NUTRITIONAL EVALUATION AND ACCEPTABILITY OF IVY GOURD GENOTYPES (*Coccinia indica* (L.) Voigt)

By

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THESIS

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DECLARATION

I, hereby declare that this thesis entitled **"Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) Voigt)"** is a bonafide record of research work done by me during the course of research and that it has not been previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) Voigt)"** is a bonafide record of research work done independently by **Miss. Renjumol, P.V** under my guidance and supervision and that it has not formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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ABBREVIATIONS

Kg-Kilogram

g - gram

mg- milligram

μg- microgram

ppm-parts per million

EDTA- Ethylene Diamine Tetra Acetic acid.

A.O.A.C- Association of Official Analytical Chemists

IIVR- Indian Institute of Vegetable Research

Sl.No. -Serial number

CD- Critical Difference.

P-Probability

VM- Vegetable maturity

OM-over maturity

OVM- observed vegetable maturity

AVM-Average vegetable maturity.

Introduction

1.INTRODUCTION

Vegetables occupy an important place in diversification of agriculture and play a pivotal role in food and nutritional security of ever growing population of our country. India is largely a vegetarian society, solely depending on vegetables for bulk of their nutritional requirement. Vegetables play an important role in human diet as an important source of protective foods. They are rich sources of essential nutrients viz vitamin C, provitamin A, folate and minerals. They also provide many nutritionally less defined, yet important components of our diet like fibres and antioxidants. Epidemiological evidence suggests that population whose diets are rich in fruits and vegetables have a reduced risk of degenerative diseases such as coronary heart diseases and cancer.

Since independence, India has emerged as the second largest producer of vegetables in the world with a total production of 84 million tonnes from 6.2 million hectares having 2.6 per cent annual growth. However, per capita availability of vegetables is far below the requirement of 285 g/capita/day for a balanced diet. (Kalloo and Singh, 2000)

The importance of vegetables to health, is becoming better known now and their consumption in rural and urban population is increasing. So, vegetable production and productivity must be increased to meet the present inadequate supply and to keep pace with the rising population for nutritional security. Commercialization of under exploited vegetables will help in solving this problem to a certain extent. (Dhankhar, 2001)

In recent years, more emphasis is given to underutilized fruits and vegetable crops due to their high nutritive and medicinal value in addition to being resistant/ tolerant to many biotic/abiotic stresses. The demand for these crops is gradually increasing resulting in tremendous potential for commercial exploitation of these crops aimed at improving the economic status of the poor and marginal farmers.

Ivy gourd (*Coccinia indica*) is a climbing perennial occurring naturally throughout India and tropical Africa (Nayar and Singh, 1998). The tender fruit of this crop is used as a vegetable. This plant is much valued in the indigenous system of medicine in the treatment of diseases such as skin infections, bronchitis and diabetis (Babu and Rajan, 2001)

This crop is fastly becoming a commercial vegetable crop of Kerala and there exist a great diversity in many quantitative and qualitative characters in this crop. No systematic attempt had so far been conducted to study the nutritive value and organoleptic qualities of this crop. Hence the present study was taken up to identify the genotypes of ivy gourd with high nutritional qualities and also to identify the vegetable maturity stage in these genotypes.

Hence, the present study entitled 'Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) voigt) was conducted with the following objectives.

1. To evaluate the nutritive value of ivy gourd genotypes in vegetable maturity and over maturity.
2. To evaluate the acceptability of ivy gourd genotypes in vegetable maturity and over maturity.

Review of literature

2.REVIEW OF LITERATURE

The literature to the study entitled 'Nutritional evaluation and acceptability of ivy gourd genotypes [*Coccinia indica* (L.) Voigt]'is reviewed under the following headings.

2.1. Importance of vegetables in our diet.
2.2. Therapeutic significance of vegetables
2.3. Nutritional significance of underexploited vegetables
2.4. Nutritional studies on ivy gourd (*Coccinia indica)*

2.1 Importance of vegetables in our diet.

'Vegetables' are important protective foods and are highly beneficial for the maintenance of health and prevention of diseases. They contain valuable food ingredients, which can be successfully utilized to build up and repair the body. Vegetables as a whole are important sources of minerals and vitamins and certain vegetables have starch and cellulose. In meal planning and dietary calculation vegetables occupy a prominent place. (Begum, 1991)

Vegetables form an important component of the Indian dietary in which they are normally prepared and consumed in the form of different types of curries as traditionally formulated in various regions of the country. They are also important as components of the rations for troops in forward areas and onboard ships and submarines. (Jayaraman *et al*., 1991)

Vegetables play a pivotal role in our health security, which is endangered by the low intake of protective foods. Vegetables are excellent sources of roughage, carbohydrates, proteins, vitamins and minerals like calcium and iron. (Dutt, 1996 and Remesh *et al*., 1997)

Kanwar *et al.* (1997) reported that vegetarianism not only reduced the food costs but also lowered blood cholesterol, non insulin dependent diabetes and has lower risk of developing some of the serious scourges of mankind like atherosclerosis, diverticular disturbances of colon, haemorrhoids, gall stones and even constipation and obesity.

Indian Council of Medical Research (ICMR, 1990) recommends that an adult should consume about 300g of vegetables daily. When compared to the consumption rates of developed countries, Indians on an average consume only about 120g of vegetables per day. (Rani *et al*., 1997)

2.2.Therapeutic significance of vegetables.

The main purpose of vegetables in human diet is that they enrich the existing diet with nutrients, enrich the staple food, make it more palatable and improve the digestion and sometimes they have a curative action. (Indira and Peter, 1988)

The large bulk of vegetables help to promote satiety and this, with their low energy value makes them useful in the prevention and treatment of obesity (Passmore and Eastwood, 1986). Cashel and Lewis (1990) reported that vegetables as a source of dietary fibre has been described as a protective agent against many of the present day diseases of affluence.

Consumption of diets rich in fruits and vegetables has lowered the risk of cardiovascular diseases and various forms of cancer (Block *et al*., 1992). The main micronutrients present in vegetables showing strong anticarcinogenic effect include provitamin A, vitamin C, vitamin E and selenium. They also act as strong antioxidants and are involved in DNA and cell membrane against oxidative damage by carcinogens like free radicals, methyl groups and hydroxyl groups. So, the consumption of vegetables had a decreased risk of cardiovascular diseases, diabetes and cancer (Ames *et al*., 1993 and Betram, 1996).

Fruits and vegetables contain a variety of carotenoids that have been shown to have antioxidant and antitumor effects, so an increased intake of fruits and vegetables has been associated with a decreased risk of lung cancer in smokers and non-smokers (Ziegler *et al*., 1996). Some anticarcinogenic compounds found in cruciferous vegetables protect against cancer by inhibiting enzymes that activate carcinogens and by inducing detoxifying agents (Verhoeven *et al*., 1996). Capsaicin the phytochemical present in chilly, impedes carcinogens such as nitrates and cigarette smoke from attaching to cellular material, thus preventing formation of cancer cells. It may also kill bacteria that can cause ulcers (Polasa, 1998).

World Cancer Research Fund and American Institute for Cancer Research (1997) reported that the diet that provide 400 to 600 g fruits and vegetables daily are associated with a reduced risk of lung and other aerodigestive epithelial cancers. Patel and Srinivasan (1997) reported the beneficial effects of bitter gourd and leaf of ivy gourd as dietary adjuncts for the treatment of diabetes mellitus. A significant reduction in cancer risk was rooted in association with increased intake of lycopene, even in smokers. Smoking alters the concentrations of most carotenoids including α-carotene and β-carotene, but not lycopene. Therefore, lycopene may have a special role in lung cancer prevention (Rao and Agarwal, 1998).

Indoles, isothiocynates and sulfarophane found in vegetables like broccoli have shown to trigger enzyme systems that block or suppress cellular DNA damage, reduce tumor size, and decrease the effectiveness of estrogen like hormones. Allylic sulphides found in onion and garlic are other examples. They enhance immune function, increase production of enzymes that help to excrete carcinogens, decrease proliferation of tumor cells and reduce serum cholesterol levels (Polasa, 1998). Vegetables belonging to allium family like garlic bulb, Chinese leek, Chinese chive, scalcion and shallot bulbs have been shown to possess strong antioxidant activity. Garlic is likely the most important herb widely quoted for its medicinal properties. The purported health benefits include chemoprotective, antibiotic and cholesterol lowering properties. Garlic components have been shown to inhibit tumerogenesis thus reducing the risk of human cancer (Saxena, 1998). Increased consumption of fruits and vegetables rich in carotenoids and other antioxidant micronutrients was found to lower urinary indexes of oxidized lipids and DNA in healthy subjects (Thompson *et al*., 1999).

Until recently most attention has been paid to vitamins such as vitamin C, provitamins and dietary fibre in vegetables but in recent years it has been shown that plant tissues contain a whole variety of potentially anticarcinogenic secondary metabolites (Savery *et al*., 1999). Liu *et al.* (2000) conducted a health study in women and showed that, higher intake of fruits and vegetables lowered the risk of cardiovascular diseases, especially myocardial infarction.

A study conducted by Michaud *et al.* (2000) showed that the phytochemicals in fruits and vegetables are important in cancer prevention. Broekmans *et al.* (2000) reported that an increase in fruit and vegetable intake to increase the serum carotenoids and other phytochemicals may prevent common forms of cancers. Apart from nutritive value of vegetables, some other constituents present in vegetables, which play a vital role in disease prevention, are antioxidants, bioflavanoids, flavour compounds and dietary fibres (Singh and Nirmal, 2001). Many phytochemicals act as powerful antioxidants, protecting cells and organs from damage caused by free radicals, by neutralizing their damaging effects. They are biologically active substances in plant that give colour, flavour and protection against human diseases (Kaur and Maini, 2001).

Green and red cabbage, broccoli, brussels’s sprouts, cauliflower, collards, kale, khol-rabi, mustard greens, turnip greens and radish are excellent sources of phytochemicals (Singh *et al*., 2005)

The beneficial effects of vegetables are also associated with the presence of fibres and several antioxidant micronutrients. In this, considerable attention has given to the carotenoids primarily β-carotene (Prayor *et al*., 2000). β-Carotene and other micronutrients afford cancer prevention by virtue of their antioxidant properties. Some carotenoids such as lutein can also act as an immuno-stimulant. Lutein also increases the density of macular pigment in eyes and may reduce the risk of age-related macular degeneration (Rai *et al*., 2004)

Vegetables are primary dietary source of essential nutrients viz. vitamin C and β-carotene, folate and minerals. Further more, vegetables provide many nutritionally less defined yet important components of our diet e.g., fibres and antioxidants (De, 2001). Vegetables also play a key role in neutralizing the acid produced during digestion of protein and fatty acids and also provide roughages in the form of dietary fibre that helps in digestion and bowel movement (Chakrabarthi, 2001).

Flavanoids are important in protecting DNA from high rates of mutation (Yang and Tsui, 1989). Flavanoids comprise one of the largest groups of secondary plant metabolites. More than 4000 flavanoids have been identified of which some are flavonols, flavones, flavanones, catechines, and biflavins. Most of these flavanoids are structurally polyphenols having antioxidant activity (Susanta, 2001).

Bioflavanoids are complex compounds closely associated with vitamin C. These are found in several vegetables. All the bioflavanoids increase the effectiveness of vitamin C and are recognized as potent antioxidants. Several flavanoids have been identified from fruits and vegetables some of the important ones are kaemperol, quercetin and myricetin. Quercetin has anticarcinogenic activity. It also inhibits growth of several types of cancer cells (Chakrabarthi, 2001) Tomato contains higher levels of flavonols. Glycosylated flavanoids are found in French beans. Fenugreek and colocasia leaves also contain flavanoids (Rai *et al*., 2004).

Fruits and vegetables provide substantial amounts of nutrients important for human health. They are particularly important sources of micronutrients such as provitamin A, vitamin C, vitamin E, vitamin B_6, folic acid, iron and magnesium (Singh and Kalloo, 2001).

Vegetables, among protective foods are rich sources of essential elements besides having medicinal and therapeutic properties and are able to provide nutritional security to a predominantly vegetarian country like India (Verma, 2001). Increasing intake of dietary antioxidants from vegetables may help to maintain an adequate antioxidant status and therefore the normal physiological functions of the living system (Kaur and Kapoor, 2001).

Vadera *et al.* (2003) reported hypocholestrerolemic and hypolipidemic effect of fibre from mustard and curry leaves with a potential antiatherogenic property. Dietry fibres are associated with reduced incidence of coronary heart diseases. It binds to bile salts and prevents its reabsorption and reduces cholesterol level in circulation (Rai *et al*, 2004). Consumption of fruits and vegetables has been reported to reduce incidence of major diseases like cancer, cardio vascular diseases, diabetes, cataract and inflammatory diseases (Sailass *et al*., 2004).

2.3.Nutritional significance of underexploited vegetables

The dietary pattern of India is changing day by day. People want a change in food habits along with their way of living. In such circumstances a new range of minor vegetables are catching the attention of growers, retailers and consumers, which are known to be underexploited or rare vegetables, the consumption of which is very less due to known preference and ignorance (Chaurasia and De, 2001)

Rare vegetables are rich sources of antioxidants which are now a days widely promoted as agents that act as protectants against various disorders of human health viz. coronary heart disease and cancer (De, 2001).

In the developing countries there is an ever increasing gap between food supplies and population growth. The search for novel high quality but inexpensive sources of food has always remained a major concern of all agencies involved in providing adequate food and improving nutritional status of the population (Sankhala *et al*., 2005).

2.3.1.Underexploited green leafy vegetables

Green leafy vegetables are known to be the most inexpensive source of several vital nutrients like vitamins and minerals and also a good source of dietary fibre. Green leafy vegetables contain antioxidants (carotenoids and ascorbic acid), which offer protection against many chronic diseases. Kerala is endowed with an array of leafy vegetables suited for cultivation in the warm humid climate all the year round. Less familiar leafy vegetables like basella, chekkurmmanis, alteranthera, water leaf, and portulaca are used locally in different parts of the country as well as in the state (Krishnakumary, 2006).

Imungi and Potter (1983) reported that cowpea leaf contain a high quality of minerals including iron, calcium, phosphorous and zinc. Levels of vitamin C, total carotene and free and total folacin were 410mg, 57mg, 334μg and 2012μg respectively per 100 g of solids.

In a study conducted by Herzog *et al.* (1993) in four wild leafy vegetables in Cote d'Ivoire the leaves were found to be good in iron and calcium. Special attention was given to their mucilage contents.

Handique (1993) reported that the non-conventional leafy vegetables contain seven essential amino acids in various concentrations indicating their high nutritive value.

Yeoh and Wong (1993) revealed that lesser utilized tropical plants, were rich in protein, had a good complement of amino acids and favourable amounts of minerals, sugars, lipids and fibre. Further more, antinutritional factors such as trypsin and chymotrypsin inhibitors and cyanide were not detected. Overall the plants represented potential food sources with high protein content and good nutritive value.

The unconventional leafy vegetables found in the forest and cultivable wasteland of Konkan, like drumstick leaves, math, kate math, bharangi and kawala contained comparatively higher amounts of crude protein, crude fat, crude fibre and total carbohydrate (Shingade *et al*., 1995)

According to Manay and Swamy (1995) drumstick leaves were considered useful in scurvy and catarrhal affliction. Water leaf is a green leafy vegetable that grows in a semi-wild environment in the tropics and studies revealed that the nutritive value of waterleaf compared favourably with other vegetables (Akachukku and Fawusi, 1995).

Awoyinka *et al.* (1995) reported the nutrient content of young cassava leaves and their acceptance as a green vegetable in Nigeria. Cassava leaves contains a high level of crude protein compared to amaranth. Dietary fibre was very high in all samples while cyanide potential was low.

Spinach, drumstick, mint, coriander etc. are equally good sources of vitamin C, comparable to fruits (Thimmayamma and Pasricha, 1996). Ejoh *et al.* (1996) analysed the flowers and leaves of colocasia and the green fruits of *Solanum melongena* and reported that the leaves of *Colocasia esculenta* had the highest crude protein value of 307g / Kg. These foods also contained moderate quantities of calcium, phosphorous and magnesium.

In the wild leaves, higher concentrations of the macronutrients were found than in commercially exploited cultivars such as Swiss chard, spinach and chicory. *Amaranthus quitensis* contain high levels of calcium, iron and magnesium and the Remex sp.contain high amount of ascorbic acid (Rozycki *et al*., 1997)

Barminas and Emmanuel (1998) analysed six non-conventional leafy vegetables consumed largely by the rural populace of Nigeria for mineral composition and reported that *Amaranthus spinosus* and *Adansonia digitata* leaves contained the highest level of iron (38.4 mg / 100g and 30.6 mg / 100 g respectively). All the vegetables contained high levels of calcium compared to common vegetables. Zinc content was highest in *Moringa oleifera*, *Adansonia digitata* and *Cassia tora* leaves, while the manganese content was comparatively higher in *Colocasia esculenta*.

According to Mathew (2000) the calcium content of different less familiar leafy vegetables ranged from 13.42 mg / 100 g in basella to 135.20mg in Bengal keera. Phosphorous ranged from 5.60 mg to 13.84 mg /100g of leaves. The highest value was obtained in kang kong and the lowest in water leaf.

Singh *et al.* (2001) analysed six vegetables including spinach and amaranth and found that the maximum content of copper, manganese and zinc in spinach.

Sankhala *et al.* (2005) analysed the iron, calcium, β-carotene, vitamin C and oxalic acid content of the less familiar edible leaves of Udaipur and found that these leaves were exceptionally rich sources of iron and β-carotene with maximum values in the leaves of Hatda (32.0 mg / 100g) and drumstick (6700 μg /100g) respectively.

Chekkurmmanis plant is reputed for its high nutritive value and there fore popularly known as ‘multivitamin greens’ and ‘multimineral packed leafy vegetable’ (Krishnakumary, 2006).

Indira *et al.* (2006) conducted a study on underexploited wild leaves in tribal areas of Kerala and analysed the various constituents in these edible leaves. Most of the leaves had higher protein, fibre, vitamin C, calcium phosphorous, iron potassium, magnesium, copper, manganese and zinc, and they also contained lower amount of antinutritional factors like oxalates and nitrates.

2.3.2 Underexploited roots and tubers.

Tropical roots and tubers are categorized as energy rich food crops due to their starch content, yam having 18-25 per cent and aroid 19-21 per cent. The starch content of Amorphophallus is reported to be in the range of 14-18 per cent (Kay, 1975).

Wanasundera and Ravindran (1994) analysed the nutrient and antinutrient components of tubers from seven cultivars of *Dioscorea alata* and found that the crude protein content of *D.alata* tubers was 7.4 per cent, and starch 75.6 to 84.3 per cent. Vitamin C content of the yam tubers ranged from 13.0 to 24.7 mg / 100 g fresh weight basis. The results showed that the yams to be reasonably good sources of minerals. The phytic acid content of yams were low (58.6 to198.0 mg /100g dry matter). Total oxalate levels were found to be 486 to 781 mg /100g dry matter in that 50 to 75 per cent of the oxalates were in the water soluble form.

Dietary fibre in white yam has been reported as 16.3 per cent and white yam diets may protect against cancers of the colon and rectum (Dhankhar, 2001)

The winged bean tubers are reported to be rich in vitamin A, vitamin B and minerals like calcium and phosphorous (NAS, 1975a). Rao and Belavady (1979) reported a high protein content in winged bean tubers with high methionine and lysine values.

According to Freyre *et al.* (2000) the roots of *Canna coccinea* contain high amount of phosphorous but the study revealed that it has low energy value (34 Kcal /100g)

2.3.3.Underexploited other vegetables

Still, there are a number of minor crops, which are used for vegetable purpose in different parts of the country. These underutilized crops are to be collected, evaluated, characterized and maintained to prevent genetic erosion. Medicinal values and nutritional significance of these underutilized vegetables are also to be studied so as to make it popular among the rural as well as urban population (Gopalakrishanan *et al*., 2006)

Khalil *et al.* (1986) invented the chemical and cooking characteristics of field pea (*Pisum arvense*), moth bean (*Vigna aconitifolia*) and pigeon pea (*Cajanas cajan*). They reported that the crude protein content was 24.5 per cent for field pea, 22.7 per cent for moth bean and 21.3 per cent for pigeon pea.

Dhanprakash *et al.* (1993) reported that the seeds of chenopodium species contained 106 to 142 g / Kg protein and 30 to 62 g / Kg fat. Raghuvanshi *et al.* (2001) conducted a study on uncommon fruits and vegetables including *Chenopodium album* Linn., *Fagopyrum esculentum* Moench etc and found that all samples are good sources of micronutrients.

Fruits of *Solanum torvum* are cooked and eaten as a vegetable. They are considered useful in case of liver and spleen enlargements. The fruits had a calcium content of 390 mg / 100g, phosphorous of 180mg / 100 g, iron 22.2 mg /100g and vitamin A 750 IU (CSIR, 1972). Ejoh *et al.* (1996) reported that the green fruits of *Solanum melongena* contain high crude protein (138 g / Kg) and total lipids (71 g/ Kg).

Wax gourd popular in Asian tropics contains 4 per cent protein, 3.2 per cent carbohydrate and 0.1 per cent fat. The seeds of buffalo gourd, a drought tolerant under exploited vegetable contains about 30 per cent and 34 per cent oil (NAS, 1975b).

Giant granadilla (*Passiflora quadrangularis* Linn.) is a widely distributed underexploited vegetable in tropical areas. Its edible flesh contains water 93.7 per cent, protein 0.7 per cent, fat 0.2 per cent, carbohydrate 4.3 per cent, fibre 0.7 per cent and ash 0.4 per cent (Krishnakumary and Rajan, 1997)

According to Neeliyara (1998) the crude protein content of the winged bean pods were found to be 2.9 per cent. The fat content varied from 0.4 per cent to 0.7 per cent and the fibre content varied from 16.8 per cent to 19.4 per cent.

A study was conducted by Thampi and Indira (2000) on the nutritive value of thamara venda genotypes. The mean protein content ranged from 14.19g / 100 g to 17.65g / 100g on dry weight basis. Fat value showed a variation ranging from 12.52g / 100g to 14.83g /100g and the calcium ranged from 926mg / Kg to 1406mg / Kg.

Spine gourd is a diaecious, perennial, cucurbitaceous vegetable and grows as wild on hedges throughout the country. It has high food value, containing the highest amount of protein (3.1g /100g) among the cucurbitaceous vegetables (Bharathi *et al*., 2006a)

According to Bharathi *et al.* (2006b) Melonthria (*Solena amplexicaulis* (Lam.) Gandhi) also called clasping stemmed solena or creeping cucumber, the immature fruits of this are used as salad as well as for curry by the tribals of eastern region of India and it has some medicinal property also.

2.5. Nutritional studies on Ivy gourd (*Coccinia indica*).

Ivy gourd is a tropical plant in the family of cucurbitaceae. It is an aggressive climbing vine that can spread quickly over trees, shrubs, fences and other supporters. The ivy gourd fruit belongs to the berry type, oval and hairless with thick and sticky skin. The raw fruits are green in colour and turns bright red when it is ripe. The mature fruit is usually from 25mm to 60mm long by 15mm to 35mm diameter and contain several pale, flattened seeds (Wasantwisut and Viriyapanich, 2003)

The tender fruits taste like cucumber and are used as salad or as a delicious vegetable in various curry preparations (Indira and Peter, 1988). Sarnaik *et al.* (1999) collected 35genotypes of *Coccinia grandis* from remote tribal areas of Madhya Pradesh and wide variability was recorded for all the characters studied.

Several varieties of this crop are cultivated in different regions. They differ in shape, size, length, odour and pattern of stripes on fruits. In the east, and in parts of western states, strains bearing long and dark green or light green fruits with scattered small longitudinal white stripes and rounded ends are seen. (Nath, 1975). *Coccinia* is widely grown in the eastern, western and southern states of India (Nath, 1976).

The fruits of ivy gourd are of varying size. There are clones that produce parthenocarpic fruits and also bitter fruits (Singh, 1989). The lines with bitter fruits could be used for pickle making after curing with 15 per cent sodium chloride.

Joseph (1999) reported that in ivy gourd genotypes CG-23, CG-45 and CG-44 were high in carotene, vitamin C and calcium content respectively. Polyphenol was found to be minimum in the accessions CG-78 and CG-74.

The tender fruits of ivy gourd are used as a vegetable. This plant is much valued in the indigenous system of medicine in the treatment of diseases such as skin infections, bronchitis and diabetes. The fruits contain appreciable amounts of iron, β-carotene and vitamin C (Babu and Rajan, 2001)

Ivy gourd is rich in β-carotene, a major precursor of vitamin A from plant sources, also a good source of protein, fibre and a moderate source of calcium and compares well to other commonly eaten vegetables. Since ivy gourd is rich in β-carotene, readily acceptable for consumption by all age groups, inexpensive as well as accessible to the village households, this vegetable was selected for several studies in Thailand to demonstrate an effect of dietary intervention to improve vitamin A nutrition (Xu *et al*., 2003).

Although ivy gourd is rich in pectin, it also helps to inhibit gluconeogenesis and stimulate glucose oxidation (Khan *et al*., 1980). The alcoholic extract of *Coccinia indica* was found to be more active in reducing blood glucose level (Singh *et al*., 1985). Kumar *et al.* (1993) revealed that daily oral administration of pectin isolated from the fruits of *Coccinia indica* (200mg / 100g body weight) exhibited a significant hypoglycaemic action in normal rats.

Vaishnav and Gupta (1996) reported that *Coccinia indica* is used in traditional medicine to treat diabetes, skin eruptions, sores on tongue and for ear ache. Pectin from *Coccinia indica* is reported to be responsible for the decreased concentration of cholesterol. Also the activities of lipoprotein lipase in adipose tissue and heart were significantly increased following pectin feeding suggesting they could be responsible for the decreased concentration of triacylglycerols in serum (Roy and Dutta, 1989; Bhardwaj *et al*., 1994; Kumar *et al*., 1997; and Pari and Venkateswaran, 2003).

Materials and Methods

3.MATERIALS AND METHODS

1.Selection of genotypes

Out of the 20 ivy gourd genotypes maintained in the department of Olericulture, College of Horticulture, Vellanikkara, three genotypes with maximum yield and distinct fruit characteristics and the released variety Sulabha were selected for the study.

Selected genotypes

CG-27

CG-81

CG-82

Sulabha

Selected genotypes in the field are presented in Plates 1 to 4.

2.Standardisation of vegetable maturity stage

In each genotype, flowers in a plant were tagged on the day of flower opening. Fruit development was observed in each day by measuring the girth of the fruit each day and also by observing the texture of the seed coat by pressing it with fingernails. Number of days from first flower opening to maximum fruit girth, with soft seed coats and with colourless flesh was taken as vegetable maturity stage of that genotype. This vegetable maturity stage of each genotype was taken as the observed vegetable maturity stage. The average of the days of attaining vegetable maturity of the four genotypes was taken as average vegetable maturity stage. When the colour of the flesh turned red and seed coat became hard, this stage was taken as over maturity stage.

3.Collection of the samples

Triplicate samples of fruits from each genotype were randomly collected at vegetable maturity stage and over maturity stage.

Plate.1.Genotype CG-27 in the field

Plate.2.CG-81 in the field

Plate.3.Genotype CG-82 in the field

Plate.4. Sulabha in the field

Average day required for attaining vegetable maturity of the four genotypes was calculated inorder to collect samples before the average day of vegetable maturity and after the day of average vegetable maturity. All the samples were collected in triplicate after tagging the flowers on the day of flower opening.

4.Fruit characteristics of ivy gourd genotypes.

The following physical characteristics were observed in each genotype at vegetable maturity stage and over maturity stage.

4.1.Fruit shape.

Shape of six fruits in each genotype was observed and noted in the vegetable maturity and over maturity stage.

4.2.Fruit colour.

Colour of six fruits in each genotype was observed and noted in their vegetable maturity and over maturity stage.

4.3.Fruit length

Length of six fruits in vegetable maturity and over maturity stages in each genotype was recorded in centimeters and worked out the mean value.

4.4. Fruit girth

The girth at the middle of six fruits in vegetable maturity and over maturity was recorded for each genotype after harvest and average was worked out.

4.5.Fruit firmness.

Firmness of six fruits in vegetable maturity and over maturity stage in each genotype was measured using a penetrometer.

4.6.Fruit weight.

The weight of six fruits in vegetable maturity and over maturity stage in each genotype was taken using an electronic balance and average fruit weight was calculated in grams.

5. Analysis of constituents in ivy gourd genotypes.

The ivy gourd genotypes in their respective vegetable maturity stage and over maturity stage were analysed for the following constituents.

1.Moisture
2.Fibre
3.Protein
4.Calcium
5.Phosphorus
6.Iron
7.Potassium
8.Vitamin C
9.β Carotene
10.Total phenols
11.Total pectins
12.Mucilage.

Constituents such as vitamin C, β carotene and total phenols were analysed in all genotypes just before the day of average vegetable maturity also calculated for the selected four genotypes, the day of average vegetable maturity and also on the day just after the day of average vegetable maturity.

5.1.Moisture.

Moisture content of the selected genotypes was estimated using the method of A.O.A.C (1980)

To determine the moisture content, ten gram of the fresh sample was weighed into a weighed moisture box and dried in an oven at 100^{o} C to 105 ^{o} C and cooled in a desiccator. The process of heating and cooling was repeated till constant weight was achieved. The moisture content of the sample was calculated from the loss in weight during drying.

5.2.Fibre.

The fibre content was estimated by acid alkali digestion method as suggested by Chopra and Kanwar (1978)

Two gram of the dried and powdered sample was boiled with 200ml of 1.25 per cent sulphuric acid for thirty minutes. It was filtered through a muslin cloth and washed with boiling water and again boiled with 200ml of 1.25 per cent sodium hydroxide for thirty minutes. Again, it was filtered through a muslin cloth and washed with sulphuric acid, water and alcohol. The residue was transferred to a pre weighed ashing dish, dried, cooled and weighed. The residue was then ignited for thirty minutes in a muffle furnace at 600^{o}C, cooled in a desiccator and reweighed. The fibre content of the sample was calculated from the loss in weight on ignition and then converted to fresh weight basis.

5.3.Protein

The protein content was estimated using the method suggested by Fischer (1973).

In one litre of distilled water, dissolved 0.382g of NH_4Cl and from that 100ppm, 120ppm, 140ppm, 160ppm, 180ppm and 200ppm were read colorimetrically for the preparation of standard graph. Weighed 0.5g of sample and was digested in concentrated Suphuric acid for 10 minutes and added 2-3ml of hydrogen peroxide drop wise till the solution become colourless. The solution was made up to 100ml. From the working solution, 5ml was taken and 1ml of 10 per cent sodium silicate followed by 2ml of 10 per cent sodium hydroxide were added and made up to 50ml. To this 1.6 ml of Nessler's reagent was added and red colour developed was read at 410nm. Standard graph was prepared and estimated the protein content.

5.4.Calcium

The calcium content was estimated using titration method with EDTA as suggested by Hesse (1971)

One gram of dried and powdered sample was pre digested with 12ml of 9:4 diacid and volume made up to 100ml. One ml of aliquot was taken and added 10ml water, 10 drops of five per cent hydroxylamine, 10 drops of triethanolamine and 2.5 ml of 10 per cent sodium hydroxide and 10 drops of calcon. Then it was titrated using EDTA till the appearance of permanent blue colour. It was expressed in mg per 100g of sample and converted to fresh weight basis.

5.5.Phosphorus

The phosphorous content was analysed colorimetrically after preparing a diacid extract, by vanadomolybdophosphoric yellow colour method in nitric acid medium (Jackson, 1973)

One gram of the sample digested in diacid, was made up to 100ml. Five ml of the aliquot was pipetted into a 25 ml volumetric flask, and made up to 25 ml. After 10 minutes the intensity of yellow colour was read at 470nm in a spectrophotometer. A standard graph was prepared using serial dilutions of standard phosphorous solution. From the graph the phosphorous content of the sample was estimated and converted to fresh weight basis.

5.6.Iron

The iron content was analysed colourimetrically using ferric iron, which gives a blood red colour with potassium thiocyanate (Raghuramulu *et al.*, 2003)

To an aliquot of the mineral solution, enough water was added to make up to a volume of 6.5 ml followed by one ml of 30 per cent sulphuric acid, one ml of potassium persulphate solution and 1.5 ml of 40 per cent potassium thiocyanate solution. The intensity of the red colour was measured within 20 minutes at 540 nm. A standard graph was prepared using serial dilutions of standard iron solution. From the standard graph the iron content of the sample was estimated and converted to fresh weight basis.

5.7.Potassium

The potassium content was estimated using flame photometer as suggested by Jackson (1973).

One gram of dry powdered sample was digested in diacid and made up to 100ml. One ml of the sample solution was made up to 25 ml and read directly in flame photometer.

5.8.Vitamin C

The vitamin C content of the fresh sample was estimated by the method of A.O.A.C (1955)

One gram of the fresh sample was extracted in four per cent oxalic acid using a mortar and pestle and made up to 100ml. Five ml of the extract was pipetted, added 10ml of 4 per cent oxalic acid and titrated against the 2,6 Dichlorophenol indophenol dye. Ascorbic acid content of the fresh sample was calculated from the titre value.

5.9.β Carotene

β Carotene was estimated by the method of A.O.A.C (1970) using saturated n-butanol.

Five gram of powdered and dried sample was placed in a 125 ml glass flask and added 50 ml water saturated n-butanol from pipette. The flask was stoppered tightly, shook well for one minute and kept overnight, protected from sunlight. Decanted the supernatant, pipetted 0.5 ml of the supernatant and diluted with 10 ml, water saturated n-butanol and read the colour intensity in a spectrophotometer at 435.8 nm. β Carotene content of the sample was calculated from the reading and converted to fresh weight basis.

5.10.Total phenols.

The phenol content was estimated as tannic acid by colourimetric method using Folin-Denis reagent (Sadasivam and Manickam, 1992).

An exact amount of 0.5g sample was boiled with 75ml of distilled water and made upto 100ml. From the made up solution 1 ml was pipetted out to a volumetric flask having 75ml water and added 5ml Folin-Denis reagent and 10ml of sodium bicarbonate and diluted to 100ml. After 30 minutes the absorbance was read at 700 nm. The phenol content was expressed in percentage from the standard graph prepared using serial dilution of standard tannic acid.

5.11.Total pectins

Total pectin content was estimated gravimetrically (Sadasivam and Manickam, 1992)

Pectin was extracted and precipitated as calcium pectate. After thorough washing, the precipitate was dried and weighed. Pectin content was expressed as percentage of calcium pectate.

5.12.Mucilage

Mucilage content of the fruit was extracted by using ethyl alcohol (Sankar, 2002).

Twenty-five gram fresh fruit sample was taken, added 100ml of distilled water and kept for 24 hours. Then it was filtered through a muslin cloth into a flask. Fifty ml of alcohol was added to the flask and then it was filtered through a pre weighed filter paper. The filtrate along with the filter paper was dried and weighed. The percentage of the mucilage content was calculated by the formula given below.

$$\text{Percentage of mucilage} = \frac{B - A}{\text{Weight of the sample taken}} \times 100$$

B - Weight of the filter paper with mucilage

A - Weight of the filter paper alone

6.Organoleptic evaluation

Organoleptic evaluation of ivy gourd genotypes was conducted at the laboratory level.

6.1.Selection of judges

Evaluation panels of ten persons were selected between the age group of 18-35 years as suggested by Jellenik (1985)

6.2.Preparation of the sample for acceptability studies

The ivy gourd genotypes in their respective vegetable maturity stage and over maturity stage were collected and used for the acceptability studies. In all genotypes, samples were collected in three stages i.e., just before the day of average vegetable maturity calculated, during the day of average vegetable maturity and after the day of average vegetable maturity for acceptability studies.

The ivy gourd fruits (100g) were washed and cut into small pieces, cooked in 50ml of water for 10 minutes in a closed vessel by adding 5 grams of salt till the water was fully absorbed. The cooked samples were used for acceptability studies.

6.3.Sensory evaluation.

The sensory evaluation was carried out using a score card (Swaminathan, 1974) by the selected ten individuals. Five quality attributes like appearance, colour, texture, flavour and taste were evaluated using score cards. These quality attributes were assessed by a five point hedonic scale. The overall acceptability of each maturity stage was calculated statistically.

7.Statistical analysis.

Analysis of data was conducted using statistical techniques such as analysis of variance, Duncan's Multiple Range Test (DMRT) and Kendall's Coefficient of Concordance.

Results

4.RESULTS

The results of the study entitled 'Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) Voigt)' are presented under the following headings.

4.1.Standardisation of vegetable maturity in selected ivy gourd genotypes.
4.2.Fruit characteristics of ivy gourd genotypes.
4.3.Chemical constituents in ivy gourd genotypes.
4.4.Organoleptic qualities.

4.1. Standardisation of vegetable maturity in selected ivy gourd genotypes.

The number of days for attaining vegetable maturity and over maturity was counted from the date of flowering, to the day with maximum fruit size and fruit girth, and by observing the texture of the seeds and the results are presented in Table 1.

Table.1. Days for attaining vegetable maturity and over maturity.

Sl. No.	Genotypes	VM (Days)	OM (Days)
1	CG-27	8	13
2	CG-81	9	14
3	CG-82	7	12
4	Sulabha	9	15
	Mean	8.25	13.5

VM- Vegetable Maturity
OM- Over Maturity

The days for attaining vegetable maturity for the selected genotypes varied from 7 to 9 days (Observed vegetable maturiy). Maximum days was for Sulabha and CG-81 (9 days) and the least was for CG-82 (7 days). CG-27 took 8 days for attaining vegetable maturity. On an average number of days for attaining vegetable maturity was found to be 8 days (Average vegetable maturity). During this period fruits had soft seed coat and colourless flesh.

As observed, the number of days for becoming over mature stage in the selected genotypes varied from12 to 15 days, the maximum for Sulabha and the least for CG-82. CG-27 and CG-81 took 13 and 14 days respectively for attaining over mature stage. The average number of days for becoming over maturity in all the four genotypes was found to be 13 days. Hard seed coat and red flesh are the indication of over maturity.

Observed vegetable maturity stage and over maturity stage of each genotype is depicted in Plates 5 to 12.

4.2.Fruit characteristics of ivy gourd genotypes.

Fruit characteristics of the selected ivy gourd genotypes are presented in Table 2 (1) and Table 2 (2).

Table.2 (1). Fruit characteristics of ivy gourd genotypes

Sl.No.	Genotypes	Fruit shape		Fruit colour		Striations	
		VM	OM	VM	OM	VM	OM
1	CG-27	Cylindrical	Cylindrical	Light green	Light green	Broken	Broken
2	CG-81	Long	Long	Light green	Light green	Broken	Broken
3	CG-82	Oval	Oval	Green	Green	Continuous	Continuous
4	Sulabha	Long	Long	Light green	Light green	Continuous	Continuous

VM – Vegetable Maturity
OM – Over Maturity

Plate.5. CG-27 in observed vegetable maturity stage

Plate.6. CG-27 in over maturity stage

Plate.7.CG-81 in observed vegetable maturity stage

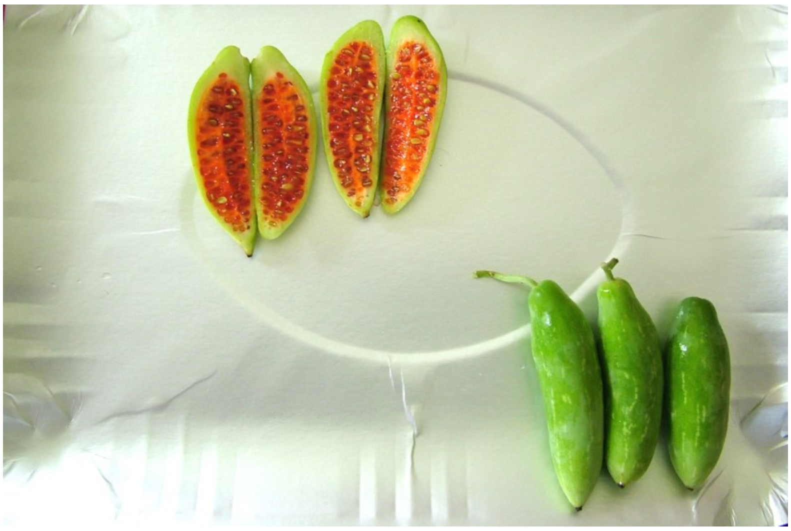

Plate.8. CG-81 in over maturity stage

Plate.9. CG-82 in observed vegetable maturity stage

Plate.10. CG-82 in over maturity stage

Plate.11. Sulabha in observed vegetable maturity stage

Plate.12. Sulabha in over maturity stage

Table-2 (2). Fruit characteristics of ivy gourd genotypes.

Sl.No.	Genotypes	Length (cm)		Girth (cm)		Firmness (Pressure Kg/cm^{2})		Weight (g)	
		VM	OM	VM	OM	VM	OM	VM	OM
1	CG-27	6.8	6.8	8.1	8.1	7.1	5.4	16.91	22.21
2	CG-81	7.4	7.4	7.7	7.7	9.3	8.7	19.36	23.53
3	CG-82	4.7	4.7	9.3	9.3	9.5	8.4	14.48	21.55
4	Sulabha	9.5	9.5	7.1	7.1	8.7	5.6	26.7	29.91
	Mean	7.1	7.1	8.05	8.05	8.65	7.03	19.36	24.3

VM-Vegetable Maturity
OM-Over Maturity

4.2.1.Fruit shape.

As revealed in Table 2 (1), in selected ivy gourd genotypes the fruit shape was different. In CG-81 and Sulabha the shape of the fruits were elongated. The fruits of CG-27 was cylindrical, were as in CG-82, the fruits were oval in shape. There was no change in the shape of fruits in their over maturity stage.

4.2.2.Fruit colour and striations.

The fruits of genotype CG-27 and CG-81 had a light green colour with broken striations, CG-82 had green coloured fruits with continuous striations. The released variety sulabha had a light green colour with continuous striations. There was no change in the colour of fruits in their over maturity stage except for the colour of the flesh.

4.2.3.Fruit length

As given in Table 2 (2), the length of the fruits in vegetable maturity varied from 4.7cm to 9.5cm, with maximum length for Sulabha (9.5cm) followed by CG-81 (7.4cm). CG-27 had a fruit length of 6.8cm, while CG-82 had the least fruit length of 4.7cm. The average fruit length for the four genotypes selected was found to be 7.1cm. There was no change in the fruit length in all genotypes in over maturity stage.

4.2.4.Fruit girth.

The fruit girth in vegetable maturity varied from 7.1cm to 9.3cm in the genotypes, with CG-82 having maximum fruit girth of 9.3cm and Sulabha had the minimum fruit girth of 7.1cm. CG-27 had a fruit girth of 8.1cm and CG-81, 7.7cm. The average fruit girth of all the four genotypes was found to be 8.05cm. There was no change in the fruit girth in over maturity stages in all genotypes.

4.2.5.Fruit firmness.

The firmness of the fruit in vegetable maturity stage varied from 7.1 to 9.5Kg/cm^2 with a mean value of 8.65 Kg/cm^2. The genotypes CG-82 had the maximum fruit firmness followed by CG-81 (9.3 Kg/cm^2). Sulabha had a firmness of 8.7 Kg/cm^2 and CG-27 had the least firmness of 7.1 Kg/cm^2.

In all genotypes fruit firmness had reduced during over maturity stage, which varied from 5.4 to 8.7 Kg/cm^2 with a mean value of 7.03 Kg/cm^2. Fruit firmness was minimum for CG –27 during over maturity stage (5.4 Kg/cm^2) followed by sulabha (5.6 Kg/cm^2). Maximum fruit firmness was found in CG-81 during over mature stage (8.7 Kg/cm^2) followed by CG-82 (8.4 Kg/cm^2).

4.2.6.Fruit weight.

The fruit weight in vegetable maturity varied from 14.48g to 26.7g in the genotypes with a mean weight of 19.36g. . Maximum fruit weight was for

Sulabha (26.7g) followed by CG-81 (19.36g). CG-27 had a fruit weight of 16.91g and the least weight was for CG-82 (14.48g).

In over maturity the fruit weight had increased in all genotypes, which varied from 21.55 to 29.91g. The maximum fruit weight in over maturity was for genotype Sulabha (29.91g) followed by CG-81 (23.53g). CG-27 had a fruit weight of 22.21g and the least was for CG-82 with 21.55g. The mean fruit weight in over maturity stage of all the genotypes was found to be 24.3g.

Fruit characteristics of the selected ivy gourd genotypes are given in Plate 13.

4.3. Chemical constituents in ivy gourd genotypes.

The chemical constituents in ivy gourd genotypes were analysed in their observed vegetable maturity and over maturity stages and are presented in Table 3 and 4.

4.3.1.Moisture.

At maturity stage, the highest moisture content was in the genotype CG-82 (95.33g/100g) and the lowest in CG-27 (92.85g/100g) with a mean value of 93.81g/100g. Sulabha showed a moisture content of 93.88g/100g and in CG-81 it was 93.18g/100g. There was a decrease in moisture content of the fruit as they became over mature. The moisture content of over mature fruits in all genotypes varied from 91.73 to 94.19g/100g with a mean value of 92.60g/100g. The highest moisture content was found in CG-82 (94.19g/100g) and lowest in Sulabha (91.73g/100g). Statistical analysis showed that there was a significant difference in the moisture content of all genotypes. The reduction in moisture content during over maturity in all genotypes was also significant. Moisture content of ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in.

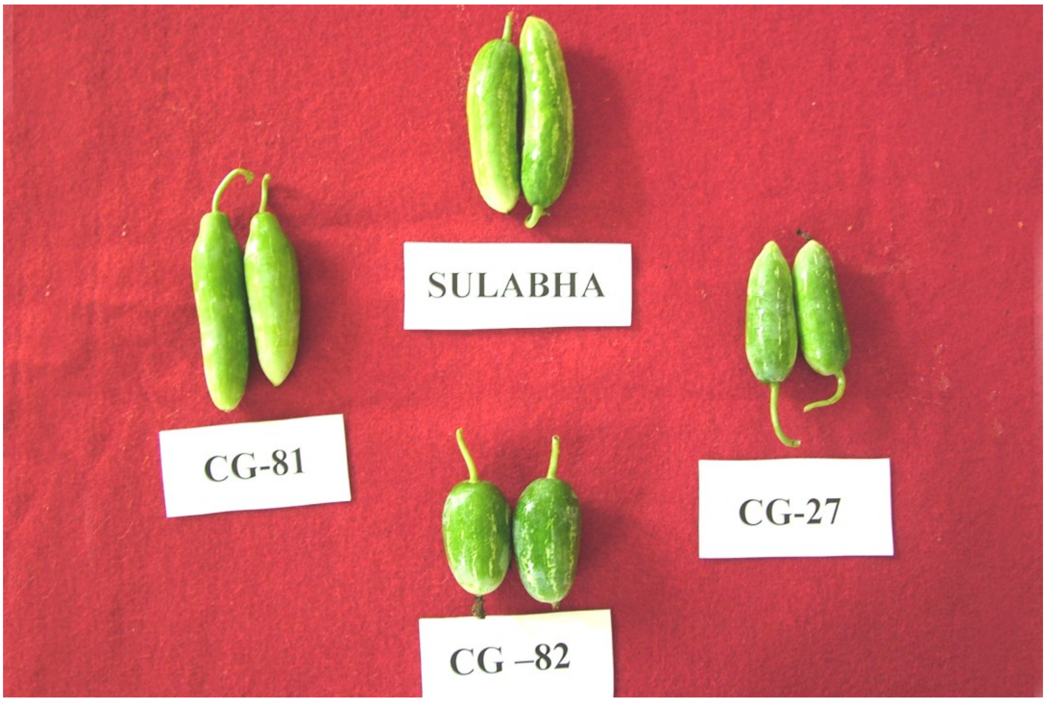

Plate.13. Distinct fruit characteristics in ivy gourd genotypes.

Table-3 . Chemical constituents in ivy gourd genotypes.

Genotypes	Moisture (g/100g)		Fibre (g/100g)		Protein (g/100g)		Vitamin C (mg/100g)		β-Carotene (μg/100g)		Total phenol (mg/100g)		Total pectins (g/100g)		Mucilage (g/100g)	
	VM	OM	VM	OM	VM	OM	VM	OM	VM	OM	VM	OM	VM	OM	VM	OM
CG-27	92.85	91.76	1.00	2.33	1.65	1.52	14.51	8.61	72.42	136.02	0.057	0.029	0.27	0.23	0.71	0.79
CG-81	93.18	92.73	1.67	2.17	1.69	1.20	12.69	5.89	84.85	108.41	0.038	0.027	0.47	0.27	0.46	0.82
CG-82	95.33	94.19	1.17	2.17	1.28	0.88	15.84	10.71	34.09	107.75	0.061	0.031	0.20	0.17	0.11	0.57
Sulabha	93.88	91.73	1.17	2.17	1.07	0.72	14.97	9.66	132.7	219.56	0.046	0.030	0.30	0.20	0.52	0.60
Mean	93.81	92.60	1.25	2.21	1.41	1.08	14.50	8.72	81.01	142.94	0.050	0.029	0.31	0.22	0.45	0.69
CD	0.51		0.41		NS		1.11		20.71		0.0045		NS		0.135	

VM- Vegetable Maturity

OM- Over Maturity.

Figure.1

4.3.2.Fibre.

The fibre content of ivy gourd genotypes in vegetable maturity stage ranged from 1.00 to 1.67g/100g, with a mean value of 1.25g/100g. Maximum fibre content was in CG-81 (1.67g/100g) and the minimum is in CG-27 (1.00g/100g). Fibre content of fruits increased in over maturity in all the genotypes, which ranged from2.17 to 2.33g/100g with a mean value of 2.21 g/100g. There was a significant variation in the fibre content of different genotypes and the increase in fibre content in over maturity was also statistically significant. Fibre content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.2.

4.3.3.Protein

The protein content in ivy gourd fruits in observed vegetable maturity and over maturity stage is presented in Table 3.

In observed vegetable maturity, protein content of the genotypes varied from 1.07 to 1.69g/100g with a mean value of 1.41g/100g. Maximum protein content was in the genotype CG-81 (1.69g/100g) and minimum was in Sulabha (1.07g/100g). It was observed that, there was a decrease in protein content in over matured fruits in all genotypes. In over matured fruits, highest protein content was in CG-27 (1.52g/100g) and the lowest in Sulabha (0.72g/100g). The mean protein content of over matured fruits was found to be 1.08g/100g. Statistical analysis showed that there was no significant difference between the maturity levels with regard to protein content. Protein content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.3.

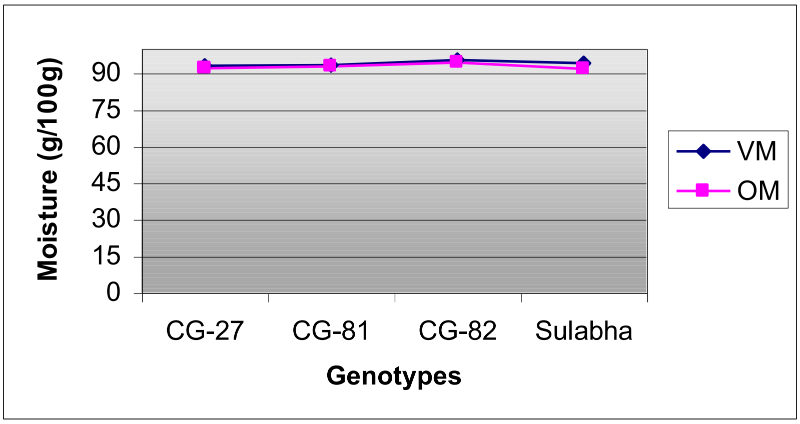

Figure 1. Moisture content in ivy gourd genotypes in observed vegetable maturity and over maturity.

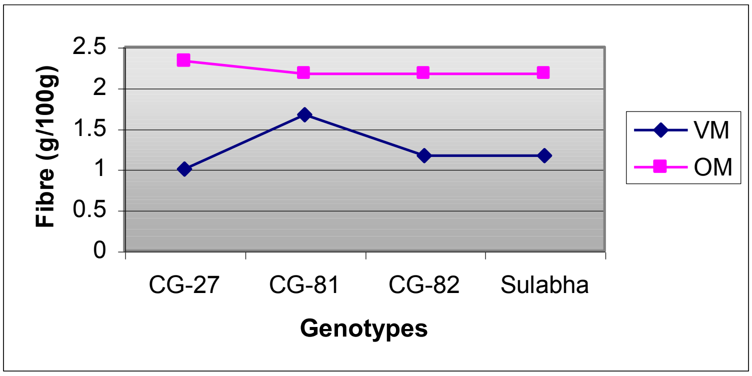

Figure 2. Fibre content in ivy gourd genotypes in observed vegetable maturity and over maturity.

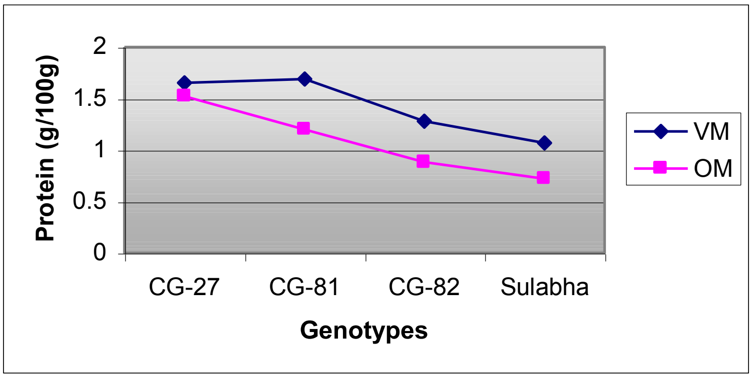

Figure 3. Protein content in ivy gourd genotypes in observed vegetable maturity and over maturity.

.3.4.Vitamin C.

The vitamin C content of ivy gourd fruits in observed vegetable maturity stage and over maturity stage is presented in the Table 3.

In observed vegetable maturity, the vitamin C content of the genotypes varied from 12.69 to 15.84 mg/100g with a mean value of 14.50 mg/100g. Maximum vitamin C content was in the genotype CG-82 (15.84 mg/100g) and the minimum was in CG-81 (12.69 mg/100g). Vitamin C content was found to decrease with maturity. In over matured fruits, maximum vitamin C was in CG-82 (10.71 mg/100g) and the lowest in CG-81 (5.89 mg/100g). The mean vitamin C content of over matured fruits of all genotypes was found to be 8.72 mg/100g. There was a significant difference in the vitamin C content of different genotypes and the decrease in vitamin C content in over maturity was also significant. Vitamin C content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.4.

4.3.5.β-Carotene.

The β-Carotene content of the ivy gourd genotypes in observed vegetable maturity stage and over maturity stage is presented in the Table 3.

In observed vegetable maturity, the β-Carotene content of the ivy gourd fruits ranged from 34.09 μg/100g in CG-82 to 132.7 μg/100g in Sulabha with a mean value of 81.01μg/100g. In over matured fruits the β-Carotene content increased and it ranged from 107.75 μg/100g in CG-82 to 219.56 μg/100g in Sulabha with a mean value of 142.94 μg/100g. Statistical analysis revealed that there was a significant difference in the β-Carotene content of all genotypes and the increase in the β-Carotene content in over maturity was also significant. β-Carotene content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.5.

4.3.6.Total phenols.

The total phenol content of the selected ivy gourd genotypes in observed vegetable maturity and over maturity is presented in Table 3.

In observed vegetable maturity, the phenol content of the fruits ranged from 0.038 to 0.061 mg/100g with a mean value of 0.050 mg/100g. The highest phenol content was in genotype CG-82 (0.061mg/100g) and the lowest was in CG-81 (0.038 mg/100g). In over matured fruits, the phenol content reduced and this ranged from 0.027 mg/100g to 0.031mg/100g with a mean value of 0.029 mg/100g. In this stage also the highest phenol content was in CG-82 (0.031 mg/100g) and lowest was in CG-81 (0.027 mg/100g). Statistical analysis revealed that there was a significant difference in phenol content between the genotypes in each maturity stage. Total phenol content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.6.

4.3.7.Total pectins.

As shown in the Table 3, total pectin content of the ivy gourd genotypes in observed vegetable maturity stage ranged from 0.20 g/100g in CG-82 to 0.47g/100 in CG-81 with a mean value of 0.31 g/100g. Pectin content of the fruits decreased in over maturity stage in all genotypes, which ranged from 0.17 to 0.27g/100g with a mean value of 0.22g/100g. There was no significant variation in the total pectin content of different genotypes and the decrease in pectin content in over maturity was also not significant. Pectin content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.7.

4.3.8.Mucilage.

As revealed in Table 3, the highest mucilage content in observed vegetable maturity was in genotype CG-27 (0.71g/100g) and lowest in CG-82 g

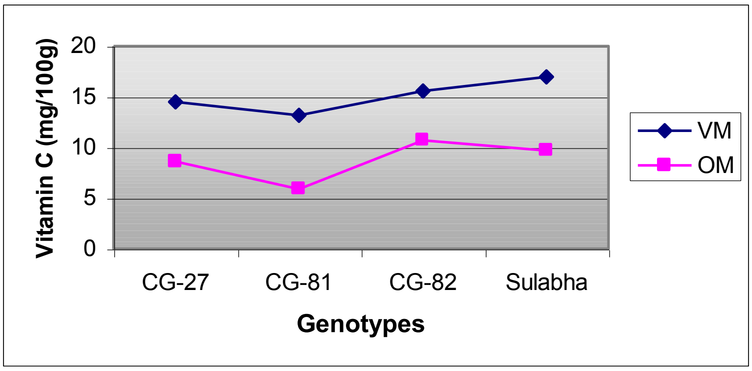

Figure 4. Vitamin C content in ivy gourd genotypes in observed vegetable maturity and over maturity.

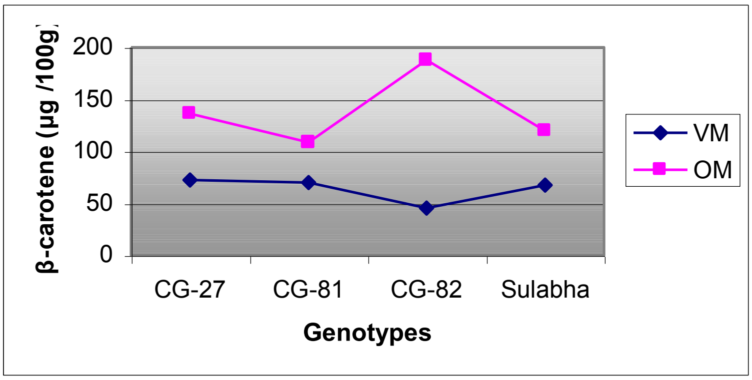

Figure 5. β-Carotene content in ivy gourd genotypes in observed vegetable maturity and over maturity.

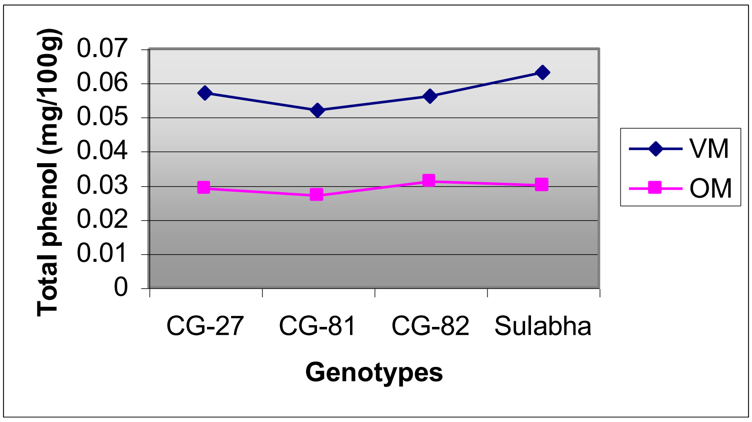

Figure 6. Total phenol content in ivy gourd genotypes in observed vegetable maturity and over maturity.

(0.11g/100g) with a mean value of 0.45 g/100g. The genotypes CG-81 and Sulabha showed a mucilage content of 0.46 g/100g and 0.52 g/100g respectively. There observed an increase in mucilage content of the fruits as they became over mature. The mucilage content of over mature fruits varied from 0.57 to 0.82 g/100g with a mean value of 0.69 g/100g. The highest mucilage content was found in CG-81 (0.82g/100g) and lowest in CG-82 (0.57g/100g). Statistical analysis revealed that there was a significant variation in the mucilage content in between genotypes and also between the two maturity levels. Mucilage content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.8.

4.3.9.Calcium.

The calcium content in ivy gourd genotypes in observed vegetable maturity and over maturity is presented in Table 4.

In observed vegetable maturity, calcium content of the fruits ranged from 18.65 to 37.61 mg/100g with a mean value of 27.89mg/100g. Maximum calcium content was in CG-82 (37.61mg/100g) followed by CG-27 (36.52 mg/100g). Calcium content of sulabha was 18.80 mg/100g and in CG-81, 18.65 mg/100g. In over maturity the calcium content of the fruits decreased which ranged from 18.01 mg/100g in CG-81 to 36.15 mg/100g in CG-82 with a mean value of 25.14 mg/100g. the result of statistical analysis showed that, there was a significant difference in calcium content between the genotypes and also between the maturity levels. Depletion of calcium was observed. Calcium content in ivy gourd genotypes in observed maturity and over maturity is depicted in figure.9.

4.3.10.Phosphorus.

As shown in the Table 4, the phosphorus content of the four genotype ranged from 28.77 to 44.49 mg/100g with a mean value of 34.62

Table-4. Mineral content of ivy gourd genotypes

Genotype	Calcium (mg/100g)		Phosphorus (mg/100g)		Iron (mg/100g)		Potassium (mg/100g)	
	VM	OM	VM	OM	VM	OM	VM	OM
CG-27	36.52	28.02	33.53	30.88	0.78	0.63	2.95	2.55
CG-81	18.65	18.01	31.71	25.81	0.97	0.87	2.80	2.60
CG-82	37.61	36.15	28.77	23.63	0.52	0.47	2.65	2.45
Mean	27.89	25.14	34.62	30.75	0.80	0.67	2.78	2.56
CD	0.36		1.58		0.033		0.0003	

calcium content between the genotypes and also between the maturity levels. Depletion of calcium was observed. Calcium content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.9.

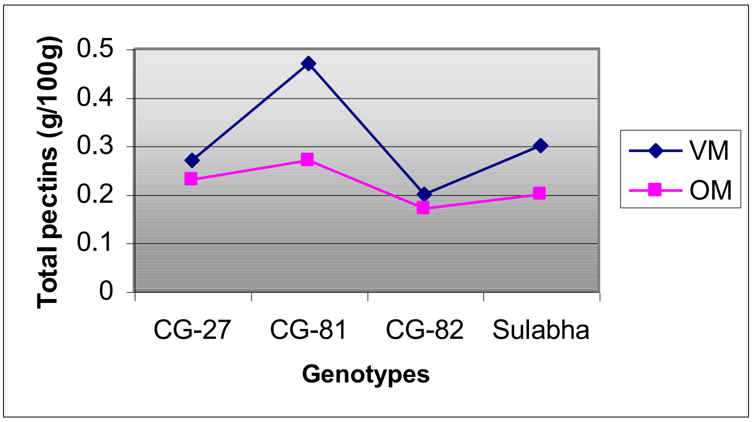

Figure 7. Total pectin content in ivy gourd genotypes in observed vegetable maturity and over maturity.

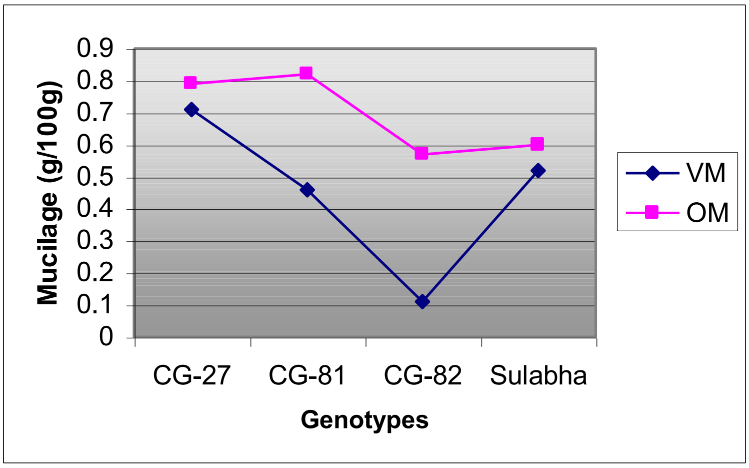

Figure 8. Mucilage content in ivy gourd genotypes in observed vegetable maturity and over maturity.

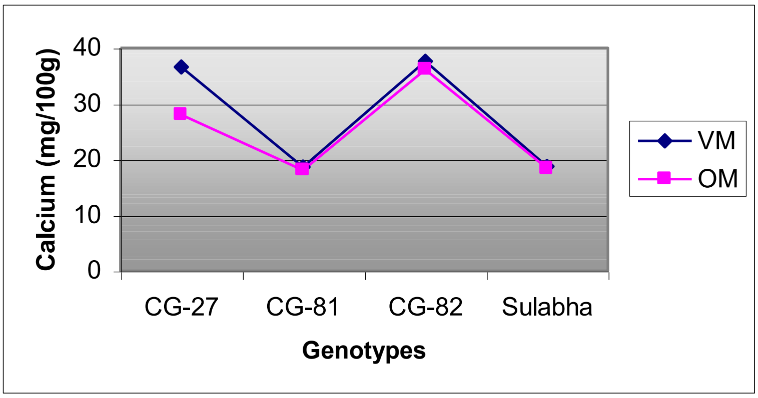

Figure 9. Calcium content in ivy gourd genotypes in observed vegetable maturity and over maturity.

mg/100g in observed vegetable maturity stage. The maximum phosphorus content was in genotype Sulabha and minimum in CG-82. In over maturity, phosphorus content decreased in all genotypes which ranged from 23.63 to 42.68 mg/100g with a mean value of 30.75 mg/100g. Statistical analysis revealed that there was a significant variation in the phosphorus content of all genotypes. The reduction in phosphorus content during over maturity in all genotypes was also significant. Phosphorus content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.10.

4.3.11.Iron.

The iron content of the ivy gourd fruits in observed vegetable maturity varied from 0.52 to 0.97 mg/100g with a mean value of 0.80mg/100g (Table 4). Maximum iron content was in CG-81 (0.97 mg/100g) and the minimum is in CG-82 (0.52 mg/100g). In over matured fruits, iron content was reduced with a mean value of 0.67 mg/100g. The highest was in CG-81 (0.87 mg/100g) and the lowest in genotype CG-82 (0.47 mg/100g). Statistically, there was a significant difference in iron content between the genotypes and also between the maturity stages. Same trend as other mineral with less content of iron. Iron content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.11.

4.3.12.Potassium.

As revealed in the Table 4, maximum potassium content in observed vegetable maturity was in CG-27 (2.95 mg/100g) and minimum in CG-82 (2.65mg/100g) with a mean value of 2.78 mg/100g. There observed a decrease in potassium content of the the over mature fruits in all genotypes varied from 2.45 to 2.65 mg/100g with a mean Value of 2.56 mg/100g. In over maturity stage, highest potassium content was in sulabha and lowest in C G-82. Statistical analysis

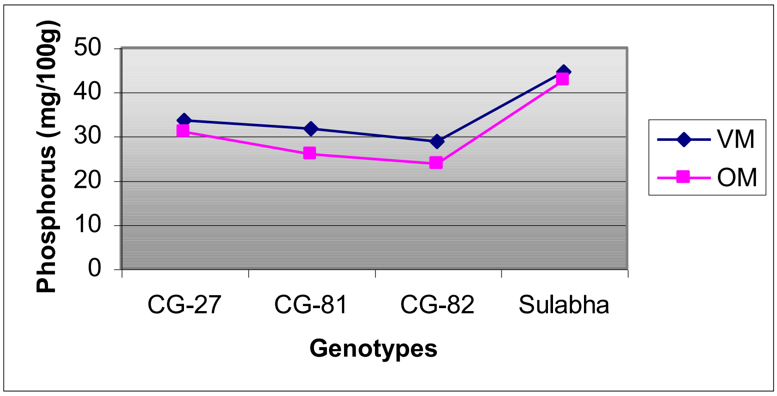

Figure 10. Phosphorus content in ivy gourd genotypes in observed vegetable maturity and over maturity.

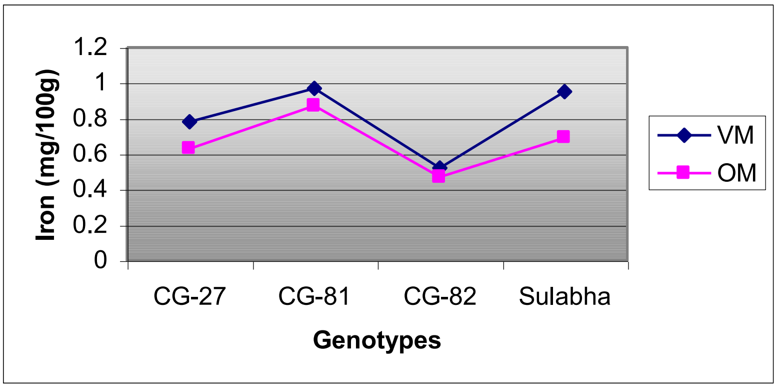

Figure 11. Iron content in ivy gourd genotypes in observed vegetable maturity and over maturity.

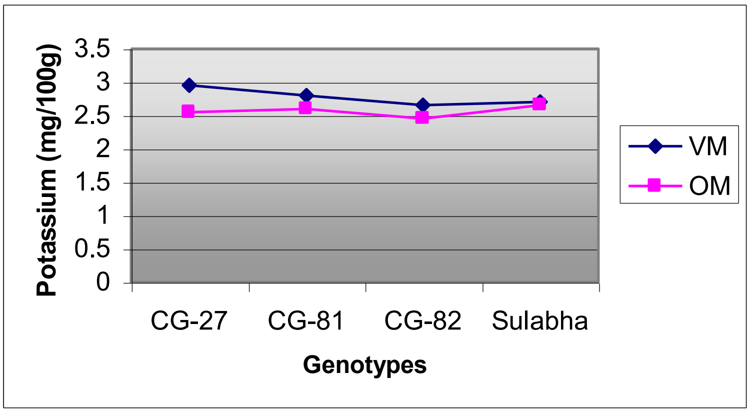

Figure 12. Potassium content in ivy gourd genotypes in observed vegetable maturity and over maturity.

showed that, there was a significant difference in potassium content of all genotypes in each maturity stages. Potassium content in ivy gourd genotypes in observed vegetable maturity and over maturity is depicted in Figure.12.

4.3.13.Changes in vitamin C, β-carotene and total phenol in different stages of maturity.

As revealed in Table 1, the average vegetable maturity of the four selected genotypes was worked out as 8 days. After flowering, samples were collected just before the day of average vegetable maturity, (7 days) at the day of average vegetable maturity, (8days) and just after the day of average vegetable maturity (9 days) and analysed for changes in vitamin C, β-Carotene and total phenols.

Changes in vitamin C content of ivy gourd genotypes, before the day of average vegetable maturity (7th day) at the day of average vegetable maturity (8th day) and after the day of average vegetable maturity (9th day) is presented in Table 5.

Table –5.Changes in vitamin C content in different stages of maturity in ivy gourd genotypes.

Sl.No.	Genotypes	Vitamin C (mg/100g)			
		7DAF	8DAF	9DAF	Mean
1	CG-27	15.27^{a}	14.51^{a}	14.16^{a}	14.65^{b}
2	CG-81	14.23^{a}	13.15^{ab}	12.69^{b}	13.36^{c}
3	CG-82	15.84^{a}	15.60^{a}	14.47^{a}	15.30^{ab}
4	Sulabha	16.23^{a}	15.96^{a}	14.97^{a}	15.72^{a}
	Mean	15.39^{a}	14.81^{a}	14.07^{a}	

DAF- Days After Flowering

Values with same superscript do not vary significantly.

In CG-27 maximum vitamin C was found during the 7th day i.e., just before the day of average vegetable maturity (15.27 mg/100g), which reduced to 14.51 mg/100g during the average vegetable maturity and reduced to 14.16 mg/100g during the 9th day (just after the day of average vegetable maturity).

Vitamin C content was found to be decreasing from the 7th day onwards but the reduction was not significant. But, when the vitamin C content was compared to the mean value for the 7th, 8th and 9th day (14.65 mg/100g), vitamin C was significantly high in the 7th day and significantly low vitamin C was observed during the average vegetable maturity, and the day just after the day of average vegetable maturity.

In CG-81 maximum vitamin C was observed during 7th day i.e., 14.23 mg/100g, which reduced to 13.15 mg/100g during 8th day and further reduced to 12.69 mg/100g during the 9th day. In this genotype, the reduction in vitamin C content was found to be significant between the 7th and 9th day. When compared to the mean value of 13.36 mg/100g, vitamin C was significantly low during the 8th and 9th day.

In CG-82 there was a reduction in vitamin C content, which ranged from 15.84 mg/100g in the 7th day to 14.47 mg/100g during the 9th day, but the reduction was not significant and there was no significant variation in vitamin C content when compared to the mean value of 15.30 mg/100g.

In Sulabha also there observed a reduction in vitamin C content from 16.23 mg/100g in 7th day to 14.97 mg/100g during the 9th day but the reduction was not significant. No significant variation was observed with the mean value of 15.72 mg/100g.

The vitamin C content during the day just before the average day of vegetable maturity (7 day) in between genotypes, ranged from 14.23 mg/100g in CG-81 to 16.23 mg/100g in Sulabha with a mean value of 15.39 mg/100g. There was no significant difference in vitamin C content between genotypes, in the day just before the day of average vegetable maturity (7th day).

During the average day of vegetable maturity (8th day), vitamin C content ranged from 13.15 mg/100g in CG-81 to 15.96 mg/100g in Sulabha with a mean value of 14.81 mg/100g. The variation in vitamin C content between genotypes was not significant.

During the day just after the day of average vegetable maturity, (9th day) vitamin C content ranged from 12.69 mg/100g in CG-81 to 14.97 mg/100g in Sulabha with a mean value of 14.07 mg/100g. Vitamin C content was significantly low in CG-81 when compared to other genotypes.

Changes in vitamin C content in different stages of maturity in ivy gourd genotypes are depicted in Figure 13.

Changes in β-carotene content of ivy gourd genotypes, before the day of average vegetable maturity (7th day), at the day of average vegetable maturity (8th day) and after the day of average vegetable maturity (9th day) is presented in Table 6.

Table-6. Changes in β-carotene content in different stages of maturity in ivy gourd genotypes

Sl.No.	Genotypes	β-Carotene (μg/100g)			
		7DAF	8DAF	9DAF	Mean
1	CG-27	46.65^{b}	72.42^{a}	77.24^{a}	65.44^{b}
2	CG-81	43.99^{c}	69.68^{b}	84.85^{a}	66.17^{b}
3	CG-82	34.09^{c}	45.42^{c}	53.13^{b}	44.21^{c}
4	Sulabha	57.38^{c}	67.61^{b}	132.7^{a}	85.88^{b}
	Mean	45.53^{c}	63.78^{b}	86.97^{a}	

DAF- Days After Flowering

Values with same superscript do not vary significantly.

In CG-27 β-carotene content was minimum during the 7th day i.e., just before the day of average vegetable maturity (46.65 μg/100g) which increased to 72.42 μg/100g during the average vegetable maturity and increased to 77.24 μg/100g during the 9th day (just after the day of average vegetable maturity). In this genotype, β-carotene content was significantly low in the 7th day. When compared to the mean value of 65.44 μg/100g, β-carotene content was significantly high in the 8th day and 9th day.

In CG-81, minimum β-carotene content was observed during 7th day, (43.99 µg/100g), which significantly increased to 69.68 µg/100g during the 8th day and further increased to 84.85 µg/100g during the 9th day. In this genotype the β-carotene content was found to be increasing significantly between 7th, 8th and 9th day. When compared to the mean value of 66.17 µg/100g, β-carotene content was significantly high in the 9th day and significantly low during 7th day.

In CG-82, β-carotene content ranged from 34.09 µg/100g in 7th day to 53.13 µg/100g during the 9th day. There was no significant increase between the 7thday and 8th day but increase in β-carotene content on the 9th day was significant. When compared to the mean value of 44.21 µg/100g, β-carotene content was low in 7th day and significantly high during 9th day after flowering.

In Sulabha also there observed an increase in β-carotene content from 57.38 µg/100g in 7th day to 132.7 µg/100g during the 9th day. Statistically there was significant difference between 7th, 8th and 9th day. When compared to the mean value of 85.88 µg/100g, β-carotene content was significantly high in the 9th day and significantly low in 7th day.

The β-carotene content during the day just before the average vegetable maturity (7th day) in between genotypes, ranged from 34.09 µg/100g in CG-82 to 57.38 µg/100g in Sulabha with a mean value of 45.53 µg/100g. During 7th day there was no significant difference in β-carotene content of CG-81, CG-82 and Sulabha.

During the average day of vegetable maturity (8th day) β-carotene content ranged from 45.42 µg/100g in CG-82 to 72.42 µg/100g in CG-27 with a mean value of 63.78 µg/100g. β-carotene content was significantly high in CG-27.

During the day just after the average vegetable maturity (9th day), the β-carotene content ranged from 53.13 µg/100g in CG-82 to 132.7 µg/100g in

Sulabha with a mean value of 86.97 μg/100g. Compared to other genotypes β-carotene content was significantly low in CG-82.

Changes in the total phenol content of ivy gourd genotypes, before the day of average vegetable maturity (7th day), at the day of average vegetable maturity (8th day) and just after the day of average vegetable maturity (9th day) is presented in Table 7 and Figure 15.

Table-7. Changes in total phenol content in different stages of maturity in ivy gourd genotypes

Sl.No.	Genotypes	Total phenol (mg/100g)			
		7DAF	8DAF	9DAF	Mean
1	CG-27	0.067^{a}	0.057^{a}	0.037^{b}	0.054^{ab}
2	CG-81	0.056^{a}	0.052^{ab}	0.038^{b}	0.049^{b}
3	CG-82	0.061^{a}	0.056^{ab}	0.042^{b}	0.053^{ab}
4	Sulabha	0.069^{a}	0.063^{a}	0.046^{b}	0.059^{a}
	Mean	0.064^{a}	0.057^{a}	0.041^{b}	

DAF- Days After Flowering

Values with same superscript do not vary significantly

In CG-27 maximum phenol was during the 7th day, i.e., 0.067 mg/100g, which reduced to 0.057 mg/100g during the average vegetable maturity and reduced to 0.037 mg/100g during the 9th day. Phenol content was found to be deceasing from the 7th day onwards and reduction was significant only on the 9th day. When compared to the mean value for the 7th, 8th and 9th day (0.054 mg/100g), no significant difference was observed in the phenol content.

In CG-81, maximum phenol was observed in 7th day (0.056 mg/100g), which reduced to 0.052 mg/100g during the 8th day and further reduced to 0.038 mg/100g during the 9th day. In this genotype, reduction in the phenol content was found to be significant between the 7th and 9th day. When compared to the mean value of 0.049 mg/100g, phenol content was significantly high in the 7th day.

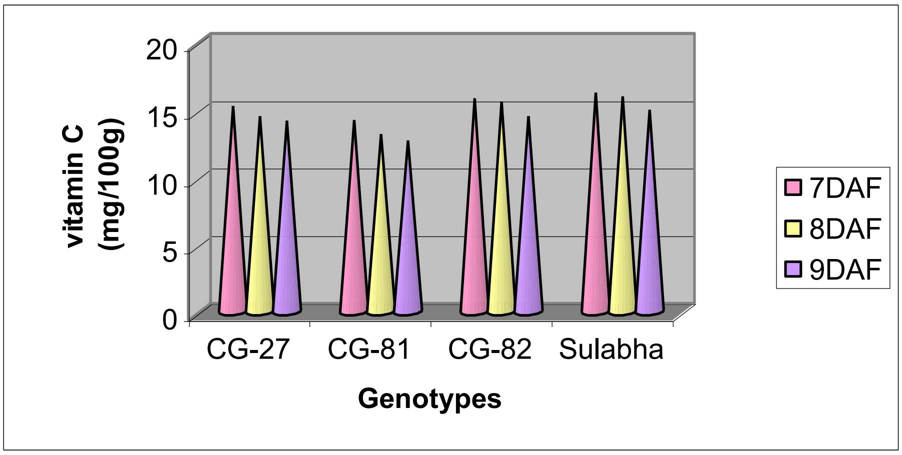

Figure 13. Changes in vitamin C content in different stages of maturity in ivy gourd genotypes.

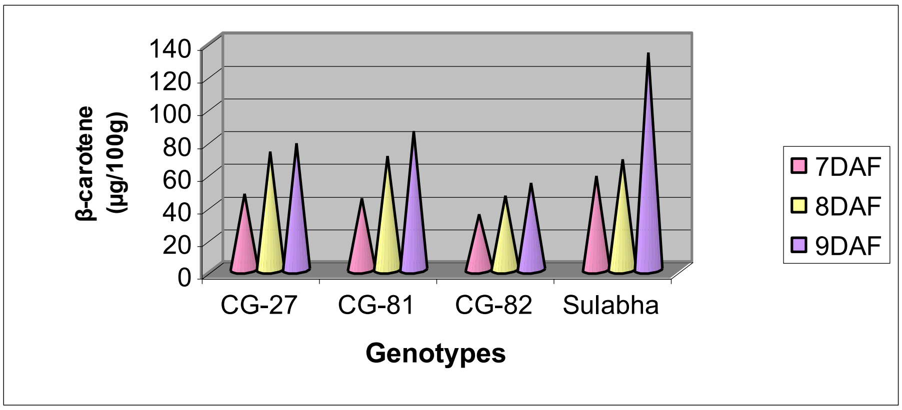

Figure 14. Changes in β-carotene content in different stages of maturity in ivy gourd genotypes.

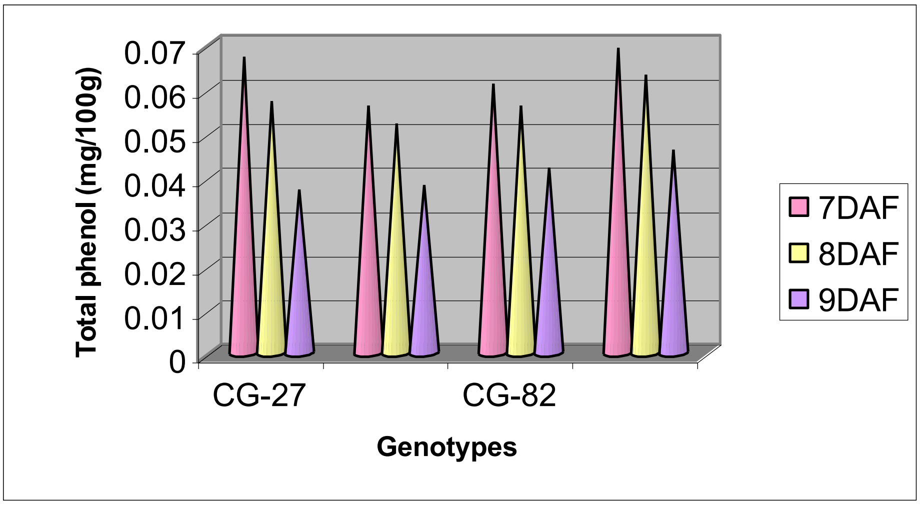

Figure 15. Changes in total phenol content in different stages of maturity in ivy gourd genotypes

In CG-82 there was a reduction in phenol content, which ranged from 0.061 mg/100g in 7th day to 0.042 mg/100g during the 9th day. The reduction in phenol content was significant between the 7th and 9th day.

In Sulabha also there observed a reduction in phenol content was observed from 0.069 mg/100g (in 7th day) to 0.046mg/100g (during the 9th day). The reduction was significant between the 7th and 9th day. When compared to the mean value of 0.059mg/100g, there was no significant variation in the phenol content except in the 9th day, which showed a significant reduction in phenol content (0.046 mg/100g).

The phenol content during the day just before the average day of vegetable maturity (7th day) in between genotypes, ranged from 0.056mg/100g in CG-81 to 0.069 mg/100g in Sulabha with a mean value of 0.064 mg/100g. There was no significant difference in phenol content between genotypes in the day just before the day of average vegetable maturity (7th day).

During the average day of vegetable maturity (8th day) phenol content ranged from 0.052 mg/100g in CG-81 to 0.063 mg/100g in Sulabha with a mean value of 0.057 mg/100g. The variation in phenol content between genotypes was not significant.

During the day just after the day of average vegetable maturity, the phenol content ranged from 0.037 mg/100g in CG-27 to 0.046 mg/100g in Sulabha with a mean value of 0.041 mg/100g. The variation in phenol content between genotypes was not significant.

4.3.14.Comparison of vitamin C, β-Carotene and total phenol content during average vegetable maturity and observed vegetable maturity in ivy gourd genotypes.

Vitamin C, β-Carotene and total phenols of the ivy gourd genotypes in their average vegetable maturity and observed vegetable maturity were compared and presented in Table 8.

Table –8. Comparison of vitamin C, β-Carotene and total phenol in average vegetable maturity and observed vegetable maturity.

Sl.No.	Genotypes	Vitamin C (mg/100g)		β-Carotene (μg/100g)		Total phenol (mg/100g)	
		AVM	OVM	AVM	OVM	AVM	OVM
1	CG-27	14.51	14.51	72.42	72.42	0.057	0.057
2	CG-81	13.15	12.69	69.68	84.85	0.052	0.038
3	CG-82	15.60	15.84	45.42	34.09	0.056	0.061
4	Sulabha	15.96	14.97	67.61	132.7	0.063	0.046
	Mean	14.81	14.50	63.78	81.01	0.057	0.050
	CD	NS		10.98		0.0072	

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

In average vegetable maturity, the vitamin C content of the different genotypes ranged from 13.15 mg/100g in CG-81 to 15.96 mg/100g in Sulabha with a mean value of 14.81 mg/100g. In observed vegetable maturity the vitamin C content of four ivy gourd genotypes ranged from 12.69 mg/100g in CG-81 to 15.84 mg/100g in CG-82 with a mean value of 14.50 mg/100g. Statistical analysis revealed that there was no significant difference between the average vegetable maturity and observed vegetable maturity with respect to vitamin C in all genotypes (Figure 16).

In average vegetable maturity, β-carotene content ranged from 45.42 μg/100g in CG-82 to 72.42 μg/100g in CG-27 with a mean value of 63.78 μg/100g. In observed vegetable maturity the β-carotene content ranged from 34.09 μg/100g in CG-82 to 132.7 μg/100g in Sulabha with a mean value of 81.01

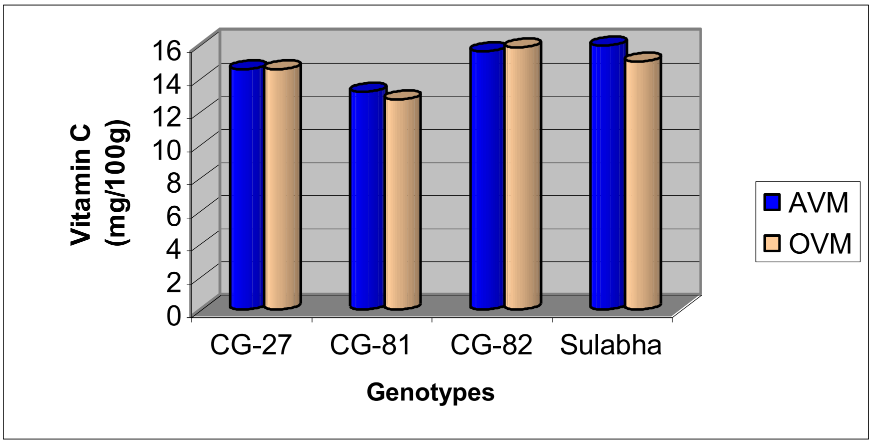

Figure 16. Comparison of vitamin C contents in ivy gourd genotypes in average vegetable maturity and observed vegetable maturity.

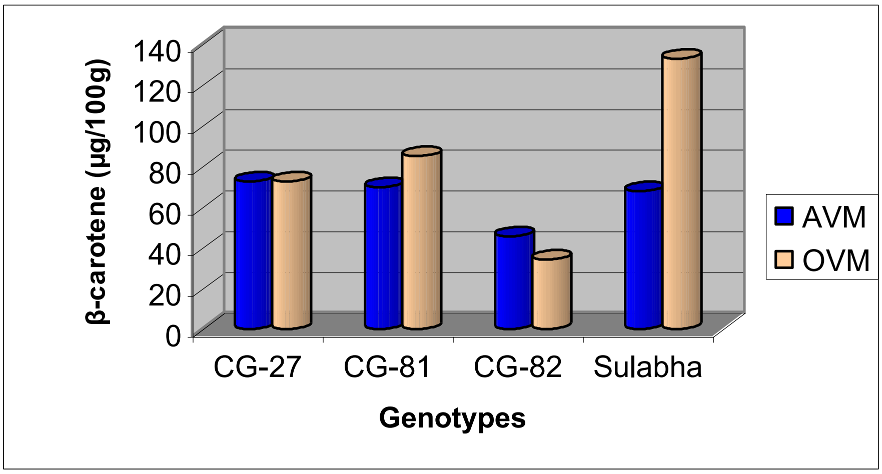

Figure 17. Comparison of β-carotene contents in ivy gourd genotypes in average vegetable maturity and observed vegetable maturity.

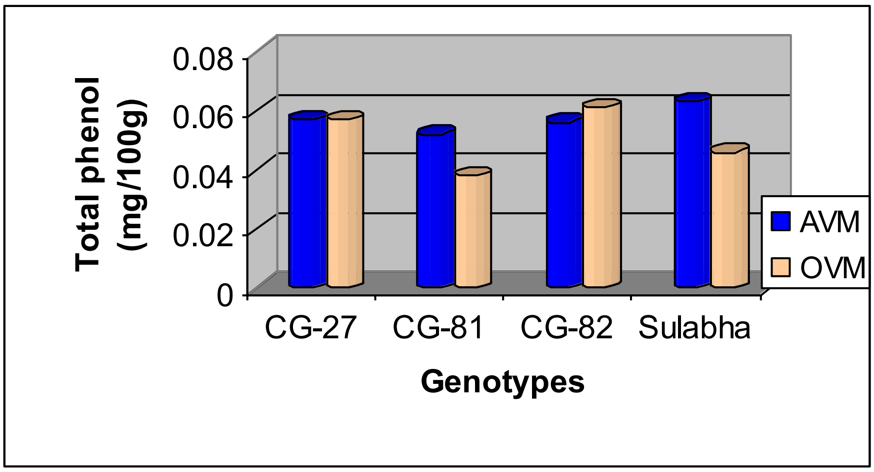

Figure 18. Comparison of total phenol contents in ivy gourd genotypes in average vegetable maturity and observed vegetable maturity

μg/100g. Statistical analysis revealed that there was a significant difference in β-carotene content between the genotypes and between the average vegetable maturity and observed vegetable maturity (Figure17).

In average vegetable maturity, total phenol content in four genotypes of ivy gourd ranged from 0.052 mg/100g in CG-81 to 0.063 mg/100g in Sulabha with a mean value of 0.057 mg/100g. In observed vegetable maturity the phenol content ranged from 0.038 mg/100g in CG-81 to 0.061 mg/100g in CG-82 with a mean value of 0.050 mg/100g. Statistical analysis showed that there was a significant difference in total phenol content between the genotypes and between the average vegetable maturity and observed vegetable maturity (Figure18).

4.4.Organoleptic qualities.

The acceptability studies of the fruits of ivy gourd genotypes at different maturity levels were conducted using score cards and the results with statistical analysis are presented in the following tables.

Kendall's Coefficient of Concordance (W) was worked out to measure the degree of agreement among the judges for the various parameters. It was observed that lower the percentage of level of significance higher the degree of agreement among the judges. All W values with less than 25% probability level of significance were judged as indicating high degree of agreement.

4.4.1.Organoleptic evaluation of ivy gourd genotypes in observed vegetable maturity stage.

The table 9 shows the results of acceptability studies conducted at vegetable maturity of selected ivy gourd genotypes and are also depicted in Figure.19.

Table.9.Organoleptic evaluation of ivy gourd genotypes in observed vegetable maturity stage.

Sl.No.	Parameters	Mean scores				W	Prob level of Sig (%)
		CG-27	CG-81	CG-82	Sulabha		
1	Appearance	3.3 (2.15)	3.9 (2.90)	3.7 (2.60)	3.6 (2.35)	0.091	43.4
2	Colour	3.5 (2.20)	3.9 (2.80)	3.7 (2.55)	3.6 (2.45)	0.054	65.2
3	Texture	2.9 (1.90)	3.8 (3.05)	3.8 (2.35)	3.7 (2.70)	0.181	14.2
4	Flavour	3.4 (2.50)	3.7 (2.80)	3.2 (2.10)	3.7 (2.60)	0.079	50.0
5	Taste	3.5 (2.10)	3.6 (2.45)	4.1 (3.00)	3.9 (2.45)	0.115	32.6
	Over all acceptability	3.3 (2.25)	3.8 (3.05)	3.7 (2.05)	3.7 (2.65)	0.123	29.7

Figures in parenthesis indicates mean ranks

W- Kendall's Coefficient of Concordance

In observed vegetable maturity, appearance of CG-81 was found to be more acceptable as indicated by the highest mean score of 3.9 followed by CG-82 with a mean score of 3.7. The mean score for Sulabha was 3.6 and least accepted genotype with respect to appearance was CG-27 with the mean score 3.3. Statistical analysis showed that, there was no significant difference between genotypes in this attribute.

The highest mean score for the parameter colour was also for the genotype CG-81 (3.9) and lowest for CG-27 (3.5) and there was no significant difference between the genotypes in this attribute also.

Among the four selected ivy gourd genotypes in their vegetable maturity, the highest mean score for the parameter texture was for genotype CG-81 and CG-82 with a mean score of 3.8 followed by genotype Sulabha (3.7) and the least mean score was for CG-27 (2.9). Statistical analysis showed that there was a significant difference between the genotypes in this quality attribute.

With respect to the parameter flavour, the highest mean score obtained in this maturity level was in genotype CG-81 and Sulabha with a mean score of 3.7 followed by CG-27 (3.4) and lowest for CG-82 (3.2). Statistically, there was no significant difference in between genotypes in this parameter. Maximum mean score for taste was for the genotype CG-82 (4.1) followed by Sulabha and CG-81 with a mean score of 3.9 and 3.6 respectively and the minimum score was for the genotype CG-27 (3.5). Here also no significant difference was observed between the genotypes in this attribute.

Overall acceptability was highest for CG-81 (3.8) followed by CG-82 and Sulabha (3.7). Least score for overall acceptability was for CG-27 (3.3). Statistically, there was no significant difference in overall acceptability between genotypes in observed vegetable maturity stage.

4.4.2.Organoleptic evaluation of ivy gourd genotypes in over maturity stage.

The Table 10 shows the mean scores obtained for organoleptic study conducted in over matured ivy gourd fruits and is also shown in Figure 20.

In over mature stage appearance was least affected in Sulabha as indicated by the highest score of 3.7. The genotype that was least acceptable with respect to appearance in over maturity stage was CG-82 with a mean score of 2.8. CG-27 and CG-81 had the same mean score for appearance (3.3). There was a significant difference between the genotypes in this attribute. Maximum mean score for the parameter colour was in genotype CG-27 and Sulabha (3.4) followed by CG-81 (3.2) and the minimum in CG-82 (3.1). There was no significant difference between genotypes in this parameter also.

Table.10. Organoleptic evaluation of ivy gourd genotypes in over maturity stage.

Sl.No.	Parameters	Mean scores				W	Prob level of Sig (%)
		CG-27	CG-81	CG-82	Sulabha		
1	Appearance	3.3 (2.45)	3.3 (2.60)	2.8 (1.90)	3.7 (3.05)	0.169	16.7
2	Colour	3.4 (2.55)	3.2 (2.60)	3.1 (2.20)	3.4 (2.65)	0.031	81.9
3	Texture	2.7 (1.90)	3.3 (2.75)	2.8 (2.30)	3.5 (3.05)	0.176	15.3
4	Flavour	2.8 (2.25)	3.4 (2.85)	3.1 (2.55)	2.9 (2.35)	0.068	56.6
5	Taste	3.0 (2.10)	3.5 (2.85)	3.5 (2.75)	3.2 (2.30)	0.089	44.8
	Over all acceptability	3.0 (2.00)	3.3 (2.90)	3.1 (2.45)	3.3 (2.65)	0.097	40.7

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

The highest mean score for the attribute texture was in genotype Sulabha (3.5) and the lowest was in CG-27 (2.7). Significant variation between genotypes in this attribute was observed. The highest mean score for the attribute flavour was in genotype CG-81 (3.4) and the minimum score was in CG-27 (2.8) there was no significant difference between the genotypes in this attribute.

The maximum mean score for the attribute taste was in genotype CG-81 and CG-82 (3.5) followed by Sulabha (3.2) and the minimum was in CG-27 (3.0). There was no significant difference between the genotypes in this attribute. Overall acceptability was highest for genotypes CG-81 and Sulabha (3.3) followed by CG-82 (3.1). Least score for overall acceptability was for CG-27 (3.0). Statistically, there was no significant difference between the genotypes in their overall acceptability in over maturity stage.

4.4.3.Organoleptic qualities of ivy gourd genotypes before the day of average vegetable maturity (7th day) at the day of average vegetable maturity (8th day) and after the day of average vegetable maturity (9th day).

Organoleptic evaluation of ivy gourd genotypes in the 7th day after flowering (just before the day of average vegetable maturity) is presented in Table 11 and is depicted in Figure 21.

The table 11 shows the results of acceptability studies on 7th day, that is the day before average vegetable maturity. During the 7th day the maximum mean score for the parameter appearance was in genotype CG-82 (3.7) followed by CG-27 and CG-81 (3.6) and the minimum is in Sulabha (3.5). Statistically, there was no significant difference between the genotypes in this attribute. The maximum mean score for the attribute colour was in CG-82 (3.7) and the minimum was in CG-27 (3.1). In this attribute also there was no significant difference between the genotypes.

Table.11. Organoleptic evaluation of ivy gourd genotypes in the 7th Day After Flowering

Sl.No.	Parameters	Mean scores				W	Prob level of Sig (%)
		CG-27	CG-81	CG-82	Sulabha		
1	Appearance	3.6 (2.50)	3.6 (2.40)	3.7 (2.60)	3.5 (2.50)	0.006	97.9
2	Colour	3.1 (2.00)	3.5 (2.50)	3.7 (2.75)	3.5 (2.75)	0.129	27.5
3	Texture	3.9 (3.05)	3.3 (2.15)	3.8 (3.00)	3.1 (1.80)	0.295	3.1
4	Flavour	3.6 (2.70)	3.6 (2.75)	3.2 (2.20)	3.3 (2.35)	0.068	56.3
5	Taste	3.7 (2.75)	3.3 (2.15)	4.1 (3.40)	3.0 (1.70)	0.430	0.5
	Overall acceptability	3.6 (2.75)	3.5 (2.25)	3.7 (2.75)	3.3 (2.25)	0.063	59.9

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

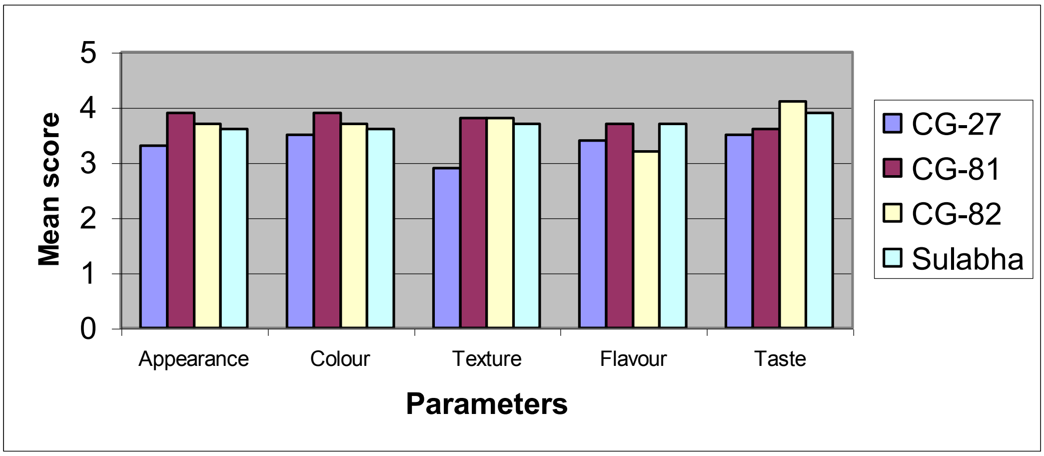

Figure19. Organoleptic evaluation of ivy gourd genotypes in observed vegetable maturity stage.

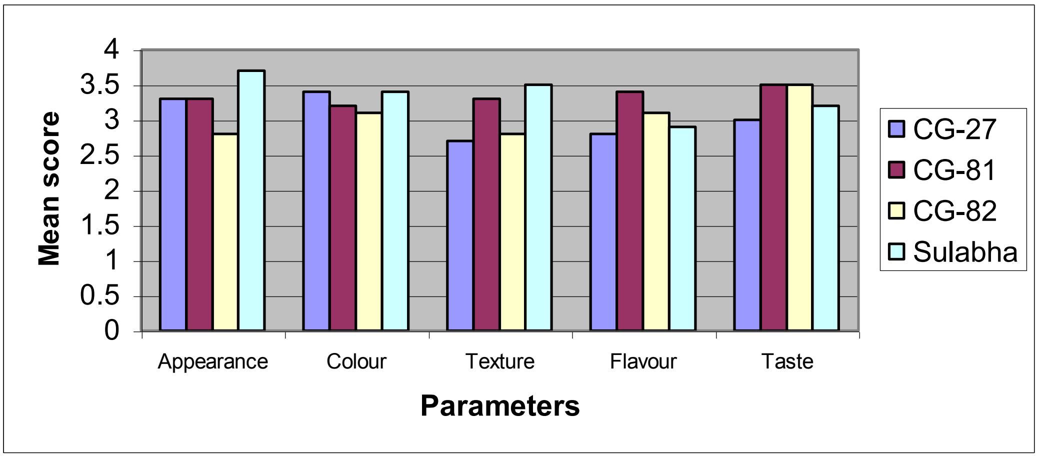

Figure20. Organoleptic evaluation of ivy gourd genotypes in over maturity stage.

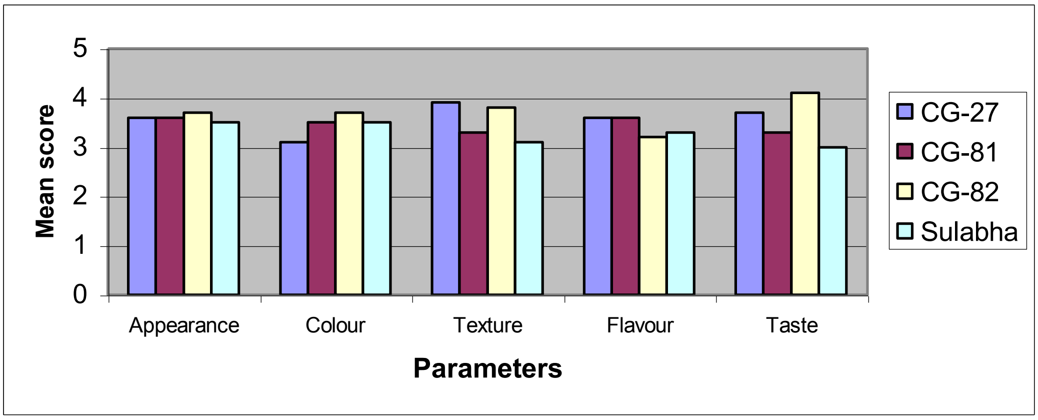

Figure 21. Organoleptic evaluation of ivy gourd genotypes in the 7th Day After Flowering .

The highest mean score for the parameter texture was in genotype CG-27 (3.9) and the lowest was in genotype Sulabha (3.1). Statistically, there was a significant variation between the genotypes in this quality attribute. The maximum mean score for the parameter flavour was for the genotype CG-27 and CG-81 (3.6) and the minimum was in CG-82 (3.2) and the difference was not significant between the genotypes in this parameter. The highest mean score for the attribute taste was in genotype CG-82 (4.1) and the lowest was in Sulabha (3.0). Significant difference in taste was observed between the genotypes in the 7th day. Overall acceptability was highest in CG-82 (3.7) and lowest in Sulabha (3.3) but the variation was not significant.

The organoleptic evaluation of ivy gourd genotypes in the 8th day after flowering (at the day of average vegetable maturity) is presented in Table 12 and in Figure 22.

Table. 12. Organoleptic evaluation of ivy gourd genotypes in the 8th Day After Flowering

Sl.No.	Parameters	Mean scores				W	Prob level of Sig (%)
		CG-27	CG-81	CG-82	Sulabha		
1	Appearance	3.3 (2.30)	3.5 (2.55)	3.5 (2.65)	3.4 (2.50)	0.018	91.3
2	Colour	3.5 (2.35)	3.7 (2.90)	3.6 (2.60)	3.4 (2.15)	0.088	45.3
3	Texture	2.9 (1.95)	3.7 (3.20)	3.2 (2.60)	3.2 (2.25)	0.208	10.0
4	Flavour	3.4 (2.60)	3.5 (2.70)	3.5 (2.70)	3.1 (2.00)	0.131	27.0
5	Taste	3.5 (2.70)	3.6 (2.65)	3.6 (2.75)	3.0 (1.90)	0.124	29.2
	Overall acceptability	3.3 (2.35)	3.6 (3.05)	3.5 (2.50)	3.2 (2.10)	0.104	37.2

Figures in parenthesis indicates mean rank
W- Kendall’s Coefficient of Concordance

The table 12 shows the results of acceptability studies on the 8th day after flowering i.e., the day of average vegetable maturity. The maximum mean score for the attribute appearance was in genotypes CG-81 and CG-82 (3.5) and minimum in CG-27 (3.3) and the variation was not significant between genotypes. The highest mean score for the parameter colour was in CG-81 (3.7) and the lowest in Sulabha (3.4) and the difference observed between genotypes was not significant.

Maximum mean score for the parameter texture was in the genotype CG-81 (3.7) and the minimum is in CG-27 (2.9). Statistically, there was a significant difference between the genotypes in this quality attribute. The highest mean score for the parameter flavour was in genotypes CG-81 and CG-82 with a same mean score of 3.5 and the lowest in Sulabha (3.1) but the variation between genotypes was not significant. The highest mean score for the attribute taste was for the genotypes CG-81 and CG-82 (3.6) and the lowest in Sulabha (3.0). There was no significant difference between the genotypes in this quality attribute also. The highest mean score for overall acceptability was in CG-81 (3.6) and lowest in Sulabha (3.2) and the variation in overall acceptability was not significant

Organoleptic evaluation of ivy gourd genotypes in the 9th day after flowering (just after the day of average vegetable maturity) is presented in Table 13 and in Figure 23.

The table 13 shows the results of acceptability studies on the 9th day after flowering i.e., on the day just after the day of average vegetable maturity.

This table revealed that the maximum mean score for the attribute appearance in this maturity level was for the genotype CG-81 (3.9) and the minimum for CG-27 (2.9). Statistical analysis showed that there was a significant difference between the genotypes in this parameter. With respect to the attribute colour, the highest mean scores was for the genotypes CG-81 and CG-82 ((3.9) followed by Sulabha (3.6) and lowest was in CG-27 (2.6). Significant variation was observed in each genotype in this quality attribute also.

Table. 13. Organoleptic evaluation of ivy gourd genotypes in the 9th Day After Flowering.

Sl.No.	Parameters	Mean scores				W	Prob level of Sig (%)
		CG-27	CG-81	CG-82	Sulabha		
1	Appearance	2.9 (1.65)	3.9 (3.10)	3.7 (2.75)	3.6 (2.50)	0.279	3.9
2	Colour	2.6 (1.15)	3.9 (3.00)	3.9 (3.15)	3.6 (2.70)	0.611	0.0
3	Texture	3.4 (2.20)	3.8 (2.85)	3.6 (2.35)	3.7 (2.60)	0.078	50.6
4	Flavour	3.3 (2.00)	3.7 (2.70)	3.6 (2.60)	3.7 (2.70)	0.089	44.3
5	Taste	3.5 (2.25)	3.6 (2.60)	3.7 (2.60)	3.9 (2.65)	0.022	88.4
	Overall acceptability	3.1 (1.35)	3.9 (3.00)	3.7 (2.90)	3.7 (2.75)	0.378	1.0

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

The highest mean score for the parameter texture was in CG-81 (3.8) and lowest is in CG-27 (3.4) but there was no significant difference between the genotypes in this quality attribute. The maximum score for the attribute flavour was in genotypes CG-81 and Sulabha (3.7) and the minimum was in CG 27 (3.3) and the variation observed between genotypes was not significant. The highest mean score for the parameter taste was in genotype Sulabha (3.9) followed by CG-82 (3.7). The lowest score is for CG-27 (3.5) and no significant difference was observed between the genotypes in this quality attribute. The highest score for the overall acceptability was in CG-81 (3.9) followed by CG-82 and Sulabha (3.7) and the lowest in CG-27 (3.1). Statistical analysis showed that there was a significant variation between genotypes in overall acceptability.

Ivy gourd genotypes before the day of average vegetable maturity (7th day) at the day of average vegetable maturity (8th day) and after the day of average vegetable maturity (9th day) is given in Plates 14 to 17

Plate.14. Different stages of vegetable maturity in CG-27

Plate.15. Different stages of vegetable maturity in C G-81

Plate.16. Different stages of vegetable maturity in CG-82

Plate.17. Different stages of vegetable maturity in Sulabha

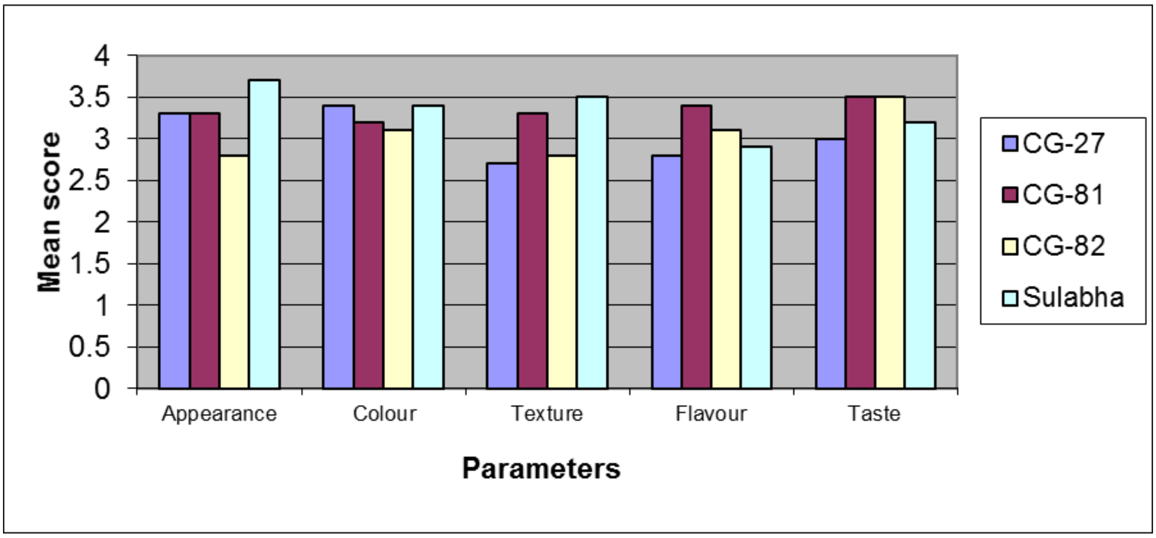

Figure 22. Organoleptic evaluation of ivy gourd genotypes in the 8th Day After Flowering.

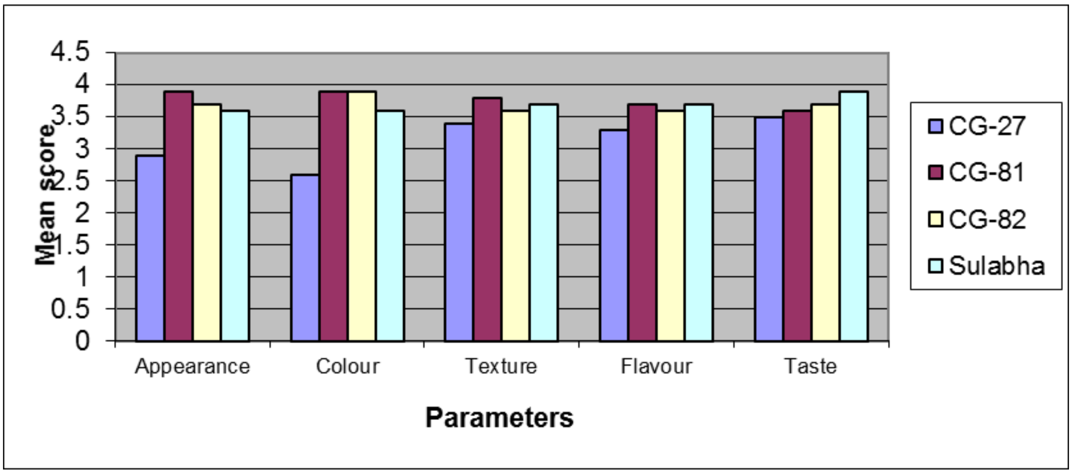

Figure23. Organoleptic evaluation of ivy gourd genotypes in the 9th Day After Flowering.

.4.4.Comparison of organoleptic qualities of ivy gourd genotypes in their observed vegetable maturity and over maturity.

Organoleptic qualities such as appearance, colour, texture, flavour, taste and overall acceptability of the selected genotypes in their observed vegetable maturity were compared with these qualities in over maturity, and the results are presented in the following tables.

The table 14 compares the mean scores obtained for the attribute appearance in the observed vegetable maturity and over maturity stage in ivy gourd genotypes and the results are also shown in Figure 24.

Table- 14. Comparison of appearance of ivy gourd genotypes between OVM and OM

Sl. No.	Genotypes	Appearance		W	Prob level of sig (%)
		Mean scores			
		OVM	OM		
1	CG-27	3.3 (1.50)	3.3 (1.50)	0.000	100
2	CG-81	3.9 (1.65)	3.3 (1.35)	0.129	25.7
3	CG-82	3.7 (1.75)	2.8 (1.25)	0.357	5.9
4	Sulabha	3.6 (1.50)	3.7 (1.50)	0.000	100
	Total mean scores	3.6 (1.70)	3.3 (1.30)	0.200	15.7

OVM- Observed Vegetable Maturity

OM- Over Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

There was no significant difference in appearance between observed vegetable maturity and over maturity in all genotypes except in CG-82. In CG-82 the mean score of 3.7 in observed vegetable maturity was significantly reduced to 2.8 in over maturity stage. The total mean score for the attribute appearance was significantly high in observed vegetable maturity (3.6).

The table 15 compares the mean score obtained for the attribute colour in observed vegetable maturity and over maturity in ivy gourd genotypes and the results are also shown in Figure.25.

Table- 15. Comparison of colour of ivy gourd genotypes between OVM and OM

Sl. No.	Genotypes	Colour Mean scores		W	Prob level of sig (%)
		OVM	OM		
1	CG-27	3.5 (1.50)	3.4 (1.50)	0.000	100
2	CG-81	3.9 (1.75)	3.2 (1.25)	0.357	5.9
3	CG-82	3.7 (1.80)	3.1 (1.20)	0.450	3.4
4	Sulabha	3.6 (1.40)	3.4 (1.60)	0.067	41.4
	Total mean scores	3.7 (1.55)	3.3 (1.45)	0.011	73.9

OVM- Observed Vegetable Maturity

OM- Over Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

With regard to the attribute colour, table 15 revealed that in all the genotypes the mean score for colour decreased in over maturity stage; but this difference was not significant in the case of CG-27 and Sulabha. In CG-81 the mean score of 3.9 in observed vegetable maturity was significantly reduced to 3.2 in over maturity and in CG-82 the mean score significantly reduced from 3.7 to 3.1 in over maturity. The total mean score for this attribute was higher in observed vegetable maturity (3.7) than In over maturity stage (3.3) but statistically there was no significant difference between these two maturity levels with regard to colour.

The table 16 compares the mean score obtained for the attribute texture in observed vegetable maturity and over maturity in ivy gourd genotypes and the results are also depicted in Figure 26.

Table- 16. Comparison of texture of ivy gourd genotypes between OVM and OM

Sl.No.	Genotypes	Texture		W	Prob level of sig (%)
		Mean scores			
		OVM	OM		
1	CG-27	2.9 (1.50)	2.7 (1.50)	0.000	100
2	CG-81	3.8 (1.75)	3.3 (1.25)	0.357	5.9
3	CG-82	3.8 (1.65)	2.8 (1.35)	0.160	20.6
4	Sulabha	3.7 (1.45)	3.5 (1.55)	0.011	73.9
	Total mean scores	3.6 (1.60)	3.1 (1.40)	0.050	48.0

OVM- Observed Vegetable Maturity

OM- Over Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

The table 16 revealed that, the mean score for texture also decreased in over maturity. The difference in the mean scores observed was not significant except for CG-81 and CG-82. In CG-81 the mean score of 3.8 in the observed vegetable maturity was significantly reduced to 3.3. In CG-82 the mean score of 3.8 was significantly reduced to 2.8 in over maturity. The total mean score for this attribute was 3.6 in observed vegetable maturity and 3.1 in over maturity and the variation observed was not statistically significant.

The table 17 compares the mean score obtained for the attribute flavour in observed vegetable maturity and over maturity in ivy gourd genotypes and the results are also shown in Figure 27

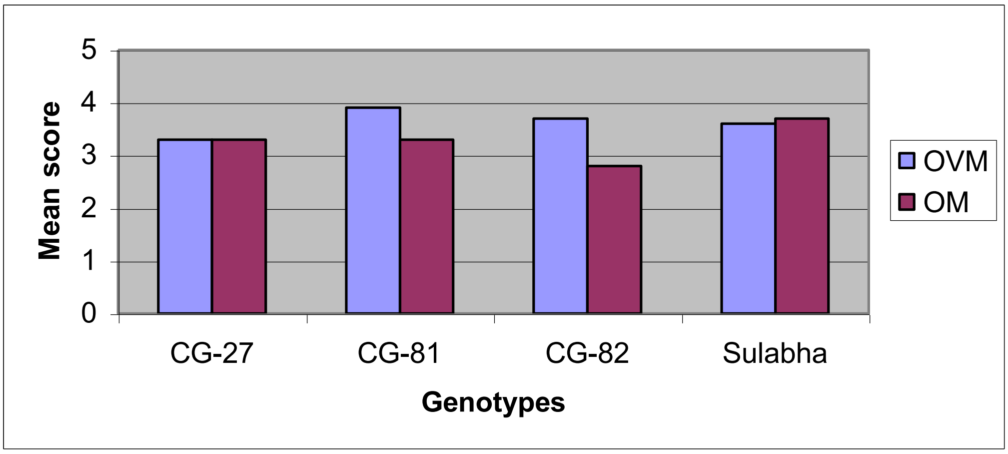

Figure 24. Comparison of appearance of ivy gourd genotypes between OVM and OM

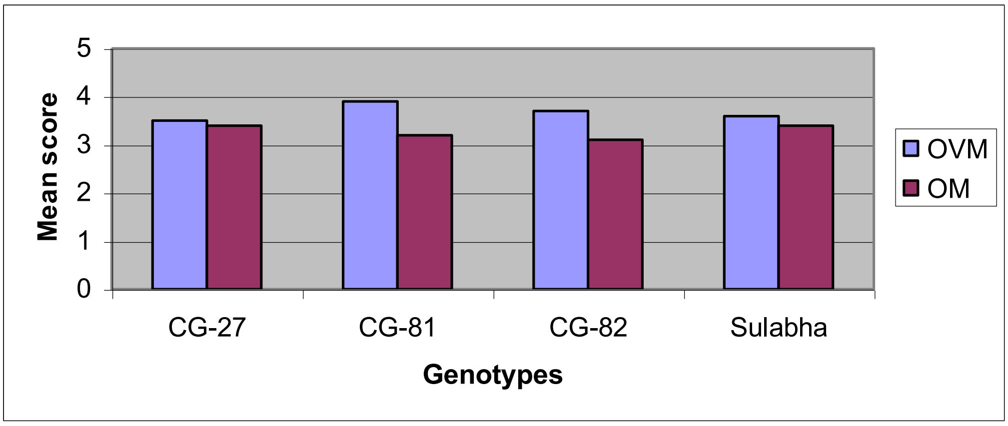

Figure25. Comparison of colour of ivy gourd genotypes between OVM and OM

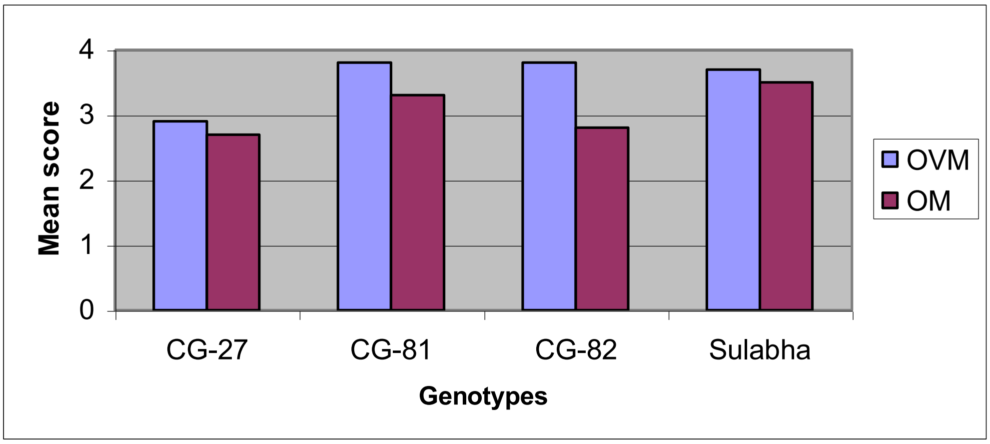

Figure 26. Comparison of texture of ivy gourd genotypes between OVM and OM

Table- 17. Comparison of flavour of ivy gourd genotypes between OVM and OM

Sl.No.	Genotypes	Flavour Mean scores		W	Prob level of sig (%)
		OVM	OM		
1	CG-27	3.4 (1.60)	2.8 (1.40)	0.050	48.0
2	CG-81	3.7 (1.60)	3.4 (1.40)	0.050	48.0
3	CG-82	3.2 (1.60)	3.1 (1.40)	0.067	41.4
4	Sulabha	3.7 (1.70)	2.9 (1.30)	0.200	15.7
	Total mean scores	3.5 (1.65)	3.1 (1.35)	0.100	31.7

OVM- Observed Vegetable Maturity

OM- Over Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

As shown in Table 17 in all genotypes higher mean score for the attribute flavour was in observed vegetable maturity. Statistically, there was no significant difference in flavour between these two maturity levels in all genotypes except in Sulabha. In Sulabha the mean score of 3.7 in observed vegetable maturity was significantly reduced to 2.9 in over maturity. In this attribute also the total mean score was higher in observed vegetable maturity (3.5) but the difference observed was not statistically significant.

The table 18 compares the mean score obtained for the attribute taste in observed vegetable maturity and over maturity in ivy gourd genotypes and the results are also shown in Figure 28.

With respect to the mean score for the attribute taste, it was found to be decreasing in over maturity. Statistical analysis showed that in all genotypes except inCG-81 there was significant difference in taste between observed vegetable maturity and over maturity. Total mean score was significantly high in observed vegetable maturity (3.8).

Table- 18. Comparison of taste of ivy gourd genotypes between OVM and OM

Sl.No.	Genotypes	Taste		W	Prob level of sig (%)
		Mean scores			
		OVM	OM		
1	CG-27	3.5 (1.70)	3.0 (1.30)	0.200	15.7
2	CG-81	3.6 (1.60)	3.5 (1.40)	0.067	41.4
3	CG-82	4.1 (1.70)	3.5 (1.30)	0.267	10.2
4	Sulabha	3.9 (1.70)	3.2 (1.30)	0.160	20.6
	Total mean scores	3.8 (1.80)	3.3 (1.20)	0.450	3.4

OVM- Observed Vegetable Maturity

OM- Over Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

The table 19 compares the mean score obtained for overall acceptability in observed vegetable maturity and over maturity in ivy gourd genotypes and is also shown in Figure 29.

In all the genotypes overall acceptability was higher in observed vegetable maturity than over maturity. Statistical analysis revealed that there was no significant variation in the overall acceptability except in appearance and taste. Appearance and taste of genotypes was better accepted in observed vegetable maturity as indicated in their high mean score (3.6 and 3.8 respectively).

Table 19. Comparison of overall acceptability of ivy gourd genotypes in OVM and OM

Sl.No.	Parameters	Overall acceptability		W	Prob level of sig (%)
		Mean scores			
		OVM	OM		
1	Appearance	3.6 (1.70)	3.3 (1.30)	0.200	15.7
2	Colour	3.7 (1.55)	3.3 (1.45)	0.011	73.9
3	Texture	3.6 (1.60)	3.1 (1.40)	0.050	48.0
4	Flavour	3.5 (1.65)	3.1 (1.20)	0.100	31.7
5	Taste	3.8 (1.80)	3.3 (1.20)	0.450	3.4
	Total mean scores	3.6 (1.63)	3.2 (1.37)	0.063	11.4

OVM- Observed Vegetable Maturity

OM- Over Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

4.4.5.comparison of organoleptic qualities of ivy gourd genotypes in their average vegetable maturity and observed vegetable maturity.

Organoleptic qualities such as appearance, colour, texture, flavour, taste and overall acceptability of ivy gourd genotypes in their average vegetable maturity and observed vegetable maturity were compared and presented in the following tables.

The table 20 compares the appearance of ivy gourd genotypes in their average vegetable maturity and observed vegetable maturity and the results are also presented in figure 30. Except in CG-27, mean score for appearance was higher in observed vegetable maturity than in average vegetable maturity, but the difference was not significant. In this attribute the highest total mean score was also observed in observed vegetable maturity than in average vegetable maturity but statistically there was no significant difference between these two maturity stages. As revealed in Table 21 the mean score for colour in all genotypes except

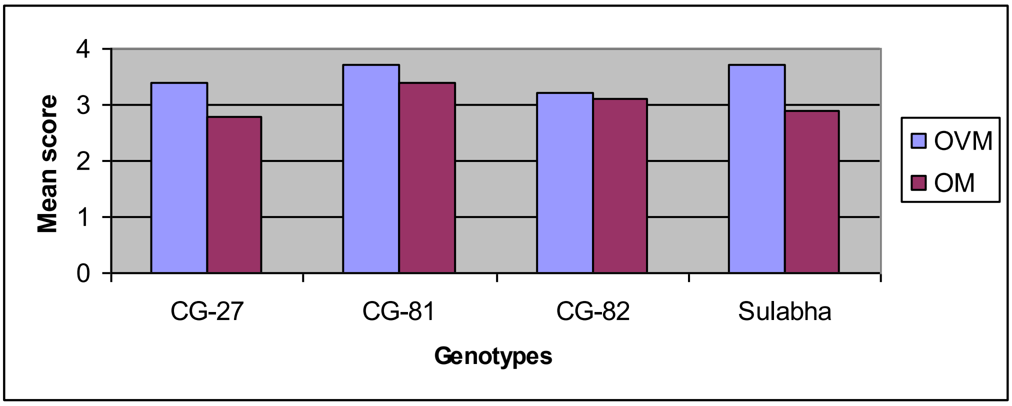

Figure 27. Comparison of flavour of ivy gourd genotypes between OVM and OM

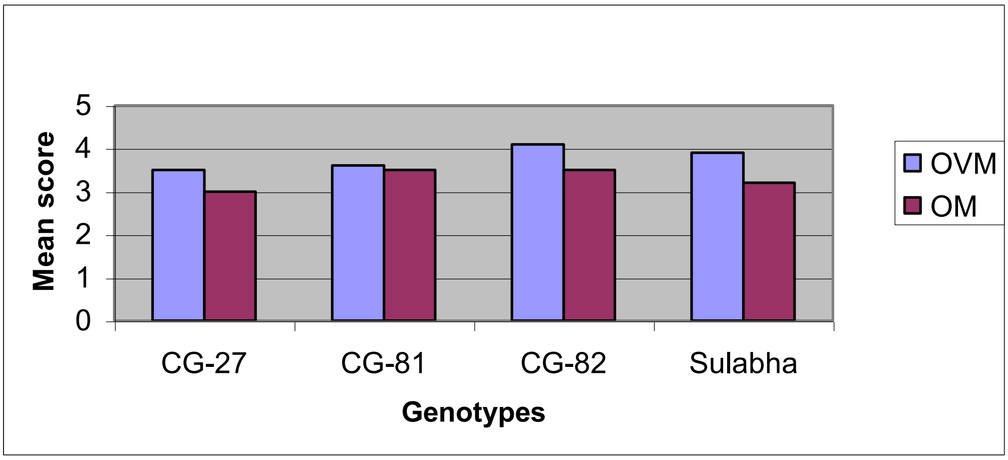

Figure 28. Comparison of taste of ivy gourd genotypes between OVM and OM

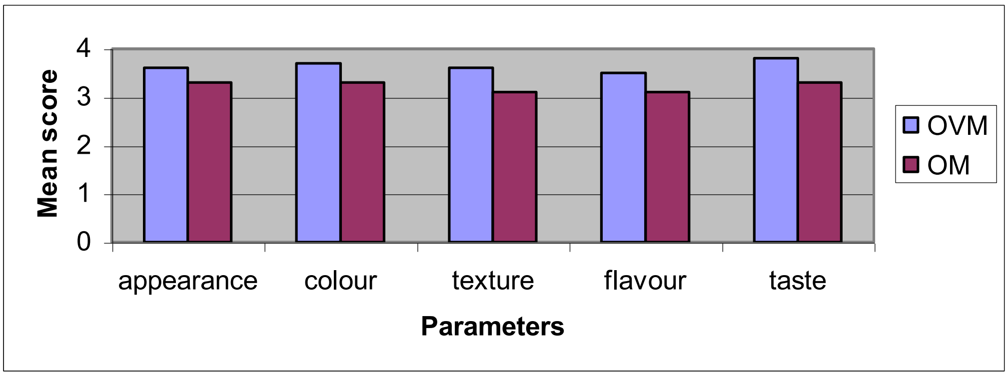

Figure29. Comparison of overall acceptability of OVM and OM

in CG-27, was higher in observed vegetable maturity (Figure 31), but the difference observed in colour was also not significant.

Table- 20.Comparison of appearance of ivy gourd genotypes between AVM and OVM

Sl.No.	Genotypes	Appearance		W	Prob level of sig (%)
		Mean scores			
		AVM	OVM		
1	CG-27	3.3 (1.50)	3.3 (1.50)	0.000	100.0
2	CG-81	3.5 (1.40)	3.9 (1.60)	0.067	41.4
3	CG-82	3.5 (1.45)	3.7 (1.55)	0.011	73.9
4	Sulabha	3.4 (1.45)	3.6 (1.55)	0.033	56.4
	Total mean scores	3.5 (1.50)	3.6 (1.50)	0.000	100.0

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Table- 21. Comparison of colour of ivy gourd genotypes between AVM and OVM

Sl.No.	Genotypes	Colour		W	Prob level of sig (%)
		Mean scores			
		AVM	OVM		
1	CG-27	3.5 (1.50)	3.5 (1.50)	0.000	100
2	CG-81	3.7 (1.45)	3.9 (1.55)	0.020	70.5
3	CG-82	3.6 (1.45)	3.7 (1.55)	0.014	70.5
4	Sulabha	3.4 (1.35)	3.6 (1.65)	0.129	25.7
	Total mean scores	3.6 (1.40)	3.7 (1.60)	0.069	41.4

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Table- 22. Comparison of texture of ivy gourd genotypes between AVM and OVM

Sl.No.	Genotypes	Texture		W	Prob level of sig (%)
		Mean scores			
		AVM	OVM		
1	CG-27	2.9 (1.50)	2.9 (1.50)	0.000	100
2	CG-81	3.7 (1.45)	3.8 (1.55)	0.014	70.5
3	CG-82	3.2 (1.35)	3.8 (1.65)	0.200	15.7
4	Sulabha	3.2 (1.35)	3.7 (1.65)	0.180	18.0
	Total mean scores	3.2 (1.30)	3.6 (1.70)	0.200	15.7

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

With regard to the parameter texture, Table 22 showed that in all genotypes the mean score as well as the total mean score was higher in observed vegetable maturity but significant difference was given only by CG-82 and Sulabha (Figure.32). Total mean score was also significantly high in observed vegetable maturity in this attribute.

The table 23 revealed that, there was no significant difference in the flavour of genotypes in their average vegetable maturity and observed vegetable maturity except in Sulabha (Figure 33). This genotype showed significantly higher mean score for flavour in observed vegetable maturity than in average vegetable maturity. As shown in table 24, there was no change in the taste of ivy gourd genotypes in CG-27 and CG-81 in their average vegetable maturity and observed vegetable maturity. But in genotypes CG-82 and Sulabha mean score for taste was significantly high in their observed vegetable maturity stage (Figure 34).

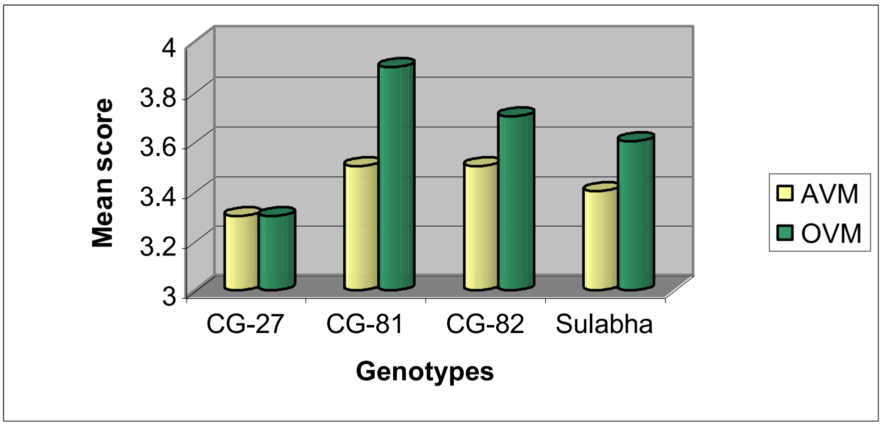

Figure 30.Comparison of appearance of ivy gourd genotypes between AVM and OVM

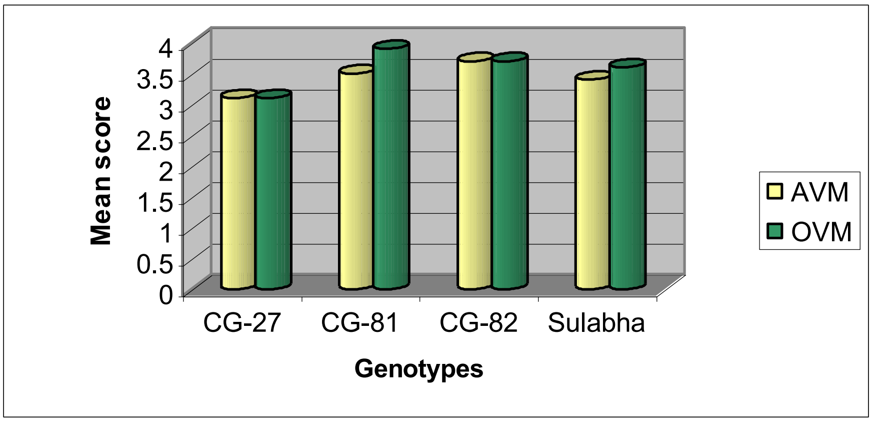

Figure 31. Comparison of colour of ivy gourd genotypes between AVM and OVM

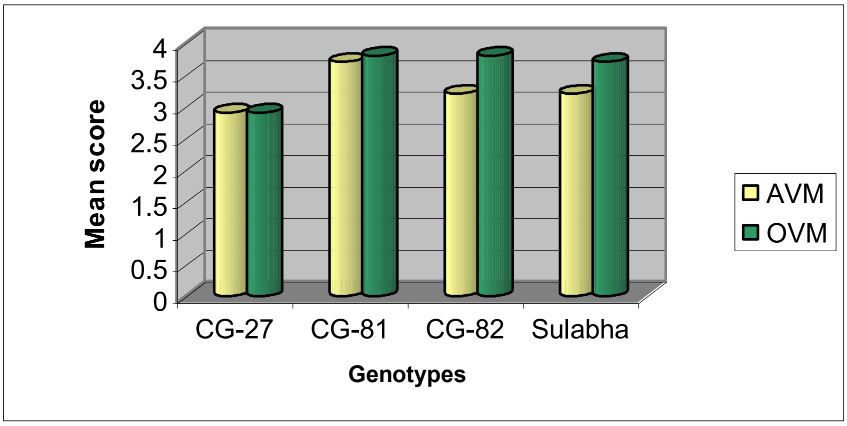

Figure32. Comparison of texture of ivy gourd genotypes between AVM and OVM

Table- 23.Comparison of flavour of ivy gourd genotypes between AVM and OVM

Sl.No.	Genotypes	Flavour Mean scores		W	Prob level of sig (%)
		AVM	OVM		
1	CG-27	3.4 (1.50)	3.4 (1.50)	0.000	100
2	CG-81	3.5 (1.45)	3.7 (1.55)	0.014	70.5
3	CG-82	3.5 (1.55)	3.2 (1.45)	0.011	73.9
4	Sulabha	3.1 (1.35)	3.7 (1.65)	0.180	18.0
	Total mean scores	3.1 (1.35)	3.5 (1.65)	0.100	31.7

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Table- 24.Comparison of taste of ivy gourd genotypes between AVM and OVM

Sl.No.	Genotypes	Taste Mean scores		W	Prob level of sig (%)
		AVM	OVM		
1	CG-27	3.5 (1.50)	3.5 (1.50)	0.000	100
2	CG-81	3.6 (1.40)	3.6 (1.60)	0.050	48.0
3	CG-82	3.6 (1.30)	4.1 (1.70)	0.200	15.7
4	Sulabha	3.0 (1.30)	3.9 (1.70)	.0267	10.2
	Total mean scores	3.4 (1.35)	3.7 (1.65)	0.129	25.7

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Table- 25.Comparison of overall acceptability of AVM and OVM

Sl.No.	Parameter	Overall acceptability		W	Prob level of sig (%)
		Mean scores			
		AVM	OVM		
1	Appearance	3.4 (1.50)	3.6 (1.50)	0.000	100.0
2	Colour	3.6 (1.40)	3.7 (1.60)	0.069	41.4
3	Texture	3.2 (1.30)	3.6 (1.70)	0.200	15.7
4	Flavour	3.3 (1.35)	3.5 (1.65)	0.100	31.7
5	Taste	3.4 (1.35)	3.7 (1.65)	0.129	25.7
	Total mean scores	3.3 (1.06)	3.6 (1.94)	0.785	00.0

AVM- Average Vegetable Maturity

OVM- Observed Vegetable Maturity

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

The table 25 compares the overall acceptability of ivy gourd genotypes in their average vegetable maturity and observed vegetable maturity and the results are also given in Figure 35. In all the genotypes mean score for all attributes were higher in observed vegetable maturity than in average vegetable maturity but significant difference was observed only in the overall acceptability of texture. In this attribute the mean score of 3.6 in observed vegetable maturity was significantly reduced to 3.2 in average vegetable maturity. Total mean score for overall acceptability was also significantly high in observed vegetable maturity.

4.4.6.Comparison of organoleptic qualities of ivy gourd genotypes in different stages of vegetable maturity (7th, 8th and 9th day after flowering).

Organoleptic qualities such as appearance, colour, texture, flavour, taste and overall acceptability of ivy gourd genotypes in their different stages of vegetable maturity such as, just before the day of average vegetable maturity (7th

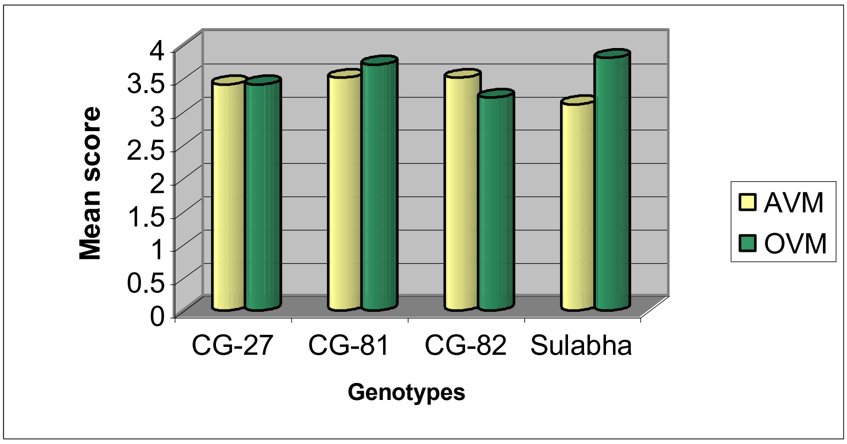

Figure 33. Comparison of flavour of ivy gourd genotypes between AVM and OVM

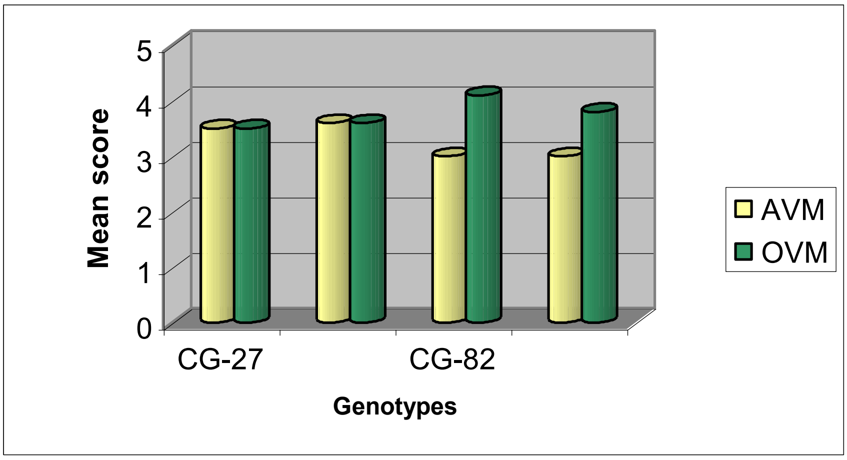

Figure 34. Comparison of taste of ivy gourd genotypes between AVM and OVM

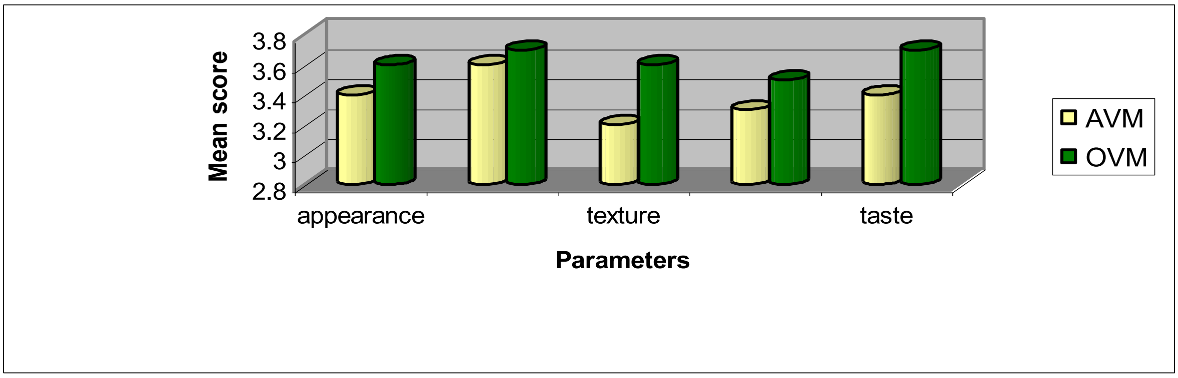

Figure 35. Comparison of overall acceptability of AVM and OVM

day), at the day of average vegetable maturity (8th day) and just after the day of average vegetable maturity were compared and presented in the following tables.

The table 26 compares the appearance of ivy gourd genotypes in their different stages of vegetable maturity (Figure 36).

Table 26.Comparison of appearance of ivy gourd genotypes in different stages of vegetable maturity.

Sl.No.	Genotypes	Appearance			W	Prob level of sig (%)
		Mean scores				
		7DAF	8DAF	9DAF		
1	CG-27	3.6 (2.40)	3.3 (2.00)	2.9 (1.60)	0.206	12.7
2	CG-81	3.6 (1.95)	3.5 (1.85)	3.9 (2.20)	0.059	55.4
3	CG-82	3.7 (2.05)	3.5 (1.85)	3.7 (2.10)	0.025	77.9
4	Sulabha	3.5 (2.15)	3.4 (1.90)	3.6 (1.95)	0.027	76.4
	Total mean scores	3.6 (2.10)	3.4 (1.90)	3.5 (2.00)	0.011	89.5

DAF-Days After Flowering.

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

In CG-27 maximum score for appearance was on the 7th day (3.6) and minimum score was on the 9th day (2.9) and this difference was found to be significant. In CG-81 maximum score for appearance was on the 9th day (3.9) and the least was on the 8th day (3.5) but the difference was not significant. In CG-82 mean score for appearance was maximum during the 7th and 9th day (3.7) and was minimum on 8th day (3.5) but the difference was not significant. In Sulabha appearance was highly acceptable on the 9th day (3.6) but the difference observed was not significant. The total mean score for appearance showed no significant difference in appearance with respect to stages in vegetable maturity.

Table 27 compares the colour of ivy gourd genotypes in their different stages of vegetable maturity and is also shown in Figure 37.

In CG-27 mean score for colour was significantly high in the 8th day (3.5) and minimum score was on the 9th day (2.6). In CG-81 maximum mean score for colour was on 9th day (3.9) and the least score in 7th day (3.5) but the variation observed was not significant. In CG-82 also maximum mean score for was on the 9th day (3.9) and the least score on 8th day (3.6) and the difference was not significant. In Sulabha mean score for colour was maximum in the 9th day (3.6) and the variation was not significant. There was no significant variation in the total mean score for colour in all the genotype.

Table 27.Comparison of colour of ivy gourd genotypes in different stages of vegetable maturity.

Sl.No.	Genotypes	Colour			W	Prob level of sig (%)
		Mean scores				
		7DAF	8DAF	9DAF		
1	CG-27	3.1 (2.05)	3.5 (2.40)	2.6 (1.55)	0.228	10.2
2	CG-81	3.5 (1.85)	3.7 (2.00)	3.9 (2.15)	0.033	71.7
3	CG-82	3.7 (1.95)	3.6 (1.85)	3.9 (2.20)	0.052	59.5
4	Sulabha	3.5 (2.30)	3.4 (1.70)	3.6 (2.00)	0.103	35.8
	Total mean scores	3.5 (2.00)	3.5 (2.20)	3.5 (1.80)	0.043	64.9

DAF-Days After Flowering.

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Table 28 compares the texture of ivy gourd genotypes in their different stages of vegetable maturity and is also depicted in figure 38.

As shown in the table, mean score or texture was maximum in the 7th day (3.9) in CG-27 and was minimum in the 8th day (2.9) and the difference observed was significant. In CG-81 there was a gradual increase in the mean score for texture, which was 3.8 in the 9th day, but the difference was not significant. In CG-82 maximum mean score for texture was in the 7th day (3.8) and the least score in the 8th day (3.2) but the variation was not significant. In Sulabha maximum mean score for texture was on 9th day (3.7) but there was no significant variation in the difference observed in texture.

Table 28.Comparison of texture of ivy gourd genotypes between different stages of vegetable maturity.

Sl.No.	Genotypes	Texture			W	Prob level of sig (%)
		Mean scores				
		7DAF	8DAF	9DAF		
1	CG-27	3.9 (2.35)	2.9 (1.65)	3.4 (2.00)	0.188	15.2
2	CG-81	3.3 (1.85)	3.7 (2.05)	3.8 (2.10)	0.025	77.2
3	CG-82	3.8 (2.25)	3.2 (1.70)	3.6 (2.05)	0.094	39.1
4	Sulabha	3.1 (1.80)	3.2 (1.85)	3.7 (2.35)	0.112	32.6
	Total mean scores	3.5 (1.90)	3.2 (1.75)	3.6 (2.35)	0.111	32.8

DAF-Days After Flowering.

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

The table 29 compares the flavour of ivy gourd genotypes in different stages of vegetable maturity and is also presented in figure 39.

In CG-27 maximum mean score for flavour was in the 7th day (3.6), which showed a gradual decrease, and reached to 3.3 in the 9th day but the variation observed was not significant. In CG-81 maximum mean score for flavour was in 9th day (3.7) and minimum in 8th day (3.5) but the difference was not significant. In CG-82 and Sulabha also maximum mean score was in the 9th day (3.6 and 3.7 respectively) but the difference was not significant.There was no

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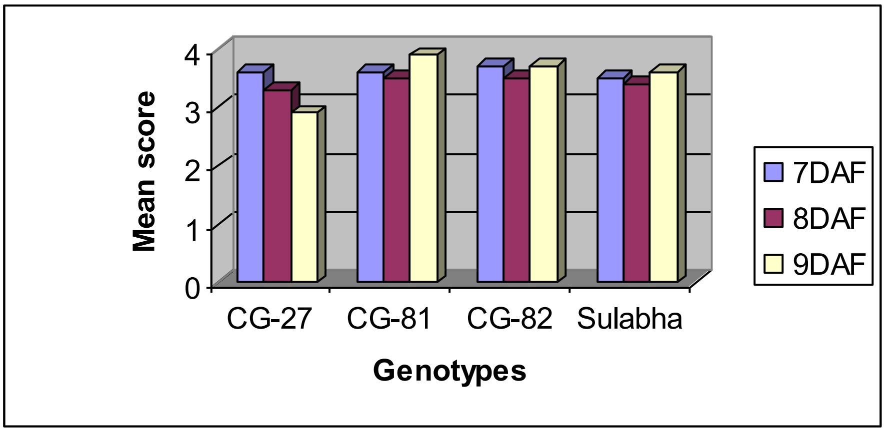

Figure 36.Comparison of appearance of ivy gourd genotypes between different stages of vegetable maturity.

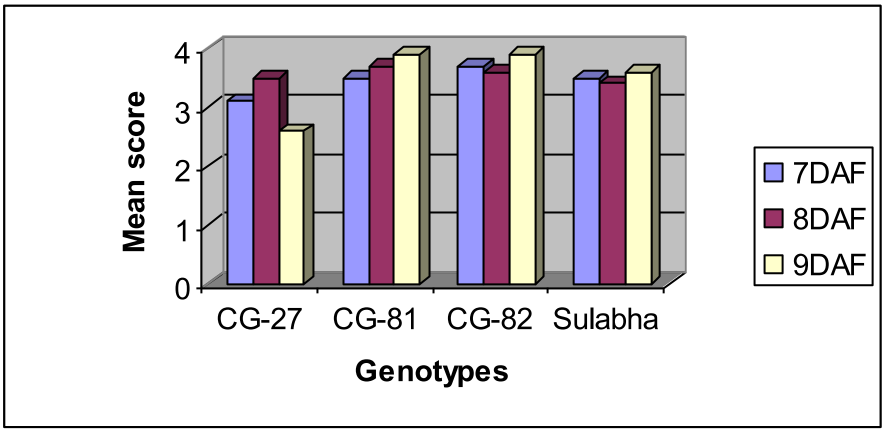

Figure 37. Comparison of colour of ivy gourd genotypes between different stages of vegetable maturity.

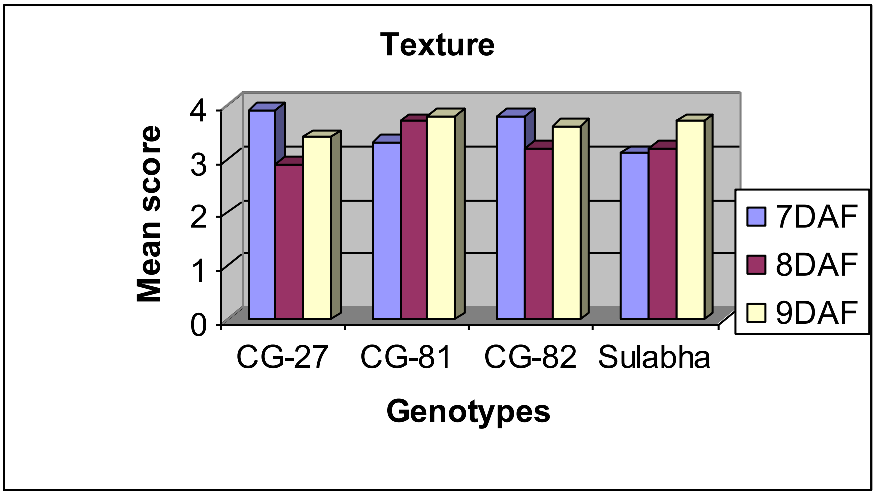

Figure 38. Comparison of texture of ivy gourd genotypes between different stages of vegetable maturity.

significant variation in the total mean score for flavour in all genotype with respect to different stages in their vegetable maturity

Table 29.Comparison of flavour of ivy gourd between different stages of vegetable maturity.

Sl.No.	Genotypes	Flavour Mean scores			W	Prob level of sig (%)
		7DAF	8DAF	9DAF		
1	CG-27	3.6 (2.25)	3.4 (2.05)	3.3 (1.70)	0.103	35.6
2	CG-81	3.6 (2.00)	3.5 (1.90)	3.7 (2.10)	0.014	86.7
3	CG-82	3.2 (1.80)	3.5 (2.00)	3.6 (2.20)	0.048	61.6
4	Sulabha	3.3 (2.05)	3.1 (1.70)	3.7 (2.25)	0.100	36.8
	Total mean scores	3.4 (1.95)	3.4 (1.90)	3.6 (2.15)	0.018	83.6

DAF-Days After Flowering

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Table 30.Comparison of taste of ivy gourd genotypes between different stages of vegetable maturity.

Sl.No.	Genotypes	Taste Mean scores			W	Prob level of sig (%)
		7DAF	8DAF	9DAF		
1	CG-27	3.7 (2.25)	3.5 (1.85)	3.5 (1.90)	0.066	51.9
2	CG-81	3.3 (1.90)	3.6 (1.90)	3.6 (2.20)	0.040	67.0
3	CG-82	4.1 (2.35)	3.6 (1.80)	3.7 (1.85)	0.116	31.5
4	Sulabha	3.0 (1.80)	3.0 (1.80)	3.9 (2.40)	0.192	14.7
	Total mean scores	3.5 (2.00)	3.4 (1.85)	3.7 (2.15)	0.024	78.4

DAF-Days After Flowering

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

Is revealed in Table 30, maximum mean score for taste in CG-27 was in 7th day but no variation observed in the 8th and 9th day but the difference observed in the 7th day was not significant. In CG-81 mean score for taste was 3.6 in the 8th day and 9th days but on 7th day it was 3.3 and the variation was not significant. In CG-82 maximum mean score for taste was in the 7th day (4.1) and reduced to 3.6 in the 8th day. The reduction in the mean score for taste was not significant. In Sulabha the mean score for taste was significantly high in the 9th day (3.9) when compared to the 7th and 8th days (3.0). The results are also presented in Figure 40.

There was no significant variation in the total mean score for taste in all genotypes with respect to different stages in the vegetable maturity.

The table 31 reveals the overall acceptability of ivy gourd genotypes in different stages of vegetable maturity stage and the results are also depicted in Figure.41.

Table 31.Comparison of overall acceptability between different stages of vegetable maturity.

Sl.No.	Parameters	Overall acceptability			W	Prob level of sig (%)
		Mean scores				
		7DAF	8DAF	9DAF		
1	Appearance	3.6 (2.10)	3.4 (1.90)	3.5 (2.00)	0.011	89.5
2	Colour	3.5 (2.00)	3.6 (2.20)	3.5 (1.80)	0.043	64.9
3	Texture	3.5 (1.90)	3.3 (1.75)	3.6 (2.15)	0.111	32.8
4	Flavour	3.4 (1.95)	3.4 (1.90)	3.6 (2.15)	0.018	83.6
5	Taste	3.5 (2.00)	3.4 (1.85)	3.7 (2.35)	0.024	78.4
	Total mean scores	3.5 (1.99)	3.4 (1.96)	3.6 (2.05)	0.002	91.5

DAF-Days After Flowering

Figures in parenthesis indicates mean rank

W- Kendall's Coefficient of Concordance

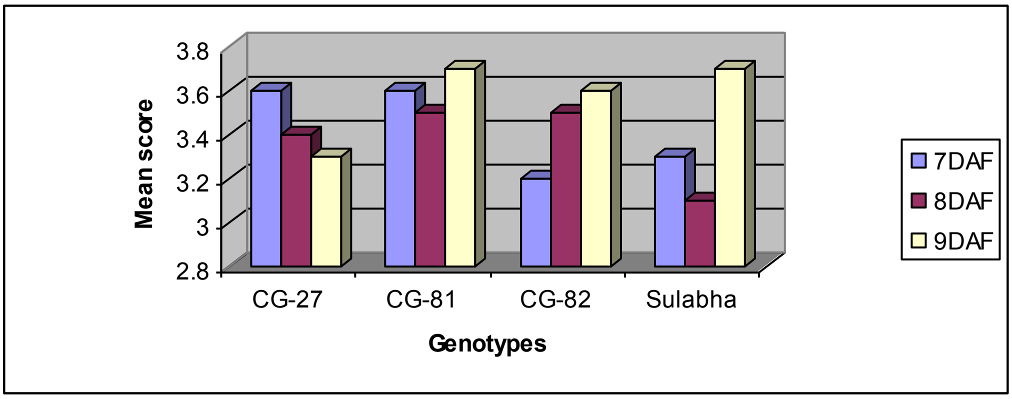

Figure 39. Comparison of flavour of ivy gourd between different stages of vegetable maturity.

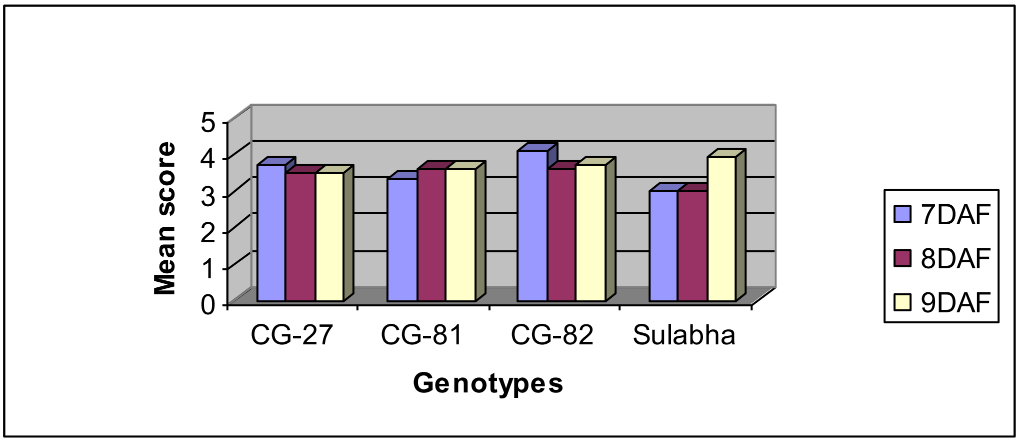

Figure 40. Comparison of taste of ivy gourd genotypes between different stages of vegetable maturity.

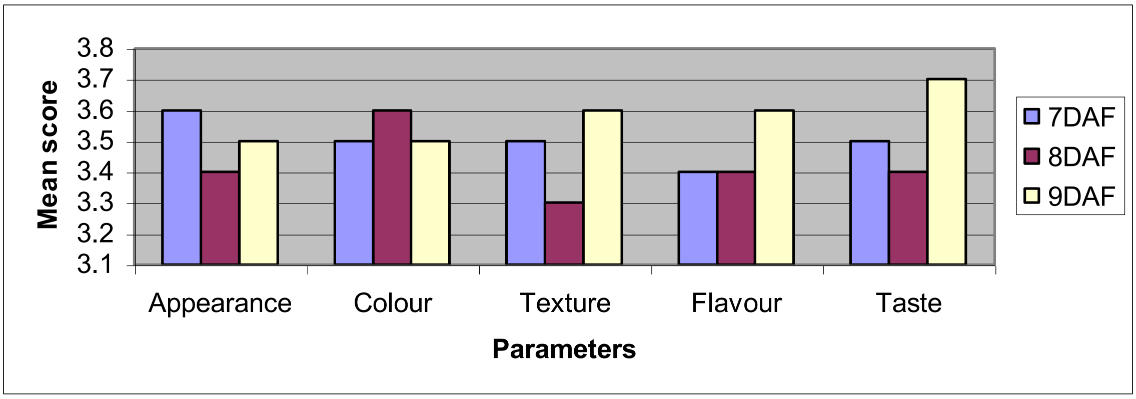

Figure 41. Comparison of overall acceptability between different stages of vegetable maturity.

The mean score for overall acceptability for appearance was maximum in the 7th day (3.6) for all the genotypes but the variation observed was not significant. No significant variation in the overall acceptability of colour was also noted in all genotypes in the different vegetable maturity levels. Maximum overall acceptability for texture was noted in the 9th day (3.6) in all genotypes, which was not significantly different from overall acceptability for other days. Flavour and taste also showed no significant variation in their overall acceptability with respect their different vegetable maturity stage.

The total mean score for the overall acceptability of different genotypes showed no significant variation with respect to different stage of vegetable maturity.

Discussion

5.DISCUSSION

The study on 'Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) Voigt)' was conducted to evaluate the chemical composition and acceptability of four genotypes in vegetable maturity and over maturity stages. For the study, three morphologically distinct genotypes with maximum yield and the released variety Sulabha were selected. The discussion of the study is presented under the following headings.

5.1.Maturity stages of ivy gourd genotypes.
5.2.Fruit characteristics of ivy gourd genotypes.
5.3.Chemical constituents in ivy gourd genotypes.
5.4.Acceptability of ivy gourd genotypes.

5.1. Maturity stages of ivy gourd genotypes.

In the present study, the day of vegetable maturity of ivy gourd genotypes was minimum in CG-82 (7 days) and maximum in CG-81 and Sulabha (9 days), with a mean of 8 days. This finding agrees with the observation of Joseph (1999), who observed that the mean days of vegetable maturity of 20 genotypes of ivy gourd was 8 days. In genotypes other than Sulabha over mature stage was attained within five days after attaining vegetable maturity by visible changes in their flesh colour. But, in Sulabha it took 6 days from vegetable maturity to show the visible changes of over maturity.

5.2. Fruit characteristics of ivy gourd genotypes.

Among fruit characteristics, the fruit shape was oval or cylindrical or long cylindrical fruits. The colour variability of the fruit skin ranged between green and light green. The fruits were having the characteristic stripe design on them. The genotypes CG-27 and CG-81 had broken striations where as CG-82 and Sulabha had continuous striations. Joseph (1999) had also observed variability in physical characteristics of ivy gourd genotypes. Maximum fruit length was observed in the released variety Sulabha (9.5 cm). Fruit length was minimum in CG-82 (4.7 cm) but it had maximum fruit girth (9.3 cm). Because of its shorter fruit length and high fruit girth, the fruit finally had a spherical appearance. In the observed vegetable maturity of 7 days after flowering, CG-82 was more crisp (9.5 pressure Kg/cm^2) in texture with semihard seeds making it suitable for salads. In the market, always long fruited types have better acceptability and appeal. Sulabha had a fruit length more than 9 cm and also maximum fruit weight (26.7g in vegetable maturity). It is interesting to note that about 38 fruits of Sulabha could make a kilogram of fruit and therefore exhibits good potential as a commercial variety. As reported in the Annual Report of All India Coordinated Research Project-Vegetable Crops. 2004-2005 (IIVR, 2005), among the ten ivy gourd genotypes characterised during the year 2004-2005 in Vellanikkara, maximum fruit length, fruit weight and yield/plant was for Sulabha. Raju and Peter (1995) also reported a high yield of 18.158 Kg fruits/year for Sulabha.

In over maturity stage, changes were observed in the flesh colour, in the firmness of the fruits and in fruit weight. Flesh colour became slightly red in over mature stage and the firmness of the fruits were reduced and this may be due to changes in the cell wall structure due to ripening of fruits. Wasantwisut and Viriyapanich (2003) had also observed these characters in ivy gourd genotypes. Maximum fruit firmness in over maturity was for CG-81. Next to Sulabha, CG-81 had fruit length (7.4 cm), fruit girth (7.7 cm), and maximum firmness of fruits in over maturity stage (8.7 Kg/cm^2) and fruit weight was for CG-81. Fruit weight was found to be increasing in all genotypes in the over maturity stage.

5.3. Chemical constituents in ivy gourd genotypes

In vegetable maturity the moisture content of four ivy gourd genotypes ranged from 92.85 (CG-27) to 95.33 per cent (CG-82), with a mean value of 93.81 per cent. The moisture content of the released variety Sulabha was 93.88 per cent. There observed a significant variation in moisture content in between genotypes. The mean moisture content of the ivy gourd genotypes was found to be slightly higher than the value reported by Guha and Sen (1998). When fruits were over matured, the moisture content decreased with a mean value of 92.60 per cent. There was a significant reduction in the moisture content in over maturity stage between genotypes. This finding is supported by the findings of Culpepper (1987) who observed that in summer squash (*Cucurbita pepo*) the moisture content increased at the first stage of maturity and then it became reduced in over maturity.

The fibre content of ivy gourd genotypes in vegetable maturity ranged from 1.00 to 1.67 per cent with a mean value of 1.25 per cent. This value was lower than the value reported by Guha and Sen (1998). In these 4 genotypes the maximum fibre content in vegetable maturity was observed in CG-81 (1.67 %). When the maturity increased the fibre content of the fruits increased significantly with a mean value of 2.21 per cent. The increase in total fibre content in over maturity may be due to the hardened seed coat of the fruits.

Protein content of 4 genotypes of ivy gourd in their vegetable maturity ranged from 1.07 to 1.69 per cent with a mean value of 1.41 per cent. The protein content of ivy gourd genotypes did not vary significantly. The mean protein content was found to be higher than the value (1.2 g/100g) reported by Guha and Sen (1998) in ivy gourd genotypes. The protein content of the ivy gourd genotypes decreased in over matured fruits, but the reduction was not significant.

The vitamin C content of the ivy gourd genotypes in their vegetable maturity stage ranged from 12.69 (CG-81) to 15.84 mg/100g (CG-82) with a mean value of 14.50 mg/100g. This value was lower than the value reported by Rai *et al.* (2004). According to Joseph (1999) the average vitamin C content of 20 different ivy gourd genotypes was 12.23 mg/100g. There was a significant reduction in vitamin C content in their over maturity stage with a mean value of 8.72 mg/100g. Maximum vitamin C in vegetable maturity was in CG-82 (15.84 mg/100g) and maximum vitamin C in over maturity stage was also in CG-82 (10.71 mg/100g). This finding is supported by the observations of Chadha (1992), who reported a decreasing trend in the vitamin C content of mango and apple with increase in maturity and also Forster *et al.* (2003) who reported that in plantains the vitamin C content decreased during ripening.

β-Carotene content of 4 ivy gourd genotypes in their vegetable maturity ranged from 34.09 µg/100g to 132.7 µg/100g with a mean value of 81.01 µg/100g. The maximum β-Carotene in this maturity stage was reported in the released variety Sulabha. Joseph (1999) reported that the β-Carotene content of 20 genotypes of ivy gourd ranged from 40.70 µg/100g to 133.70 µg/100g with a mean value of 74.42 µg/100g. The observed mean value for β-Carotene was low when compared to the value reported by Rai *et al.*(2004). There was a significant variation in the β-Carotene content of genotypes in their vegetable maturity stage. In over matured fruits, the β-Carotene content significantly increased with a mean value of 142.94 µg/100g. This findings support the findings of Ronen *et al.*(1999). According to them 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. Thus, ivy gourd in over mature stage can be consumed for its β-Carotene content, which is considered to be a very powerful antioxidant.

Total phenol content in the four genotypes ranged from 0.038 to 0.061 mg/100g with a mean value of 0.050 mg/100g. The highest phenol content present was in CG-82 and the lowest in CG-81. According to Joseph (1999) the phenol content of 20 genotypes of ivy gourd ranged from 0.096 mg/100g to 0.12 mg/100g with a mean value of 0.10 mg/100g. The observed total phenol content of 4 genotypes of ivy gourd was lower than this reported value. In over maturity stage total phenol content significantly decreased with a mean value of 0.029 mg/100g. In this stage the maximum phenol was observed in CG-82.

There was no significant variation in the total pectin content of ivy gourd genotypes in their vegetable maturity with a mean value of 0.31 g/100g. Mean pectin content decreased to 0.22g/100g on ripening but this reduction was not significant. As reported by Sreelakshmi (2003) the pectin content of fruits reduced with ripening. In ripening, the pectin in fruits were converted to pectic acid. Khan *et al.* (1980) had reported that the pectin from ivy gourd had shown significant hypoglycemic activity in rats. Reduction in the firmness of ivy gourd genotypes observed during over maturity may be due to this reduction in the pectin content of the fruits.

Mucilage content of the ivy gourd fruits in vegetable maturity ranged from 0.11g/100g to 0.71 g/100g with a mean value of 0.45g/100g. Mucilage content of the ivy gourd genotypes showed an increase in over maturity. In over matured fruits the mucilage content increased with a mean value of 0.69 g/100g. In this stage, highest mucilage content was found in CG-81 and lowest was in CG-82. Similar findings were reported by Thampi (1998) in thamara venda genotypes. According to the author the mucilage content of thamara venda genotypes increased as maturity increased.

The increased fibre content and mucilage in over mature fruits and a decrease in pectin content may be a factor which might have contributed to less firmness of the fruits and there by affecting the acceptability.

There was a significant variation in the calcium content of the ivy gourd genotypes in vegetable maturity, which ranged from 18.65 to 37.61 mg/100g with a mean value of 27.89 mg/100g. The maximum calcium content found in this maturity stage was in CG-82 and minimum in CG-81. The mean calcium content of ivy gourd genotypes is lower than the value (40 mg/100g) reported by Rai *et al.*(2004). The range of calcium content in ivy gourd accessions as reported by Raju and Peter (1995) was 32.7 mg/100g to 91 mg/100g. In over matured fruits the mean calcium content significantly reduced to 25.14 mg/100g. Similar finding was reported by 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 will be hydrolysed to pectinic acid and leaching of calcium during ripening which contributes to less firmness of fruits during ripening.

The phosphorus content of Sulabha (44.49 mg/100g) was significantly high when compared to other genotypes and upon ripening phosphorus content reduced significantly. The mean value for phosphorus (34.62 mg/100g) was higher than the value (30 mg/100g) reported by Guha and Sen (1998). Higher mean phosphorus in over matured fruits was also in Sulabha (42.68 mg/100g).

There was a significant variability in iron content of genotypes in their vegetable maturity with a maximum iron in CG-81 (0.97 mg/100g). The mean iron content of four ivy gourd genotypes (0.80 mg/100g) was higher than the value (0.38 mg/100g) reported by Rai *et al.* (2004).

There was a significant variation in the potassium content of ivy gourd genotypes in vegetable maturity with a mean value of 2.78 mg/100g. Highest potassium content was observed in CG-27 (2.95 mg/100g). In over matured fruits the potassium content significantly reduced with a mean value of 2.56 mg/100g. But, in over mature stage, potassium content was highest in Sulabha (2.65 mg/100g). This 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 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.

The changes occurring in constituents like vitamin C, β-carotene and total phenol, before and after the day of average vegetable maturity revealed that in all genotypes, maximum vitamin C content was observed on the day just before the day of average vegetable maturity i.e., the 7^{th} day after flowering. But there was no significant variation in vitamin C content on the 8^{th} day (average vegetable maturity) and 9th day, except in CG-81, which showed a significant reduction in vitamin C content between the 7th and 9th day (12.69 mg/100g)

In all genotypes the β-carotene content was maximum during the 9th day after flowering that is after the day of average vegetable maturity. Only in CG-27 there was no significant variation in β-carotene content between the average vegetable maturity (8th day) and the day after average vegetable maturity (9th day). So average vegetable maturity stage cannot be taken for maximum β-carotene content of ivy gourd genotypes except for CG-27.

Total phenol content was maximum in 7th day after flowering in all genotypes but no significant variation was observed on the 8th day after flowering (average vegetable maturity). So average vegetable maturity (8th day) can be taken for total phenol content without significant variation. But after the day of average vegetable maturity (9th day after flowering) phenol content was significantly reduced in CG-27, and Sulabha.

Thus, with regard to vitamin C and total phenol, there was no significant difference in average vegetable maturity stage (8th day) compared with the stage with maximum content of these nutrients but, significantly high β-carotene content was observed on the 9th day (after the day of average vegetable maturity) in all genotypes except in CG-27. In this genotype significant variation in β-carotene content was not observed during the 8th day (average vegetable maturity).

The changes in vitamin C, β-carotene and total phenols between average vegetable maturity and observed vegetable maturity revealed that there was no difference in these constituents in CG-27 since the observed vegetable maturity and average vegetable maturity was the same (8th day after flowering). In the other three genotypes significant difference was not observed in vitamin C content between average vegetable maturity and observed vegetable maturity. Significant variability was observed in β-carotene and total phenol content in their average vegetable maturity and observed vegetable maturity. β-carotene was significantly high in CG-81 and Sulabha in their observed vegetable maturity (84.85 and 132.7μg/100g) respectively because their observed vegetable maturity was on the 9th day and β-carotene showed an increasing trend with maturity, where as average vegetable maturity was on the 8th day. In CG-82, β-carotene was significantly low in observed vegetable maturity (34.09 μg/100g) since observed vegetable maturity of this genotype was on the 7th day.

Total phenol was significantly low in observed vegetable maturity in genotypes CG-81 (0.038 mg/100g) and Sulabha (0.046 mg/100g), because their observed vegetable maturity was on the 9th day and total phenol showed a decreasing trend with maturity. In CG-82 total phenol was significantly high in observed vegetable maturity (0.061 mg/100g) since observed vegetable maturity of this genotype was on the 7th day.

5.4. Acceptability of ivy gourd genotypes.

In observed vegetable maturity, the mean score for overall acceptability revealed that, there was no significant difference in the overall acceptability in between genotypes. Overall acceptability was based on individual crieterias such as appearance, colour, texture, flavour and taste of the cooked fruits. When individual crieterias were assessed, significant difference was observed only with respect to texture. Maximum score for texture was for CG-81 and CG-82 (3.8). In over mature stage there was no significant difference in the overall acceptability in between genotypes but when individual crieterias were assessed significant difference in appearance and texture was observed in over matured fruits. Sulabha was the most acceptable genotype in the over mature stage with regard to appearance (3.7) and texture (3.5).

When the overall acceptability of ivy gourd genotypes in their observed vegetable maturity and over maturity was compared, overall acceptability of ivy gourd genotypes in their observed vegetable maturity was significantly high (3.6) when compared to over maturity (3.2). This variability in overall acceptability in observed vegetable maturity was mainly contributed by the significantly high score for appearance in CG-81 (3.9), colour in CG-82 (3.7) and CG-81 (3.9),texture in CG-81 (3.8) and CG-82 (3.8), flavour in Sulabha (3.7) and CG-81 (3.7) and taste in Sulabha (3.9), CG-82 (4.1) and CG-27 (3.5) in their observed vegetable maturity. A general pattern observed was that total phenol and mucilage contributed to the palatability of ivy gourd genotypes. High total phenols and low mucilage content in observed vegetable maturity, may also be a factor which had improved their overall acceptability.

The comparison of the overall acceptability of genotypes between the average vegetable maturity and observed vegetable maturity revealed that, the mean scores for the overall acceptability was significantly high in observed vegetable maturity (3.6). This variability was contributed mainly by the high scores for texture in CG-82 (3.8), and CG-81 (3.8), flavour in Sulabha (3.7) and CG-81 (3.7) and taste in CG-82 (4.1) and Sulabha (3.9) in their observed vegetable maturity.

In the present study the selected ivy gourd genotypes were evaluated for their organoleptic qualities in the 7th day after flowering (just before the day of average vegetable maturity) in the 8th day after flowering (which is the day of average vegetable maturity) and in the 9th day after flowering (just after the day of average vegetable maturity) because the quality of vegetables are affected markedly by such factors as variety, geographic location of growth, temperature, moisture, stage of maturity etc.

There was no significant difference in appearance in the 7th, 8th and 9th day except in CG-27. In this genotype, appearance was significantly affected on the 9th day with a minimum score of 2.9. The observed vegetable maturity of this genotype was in the 8th day. In other genotypes maximum score for appearance was in their respective observed vegetable maturity.

Colour of CG-27 was also significantly high in its observed vegetable maturity which is also same as the average vegetable maturity (3.5). In all other genotypes there was no significant difference in colour in different vegetable maturity levels.

Texture of CG-27 was significantly high in the 7th day of maturity (3.9), but its observed vegetable maturity and average vegetable maturity was on the 8th day. There was no variation in the texture of other genotypes on the 7th, 8th and 9th day of maturity.

There was no significant difference in flavour in different maturity levels. Taste was significantly high in Sulabha in their observed vegetable maturity that is on the 9th day (3.9). In all other genotypes taste was not varying with different maturity levels. Thus, there was no significant difference in the overall acceptability of genotypes in their 7th, 8th and 9th day of maturity. Variability was found in CG-27 with respect to appearance, colour and texture the score being maximum in their observed vegetable maturity, which is same as average vegetable maturity (8th day). In Sulabha taste was significantly high in their observed vegetable maturity (9th day) than its average vegetable maturity.

Thus in CG-27, variability was found in appearance, colour and texture which was high in the 8th day. In this genotype average vegetable maturity and observed vegetable maturity are the same (8th day). Significant difference was not observed in nutrients like vitamin C, β-carotene and total phenols in the 8th day of maturity. So 8th day that is the average vegetable maturity can be recommended for CG-27 as its vegetable maturity.

In CG-81 there was no significant difference in the overall acceptability between 7th, 8th and 9th day of maturity. In this genotypes the observed vegetable maturity was on the 9th day. There was no significant difference in vitamin C and total phenol content but β-carotene content was significantly high in the 9th day (observed vegetable maturity). This is because the β-carotene content was found to be increasing with maturity and maximum β-carotene was in the over mature stage.

In CG-82 there was no significant difference in the overall acceptability between 7th, 8th and 9th day of maturity. In this genotype the observed vegetable maturity was on the 7th day. Here also there was no significant difference in vitamin C and total phenol content but β-carotene was significantly low because of its low maturity level (7th day after flowering), and again it is significantly low in average vegetable maturity (8th day) when compared to observed vegetable maturity (9th day).

In Sulabha also even though the overall acceptability was comparable between 7th, 8th and 9th day, taste was significantly high in the 9th day, which was its observed vegetable maturity. There was no significant variation in vitamin C in the 7th, 8th and 9th day of maturity but β-carotene was significantly high and total phenol was significantly low in the 9th day. So for Sulabha the vegetable maturity can be taken as 9th day after flowering. And the fruits attain maximum length and fruit weight by 9th day after flowering. Besides this variety attain over maturity only after 6 days from observed vegetable maturity (9 day after flowering).

In the over mature stage of all genotypes the fruit weight increased considerably but nutrients like calcium, phosphorus, iron, potassium and vitamin C decreased significantly in over mature stage. Acceptability of ivy gourd genotypes in their over mature stage was also significantly low.

Summary

6.SUMMARY

The study on 'Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) Voigt)' was conducted to evaluate the chemical composition and acceptability of ivy gourd genotypes in different stages of maturity, maintained in the Department of Olericulture, College of Horticulture, Vellanikkara, Thrissur. For the study three morphologically distinct genotypes with maximum yield, i.e., CG-27, CG-81 and CG-82 and the released variety Sulabha were selected.

In this study the day of attaining vegetable maturity was minimum for CG-82 (7 days after flowering) and maximum for Sulabha and CG-81 (9 days after flowering) and the average day for the four genotypes to attain vegetable maturity was 8 days after flowering. All genotypes, except Sulabha became over mature within five days after attaining vegetable maturity and for Sulabha it was 6 days from vegetable maturity to show the visible changes of over maturity inside the fruits.

The physical characters like fruit length, fruit weight, fruit colour, fruit firmness, fruit girth and fruit shape was varied. The fruit length (9.5 cm) and fruit weight (26.7 g) was higher in Sulabha in vegetable maturity, and this long fruited type exhibited good potential as a commercial variety. In CG-82, because of shorter fruit length and high fruit girth, the fruit finally had a spherical appearance. The fruit colour varied from green to light green with the characteristic stripe design in four genotypes. In over maturity the skin colour of the fruits did not change, but the flesh colour changed to red. In over maturity the fruit weight had increased. Fruit firmness was maximum in CG-82 in vegetable maturity and fruit firmness was reduced in over maturity, fruit girth was also maximum for CG-82 (9.3 Kg/cm^2).

The chemical constituents like moisture, fibre, protein, vitamin C, β-carotene, total phenol, total pectins, mucilage, calcium, phosphorus, iron and potassium were estimated in two different stages of maturity such as vegetable maturity and over maturity in the selected ivy gourd genotypes. The nutrients like vitamin C, β-carotene and total phenol were also analysed in three different stages of vegetable maturity like, just before the day of average vegetable maturity (7th day), at the day of average vegetable maturity (8th day) and just after the day of average vegetable maturity (9th day). The acceptability study of the fruits were conducted at all these stages of vegetable maturity and over maturity.

The results of the study indicated that the highest moisture content in vegetable maturity was in genotype CG-82 (95.33 g/100g). The moisture content in vegetable maturity ranged from 92.85 to 95.33 per cent, with significant difference between the genotypes. In over maturity the moisture content reduced significantly in all genotypes.

The fibre content of the ivy gourd genotypes were significantly higher in over maturity than in vegetable maturity. In vegetable maturity, fibre content ranged from 1.00 to 1.67 per cent and in over maturity, it ranged from 2.17 to 2.33 per cent.

The protein content of the genotypes in vegetable maturity ranged from 1.07 to 1.69 g/100g, and maximum was in genotype CG-81. In over matured fruits protein content did not reduce significantly.

The vitamin C content in ivy gourd genotypes in observed vegetable maturity ranged from 12.69 to 15.84 mg/100g. In over maturity this was significantly reduced to a range of 5.89 to 10.71 mg/100g. In both vegetable maturity and over maturity stage, genotype CG-82 had the maximum vitamin C content.

The β-carotene content of the genotypes ranged from 34.09 to 132.7 μg/100g in vegetable maturity. This was significantly increased in over maturity with a maximum value of 219.56 μg/100g. In both these maturity stages the highest β-carotene content was found in the released variety Sulabha.

The total phenol content of the genotypes in vegetable maturity varied from 0.038 to 0.061 mg/100g and it was significantly reduced in over maturity. In both the maturity stages, CG-82 had the highest phenol content (0.061 mg/100g and 0.031 mg/100g respectively).

Total pectin content in the ivy gourd genotypes varied from 0.20 to 0.47 g/100g in vegetable maturity, and there was no significant reduction in total pectins in over mature stage. The genotype CG-81 had the highest pectin content.

The mucilage content in vegetable maturity of the four genotypes ranged from 0.11 to 0.71 per cent, and mucilage content increased in over maturity with a range of 0.57 to 0.82 per cent. CG-27 had the highest mucilage content in vegetable maturity and in over maturity CG-81 had the highest mucilage content.

Among minerals, calcium, phosphorus, iron and potassium are high in vegetable maturity in all genotypes, and were reduced significantly in over maturity stage. Calcium content was highest in CG-82 in both vegetable maturity and over maturity (37.61 mg/100g and 36.15 mg/100g respectively). Phosphorus was maximum in both the maturity stages in the released variety Sulabha. The iron content of the genotypes ranged from 0.52 to 0.97 mg/100g and the maximum was observed in CG-81 in both the maturity stages. The potassium content ranged from 2.65 to 2.95 mg/100g in vegetable maturity and this was significantly reduced to a range of 2.45 to 2.65 mg/100g in over maturity.

The changes in the nutrients like vitamin C, β-carotene and total phenol in different stages of vegetable maturity i.e., just before the average vegetable maturity (7^{th} day), at the day of average vegetable maturity (8^{th} day) and just after the day of average vegetable maturity (9^{th} day) were also observed. In all genotypes the vitamin C content had reduced as maturity increased. Maximum vitamin C in all genotypes was observed to be higher on the 7th day but there was no significant variation with the day of average vegetable maturity (8th day) except in CG-81. The β-carotene content had increased with maturity, in all genotypes. Lowest β-carotene content was observed in the 7th day and it was significantly increased by the 9th day. So average vegetable maturity is not the stage with maximum β-carotene in ivy gourd genotypes except for CG-27. Total phenol was also reduced as maturity increased, the maximum phenol content was observed in 7th day and there was no significant variation in the day of average vegetable maturity.

Thus with regard to vitamin C, β-carotene and total phenol no significant changes were observed in average vegetable maturity compared with the stage with maximum content of these nutrients, but significantly high β-carotene was observed in over mature stage. Changes in vitamin C, β-carotene and total phenol on average vegetable maturity and observed vegetable maturity revealed that for the genotype, CG-27 both the days were the same (8th day). In other three genotypes, significant variation was not observed in vitamin C content but variation was found in β-carotene and total phenols. β-Carotene was high in the observed vegetable maturity in Sulabha and CG-81 (9th day). In CG-82 β-carotene was significantly low in observed vegetable maturity (7th day).

Since total phenol showed a decreasing trend with maturity, significantly low total phenols were observed in CG-81 and Sulabha in their observed vegetable maturity (9th day after flowering). Total phenol was significantly high in CG-82 in their observed vegetable maturity (7th day after flowering).

The acceptability of the four genotypes of ivy gourd fruits was evaluated using score card. In observed vegetable maturity there was no significant variation in the overall acceptability in between genotypes, but when individual criterias were considered significant difference was observed only with respect to texture in CG-81 and CG-82 with a maximum score of 3.8.

In over mature stage also there was no significant difference in the overall acceptability. Sulabha was the most acceptable genotype in the over mature stage with maximum score for appearance (3.7) and texture (3.5).

Overall acceptability of ivy gourd genotypes in their observed vegetable maturity was high (3.6) when compared to their over mature stage (3.2), and this high acceptability in observed vegetable maturity was mainly contributed by high sensory qualities such as appearance of CG-81 (3.9) colour of CG-82 (3.7) and CG-81 (3.9) texture of CG-81 (3.8) and CG-82 (3.8), flavour of Sulabha (3.7) and CG-81 (3.7) and taste in Sulabha (3.9), CG-82 (4.1) and CG-27 (3.5) in their observed vegetable maturity. Overall acceptability of ivy gourd genotypes was higher in their observed vegetable maturity when compared to their average vegetable maturity.

Acceptability studies on the 7th day after flowering (just before the day of average vegetable maturity), 8th day after flowering (the day of average vegetable maturity) and in the 9th day after flowering (just after the day of average vegetable maturity) revealed that, there was no significant difference in the overall acceptability of genotypes in these maturity days except in the 9th day. When individual criterias were evaluated, acceptability of CG-27 was high with regard to appearance, colour and texture in the 8th day. In this genotype average vegetable maturity and observed vegetable maturity are in the 8th day. Significant variation was not observed in vitamin C, β-carotene and total phenols in the 8th day. So 8th day that is the day of average vegetable maturity can be recommended for CG-27 as its vegetable maturity.

In CG-81, there was no significant difference in individual quality criterias and also in vitamin C and total phenol content in the 7th, 8th and 9th day, but β-carotene was high in the 9th day. In CG-82 also the same trend was observed, but β-carotene content was significantly low on the 7th day, which was its observed vegetable maturity.

In Sulabha, even though there was no significant difference in the overall acceptability during the 7th, 8th and 9th day, taste was highly acceptable during the 9th day, which was its observed vegetable maturity. There was no difference in vitamin C and total phenols but β-carotene was significantly high in the 9th day (observedvegetable maturity). So for Sulabha, vegetable maturity can be considered as 9 days after flowering and also the fruits attained their maximum fruit length and weight by the 9th day.

In over mature stage of all genotypes acceptability was found to be low, so also the nutrients like calcium, phosphorus, iron, potassium and vitamin C decreased significantly. But in all genotypes β-carotene content was significantly high in over mature stage.

From the 67 accessions maintained in the Department of Olericulture, College of Horticulture, only 4 accessions were subjected to the nutritional and organoleptic studies, and based on this results we cannot generalize the characteristics since vide variation are existing in many characteristics in ivy gourd genotypes. Hence changes in nutritional composition and acceptability of the other genotypes are to be evaluated at different stages of maturity levels. Varietal improvement of this genotype with the objective of increasing its nutritional and organoleptic qualities should be given emphasis. Ivy gourd is grown extensively in Kerala and by popularizing the identified high yielding, nutritious and acceptable lines in their proper maturity levels, it will be possible to greatly increase the productivity and acceptability of ivy gourd.

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* Originals not seen

Appendix

APPENDIX-1

Organoleptic evaluation of cooked Ivy gourd

No.	Character	Description	Score	1	2	3	4
1	Appearance	Excellent Good Fair Poor Very poor	5 4 3 2 1				
2	Colour	Excellent Good Fair Poor Very poor	5 4 3 2 1				
3	Texture	Excellent Good Fair Poor Very poor	5 4 3 2 1				
4	Flavour	Excellent Good Fair Poor Very poor	5 4 3 2 1				
5	Taste	Excellent Good Fair Poor Very poor	5 4 3 2 1				

Date: Name & Signature

NUTRITIONAL EVALUATION AND ACCEPTABILITY OF IVY GOURD GENOTYPES (*Coccinia indica* (L.) Voigt)

By

RENJUMOL P.V

ABSTRACT OF THE THESIS

Submitted in partial fulfilment of the requirement for the degree of

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ABSTRACT

Ivy gourd (*Coccinia indica*) is a perennial underexploited cucurbitaceous vegetable grown in the southern, western and eastern parts of India. The study on 'Nutritional evaluation and acceptability of ivy gourd genotypes (*Coccinia indica* (L.) Voigt)' was also to asses the chemical composition and acceptability of four ivy gourd genotypes in different stages of maturity i.e., vegetable maturity and over maturity.

The physical characteristics of the fruits of all genotypes showed variations. Maximum fruit length and fruit weight were observed in the released variety Sulabha. The day for attaining vegetable maturity was 7 days for CG-82 and 9 days for Sulabha and CG-81. Sulabha took 6 days from vegetable maturity to show visible changes of over maturity, where as the other three genotypes over matured within 5 days.

The fruits in vegetable maturity and over maturity were analysed for moisture, fibre, protein, vitamin C, β-carotene, total phenol, total pectins, mucilage, calcium, phosphorus, iron and potassium. There was no significant difference between genotypes in the case of constituents like protein and total pectins. But in other constituents like moisture, fibre, vitamin C, β-carotene, total phenol, mucilage, calcium, phosphorus, iron and potassium, there was significant difference between the genotypes. When compared to vegetable maturity and over maturity, there was significant difference in constituents between these two maturity stages.

The changes in constituents like vitamin C, β-carotene and total phenol analysed in three different stages of vegetable maturity i.e., the day just before the average vegetable maturity (7^{th} day after flowering), the day of average vegetable maturity (8^{th} day after flowering) and the day just after the day of average vegetable maturity (9^{th} day after flowering). Vitamin C and total phenol showed a decreasing trend with increased maturity. But β-carotene content increased as

maturity increased. Changes in vitamin C, β-carotene and total phenol in average vegetable maturity and observed vegetable maturity revealed that there was no significant difference in vitamin C content of all genotypes in these two maturity stages. But in the case of β-carotene and total phenol there observed a significant difference between these two maturity stages.

The acceptability of ivy gourd genotypes revealed that in observed vegetable maturity there was no significant variation in the overall acceptability in between genotypes. In over mature stage also no significant variation was observed in overall acceptability in between genotypes.

Overall acceptability of ivy gourd genotypes in their observed vegetable maturity was found to be more acceptable when compared to their over maturity stage.

Acceptability studies on 7th, 8th and 9th days after flowering indicated that, acceptability of CG-27 with regard to appearance, colour and texture was high in the 8th day, which was also its observed vegetable maturity. Variation was not observed in vitamin C, β-carotene and total phenols in the 8th day. In CG-81 no significant variation was observed in acceptability as well as in vitamin C and total phenols between 7th, 8th and 9th day, but β-carotene was high in 9th day. In CG-82 also the same trend was observed but β-carotene was very low in the 7th day. In Sulabha taste was highly acceptable during the 9th day, which was its observed vegetable maturity. There was no difference in vitamin C and total phenols but β-carotene was high in the 9th day. In all genotypes β-carotene content was significantly high in over mature stage.