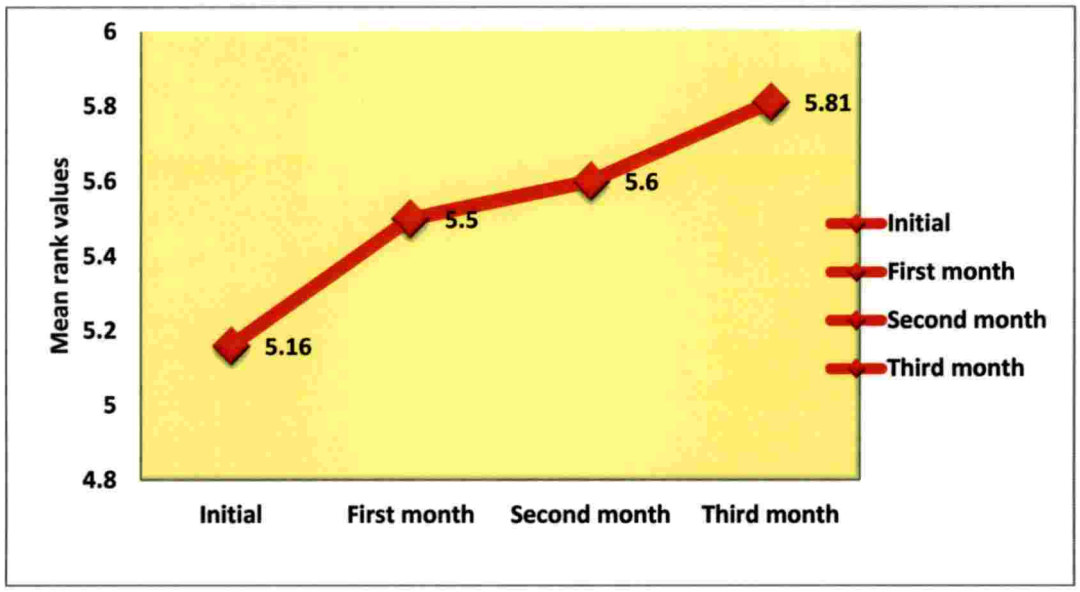


Fig.14. Moisture content of stored RTC mix

Syama, (2000) reported that the moisture content of stored vermicelli was 10.28 percent and found to increase by 11.27 percent during storage period.

5.7.3.2. Microbial profile of developed product

Spoilage causing micro organism responsible for the development of off flavour and off taste that leads to economic loss (Rao, 1993). Spoilage by micro organisms is the primary cause that curtails the shelf life and hence reduce initial microbial population (Zargory, 2003). During storage period, in this study no bacterial colonies was found to appear in the developed RTC mix. But six fungal colonies were seen in 10^3 dilution during third month of storage. However this was within permissible limits.

According to FSSAI regulation dehydrated fruit and vegetable product such as RTC and soup products should have less than 40.000 cfu/gm of microbial count. In the case of ivy gourd based RTC product it is not more than 40.000 cfu/gm.

5.7.3.3. Sensory evaluation

The acceptability of the product was examined at monthly intervals up to three months. The sensory attributes such as appearance, colour, flavour, texture, taste and overall acceptability were found to minimum changes in the organolaptic characters through the storage period of developed RTC mix.

Study conducted by Jaya and Dass (2004), reported that dehydrated mango powder stored under vaccum packed covers retained the colour and flavour of the product.

5.8. Cost of the developed product.

In the present investigation the cost of developed RTC olath mix was analysed. The cost of 1kg packet of product was Rs 350/-.

5.9. Consumer acceptability of RTE and RTC products

Convenience has become a significant driving force in the food industry. Time has become the currency of the present era. This has resulted in enhanced demand for pre-packaged and pre- cooked Ready-to-Eat (RTE) and Ready to cook foods (Yadav and Bhatnagar 2016). Consumer acceptability of developed RTE (salads) and RTC (olath mix) were observed as good besides RTC olath mix.

SUMMARY

SUMMARY

The present study entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica* L.)." was carried out in the Department of Community Science, College of Agriculture, Vellayani, Thiruvananthapuram during 2016-2017. The main intention of the study was to analyse the qualities of ivy gourd and to develop convenient to use products from ivy gourd. The major findings of the study are summarized below.

Ivy gourd needed for the study was collected from Instructional farm, College of Agriculture Vellayani and also from local sources. The nutrient composition, antioxidant activity and glyceamic index of fresh ivy gourd were determined.

The nutrient compositions of ivy gourd were ascertained with respect to carbohydrate, protein, vitamin C, β- carotene, total minerals, sodium, potassium, calcium, iron and fiber and the result revealed the values 3.79g, 2.13g, 14.55g, 145µg, 0.51g, 1.83mg, 2.10mg, 45.25mg, 0.90mg and 1.98 percent respectively. The result of antioxidant activity using different solvent such as petroleum ether, methanol and water revealed that IC_{50} value of 58.01 µg/ml in petroleum ether, 59.53 µg/ml in methanol and 61.21 µg/ml in water. Polyphenol and tannin content was 2.85mg and 10.71mg respectively.

In order to obtain the therapeutic value of ivy gourd the glyceamic index was ascertained. The glyceamic index of ivy gourd revealed that 50.61.

To evaluate changes in nutrients and antioxidants during processing of ivy gourd were processed by blanching, boiling and drying. After processing the samples were subjected to quality analysis with respect to nutrient composition and antioxidant activity. Based on the analysis of samples protein level ranged from 1.42 to 6.20 (g) and total minerals content ranged from 0.12 to 0.72 (g), fibre 1.98 to 0.95 (g), carbohydrate 7.73 to 2.13 (g), calcium 67.80 to 42.13 (mg), iron 1.03 to 0.16 (mg), β carotene 145 to 0.21 (µg), vitamin C 14.55 to 0.98 (mg), sodium 0.99 to 2.54 (mg) and potassium 5.32 to 1.97(mg). Comparative analysis

of data revealed that almost all the nutrients are highest in dried ivy gourd samples except for fiber, vitamin C and β carotene. β carotene, vitamin C and Fiber was recorded higher in fresh sample of ivy gourd followed by blanched ivy gourd sample. Lowest nutrient content observed in boiled sample of ivy gourd.

With regarded to total antioxidant activity, fresh sample of ivy gourd exhibit highest activity with an IC_{50} value 57.52µg/ml in petroleum ether. The lowest antioxidant activity was reported in dried sample of ivy gourd (67.66µg/ml). The total phenol content of samples was found to be ranged between 0.20 – 2.62 mg/100g. Phenol content was found to be more in fresh ivy gourd sample (2.62mg/100g) while lowest phenol content observed in dried sample (0.20mg/ml). In the case of tannin content of samples found to be minimum for dried ivy gourd powder 90.75(mg/100g) followed by blanched 1.40 (mg/100g) and boiled 1.89 (mg/100g) samples of ivy gourd.

Two ivy gourd based dishes were identified for standardization namely ivy gourd based salads (RTE) and ivy gourd based Olath mix (RTC) product. For standardization of salads ivy gourd cut into different shapes such as Dice, Batonet, Slicing, Roll cutting and Cubic cutting. The sliced ivy gourd was selected by analysing the OVQ scores. In order to prevent the slimy nature, sliced ivy gourd pre-treated with 3 per cent salt and 3 percent vinegar for 10 min. This treatment was identified by analysing the OVQ scores of a sensory panel. The salads were formulated with different salad dressings and selected on the basis of sensory evaluation by 10 member's panel using a nine point scale. The identified salad comprised of commercial salad dressing with mayonnaise. The sensory evaluation of ivy gourd based salads was done to find the freshness of salads after four hours. Salad dressing with mayonnaise, salad dressing with pepper and lime as salad dressing were fresh after four hours and selected as best three combinations of ivy gourd salads.

In order to analyse effect of pre-treatments on the quality characteristics of dehydrated ivy gourd slices and its storage stability, ivy gourd slices freshly

dehydrated, blanched drying, drying after blanching and treated with 0.2 percent KMS and drying after blanching and smearing with spices. These samples were dried in 55 °C. The physical characteristics like moisture loss, drying time and dehydration ratio were assessed. The moisture loss of dehydrated ivy gourd ranged from 94.32 - 95.80 percent. The highest moisture loss was noted for drying after blanching and treated with 0.2% KMS (95.80%) and the lowest moisture loss was observed for plain drying (94.32). Drying time of dehydrated ivy gourd ranged from 9 – 9.30 hrs. More drying time obtained for plain drying (9.30 hrs). The dehydration ratio of drying after blanching and smearing with spices found to be higher (0.58). While lowest dehydration ratio found in drying after blanching and treated with 0.2% KMS (0.30).

Shelf life parameters were assessed by storing the products for three months in poly propylene covers. Herein moisture content and microbial profile were analysed. Moisture content was found to increase after each month. Among the four treatments the moisture content was comparatively low in drying after blanching and treated with 0.2% KMS. The microbial evaluation of the product revealed that all the four treatments were microbiologically safe and acceptable up to three months of storage and drying after blanching and treated with 0.2%KMS selected as the best treatment which exhibited highest acceptability during storage.

In the case of standardization of RTC Olath mix size and thickness of ivy gourd slices (longitudinal $^{1}/_{4}$th) was selected based on OVQ scores. Sliced ivy gourd was pre-treated with KMS (0.2 percent) and salt (0.5 percent) for min. These treatments were identified by analysing the scores by sensory panel. The RTC olath mix were formulated and selected on the basis of sensory evaluation by 10 member's panel. The identified olath mix comprised of Ivy gourd, crushed red chilli, garlic, turmeric powder and curry leaves.

In order to give the valuable hints to the consumers for getting the best product, parameters like cooking procedure, cooking method, reconstitution time, cooking

time and addition of adjuncts were also standardized. 30 min of reconstitution time was found be best for Olath mix. After reconstitution, olath mix was standardised foe cooking time. 15 min needed for complete cooking. Among the four treatments cooking in strained hot water give the best sensory qualities to the product.

Coconut is an essential adjunct in traditional kerala cuisine. Because of its perishability coconut was not added into the mix during processing. In order to improve the taste and flavour 30g of coconut was identified optimum to be added into olath mix. 3.5ml of coconut oil were chosen as the optimum levels to be added into olath mix.

The physical characteristics like yield, dehydration ratio, bulk density and water absorption index of the developed RTC mix per 100g were assessed and the result was 38.46, 0.54, 0.18 and 4.5 respectively.

Chemical compositions like pH, TSS, reducing sugar, acidity and moisture contents of RTC mix were assessed and the values 4.84, 4.52 brix, 0.24 percent, 0.87 percent and 5.32 percent respectively.

Shelf stability of the developed product was studied by storing the product in laminated pouches up to three months. The sensory qualities, changes in moisture content and microbial profile were assessed. The organolaptic evaluation showed the slight decrease after storage period. In the case of moisture slight increase in during storage period was observed.

Microbial growth was assessed three months of storage. It was observed that bacterial colonies were found to appear in developed RTC product packed in laminated pouches. But 6 fungal colonies were seen in 10^3 dilution during third month of storage. However this was within permissible limits. No other pathogenic organisms could be detected in the developed product.

The cost of the product of 1kg ivy gourd based RTC was found to be 350/- .

The consumer preference of the developed RTE and RTC products was assessed. RTC olath mix was preferred the most although RTE salads were found acceptable.

This study highlights the nutrients and antioxidants in ivy gourd and also the scope of value addition of ivy gourd. So that this locally available vegetable could promoted for ensuring health and nutritional security.

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APPENDICES

APPENDIX I

Score card for Sensory Evaluation of RTC olath mix

Particulars	Score	Appearance			Colour			Flavour			Texture			Taste			Overall Acceptability		
		T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
Like extremely	9																		
Like very much	8																		
Like Moderately	7																		
Like Slightly	6																		
Neither Like or Dislike	5																		
Dislike Slightly	4																		
Dislike Moderately	3																		
Dislike Very Much	2																		
Dislike Extremely	1																		

Name:

Signature

APPENDIX II

Score card for Sensory Evaluation of RTE Salads

Particulars	Score	Appearance			Colour			Flavour			Texture			Taste			Overall Acceptability		
		A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3
Like extremely	9																		
Like very much	8																		
Like Moderately	7																		
Like Slightly	6																		
Neither Like or Dislike	5																		
Dislike Slightly	4																		
Dislike Moderately	3																		
Dislike Very Much	2																		
Dislike Extremely	1																		

Name:

Signature:

APPENDIX III

Score card for Sensory Evaluation of Stored RTC mix

Particulars	Score	Appearance			Colour			Flavour			Texture			Taste			Overall Acceptability		
		A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3
Like extremely	9																		
Like very much	8																		
Like Moderately	7																		
Like Slightly	6																		
Neither Like or Dislike	5																		
Dislike Slightly	4																		
Dislike Moderately	3																		
Dislike Very Much	2																		
Dislike Extremely	1																		

Name:

Signature:

Appendix -1V

Overall Visual Quality (OVQ) score card(1-9 point scale)

Criteria	Score
Excellent and fresh appearance	9
Good	7
Fair (limit of marketability)	5
Fair usable but not saleable	3
Unusable	1

ABSTRACT

QUALITY ANALYSIS AND DEVELOPMENT OF RTE AND RTC PRODUCTS FROM IVY GOURD (*COCCINIA INDICA* L.).

by

GAYATHRI DEVI. V

(2015-16-008)

Abstract of the thesis

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ABSTRACT

GAYATHRI DEVI.V
2015-16-008

DATE: 19/08/2017

The study entitled "Quality analysis and development of RTE and RTC products from Ivy gourd (*Coccinia indica* L.), was conducted at the Department of Community Science, College of Agriculture, Vellayani during 2015-2017 with the objective to ascertain the nutrients and antioxidants in *Coccinia indica* L. The study also envisaged to standardise RTE and RTC products from ivy gourd and to evaluate their quality. The present study aimed to provide information regarding nutrients and antioxidants in ivy gourd so that this locally available vegetable could be promoted for ensuring health, nutrition and security. Besides, development of RTE and RTC products from ivy gourd would enhance the consumption of this valuable vegetable in the daily diet.

Fresh tender Ivy gourd was selected based on the characteristics of fruit colour and appearance. Quality analysis such as chemical and nutrient composition, antioxidant activities and glycemic index were ascertained.

The result of chemical and nutrient analysis of fresh sample revealed that it contained protein 2.13g, total minerals 0.51g, fiber 1.98 per cent, carbohydrates 3.79g, calcium 45.25mg, iron 0.9mg, β-carotein 145µg vitamin C 14.55mg, sodium 1.83mg and potassium 2.10mg. The total antioxidant activity of ivy gourd was evaluated. The total antioxidant activity of ivy gourd was found in water 61.2µg/ml, petroleum ether 58.01 µg/ml and in methanol 59.53 µg/ml. The polyphenol content was 2.85mg and Tannin was 10.7mg.

Evaluations of loss of nutrients due to blanching, boiling and drying methods were ascertained using standard analytical procedures. Dried ivy gourd revealed highest nutrient content than other processing methods. Boiled ivy gourd showed maximum nutrient loss.

Two popular ivy gourd based dishes of Kerala namely, Salad and Olath mix were identified for standardization of RTE and RTC products. The preliminary processing methods for salad were standardized with respect to dimensions of slices, pre-treatment

media and different combinations of salad dressings. In the case of ivy gourd based dehydrated product, different pre-treatment methods for dehydration of ivy gourd were analysed. The best pre-treatment was evaluated based on drying time, dehydration ratio and moisture loss. D3 (pre-treatment3) was selected as the best pre-treatment media which was formulated by drying after blanching and treating with 0.2% KMS.

The processing methods of RTC products were standardized with respect to size and thickness of slices pre treatment media and immersion time. The adjuncts in the mixes in various proportions were formulated and dehydrated at 55°C till crisp. These formulations were cooked and evaluated for sensory quality. Cooking methods were optimised with respect to reconstitution time, cooking procedures, cooking time and additional ingredients to be added while cooking. For standardization of the RTE and RTC products the best combinations were selected by a panel of comprising 10 members. Parameters like colour appearance flavour texture taste and overall acceptability were evaluated. In the case of RTE product, the best combination identified was T6 which comprised of salad dressings with mayonnaise.

In the case of RTC olath mix T1was selected as the best combination which contained crushed read chilly, onion, garlic turmeric powder and curry leaves (their ratio being 100: 2:10:5:1:5:5). The physical properties of RTC product were analysed, moisture content the product were found to be 5.3, yield ratio for the product were 38.56, bulk density of RTC mix found to be 0.18 and dehydration ratio was 0.54. Water absorption index was found to be 15.88/100g. In order to realize the economic feasibility of the developed RTC mix the cost was calculated by taking individual cost of the ingredients used with 10 percent over head. The cost of 1kg packets of RTC mix was 350 Rs / 1kg. The consumer acceptability of RTE and RTC product were evaluated using hedonic scale in 50 consumers. High consumer acceptability score was obtained for RTC Olath mix.

The standardized products was evaluated its shelf life after packed in laminated pouches and stored in ambient conditions for 3 months. Microbial evaluation of stored products showed the growth of fungi and bacterial colonies were seen in the second month of storage.

The developed RTC (Olath mix) had good shelf life and sensory parameters hence it is suitable for off season consumption. RTE (Ivy gourd salad) was also accepted well among consumers.