PHYSICO-CHEMICAL CHARACTERISTICS OF CUCURBITACEOUS VEGETABLES AVAILABLE IN SOUTH WESTERN REGION OF BANGLADESH

A THESIS
BY
HEMA SAHA

A Thesis

(Course No. AT-6104)

Submitted to the Agrotechnology Discipline in partial fulfillment of the requirement for the degree of Master of Science in Horticulture

AGROTECHNOLOGY DISCIPLINE
KHULNA UNIVERSITY
KHULNA-9208
BANGLADESH

MAY, 2012

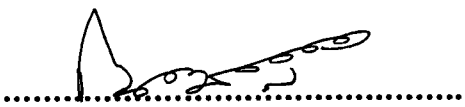
PHYSICO-CHEMICAL CHARACTERISTICS OF CUCURBITACEOUS VEGETABLES AVAILABLE IN SOUTH WESTERN REGION OF BANGLADESH

A THESIS

BY

HEMA SAHA
ROLL NO: MS-100803

Approved as to style and content by



Prof. Dr. Md. Abdul Mannan
Supervisor

Prof. Md. Rejaul Islam
Co-Supervisor

Prof. Dr. Md. Monirul Islam
Chairman
Examination Committee
And Head, Agrotechnology Discipline

AGROTECHNOLOGY DISCIPLINE
KHULNA UNIVERSITY
KHULNA-9208
BANGLADESH

MAY, 2012

DECLARATION

This thesis is entirely based on the candidate's own investigation except for quotations and citations which have been duly acknowledged and no part of this paper has been accepted nor is it being previously or concurrently submitted for any degree.

Submitted By

Hema Saha
Roll No. MS-100803

Supervisor

Prof. Dr. Md. Abdul Mannan
Professor
Agrotechnology Discipline
Khulna University
Khulna-9208
Bangladesh

DEDICATED TO

MY BELOVED PARENTS

&

All FARMERS

OF BANGLADESH

PHYSICO-CHEMICAL CHARACTERISTICS OF CUCURBITACEOUS VEGETABLES AVAILABLE IN SOUTH WESTERN REGION OF BANGLADESH

A THESIS
BY
HEMA SAHA
ROLL NO: MS-100803

MASTER OF SCIENCE
IN
HORTICULTURE

AGROTECHNOLOGY DISCIPLINE
KHULNA UNIVERSITY
KHULNA-9208
BANGLADESH

MAY, 2012

ACKNOWLEDGEMENT

The author would like to express with utmost humble gratitude and endless praises to Omnipotent Almighty God, who enabled the author to complete the research work.

The author has much pleasure to express heartfelt respect, immense indebtedness and deep appreciation to her honorable teacher and Supervisor **Prof. Dr. Md. Abdul Mannan**, Agrotechnology Discipline, Khulna University, Khulna, for his worthy guidance, valuable suggestions, encouragement and continuous supervision throughout the study work and preparation of the thesis.

The author wish to express enormous appreciation and heartiest indebtedness to her Co-Supervisor **Prof. Md. Rejaul Islam**, Agrotechnology Discipline, Khulna University, Bangladesh, for his guidance and kind co-operation.

The author wish to express enormous appreciation and heartiest indebtedness to her supervisor for giving an opportunity to be a part of the project on "Evaluation of Fruit Germplasm Available in the Southwestern Region of Bangladesh on the basis of their Physico-Chemical Characteristics and Genetic Variability by Random Amplified Polymorphic DNA (RAPD) analysis" and also for his financial support, guidance and kind co-operation during the research period.

The author extends her gratefulness to all the teachers of the Agrotechnology Discipline, Khulna University, Khulna, for their valuable advice, suggestions and constructive criticism.

Thanks also to Sk. Mohibullah, Research Assistant, Molecular Horticulture Laboratory, Khulna University for his overall assistance during the study period.

Special thanks are extended to Khulna University Library authority, Seminar Library authority of Agrotechnology Discipline, Khulna University, Khulna, from where the author found valuable information to complete the study.

Finally, the author wish to express boundless gratitude to her parents and other members of her family whose sacrifices, inspiration, and continuous blessings opened the gate and paved the way for her higher studies.

MAY, 2012 **The Author**

ABSTRACT

The study was conducted in the Molecular Horticulture Laboratory, Agrotechnology Discipline, Khulna University, Khulna, during the period from August 2011 to February 2012, with a view to determine the physico-chemical characteristics of 12 selected cucurbitaceous vegetables available in the south-western region of Bangladesh. The study was laid out in Completely Randomized Design (CRD) with three replications. A significant variation was absorbed among the vegetables in relation to vegetative characteristics. The higher values were found from bottle gourd in respect of total weight (1570 g), weight of edible part (1306 g) and non-edible portion (263.7 g) among the 12 selected vegetables. The highest length (47.10 cm) was observed in snake gourd. The highest width (24.93 cm) was recorded in pumpkin. The highest pH value (6.803) was found in teasle gourd. The highest titratable acidity (18.82%) and highest vitamin C (196.1 mg /100 g) was found in bitter gourd (Karala). The highest Iron content was recorded in sponge gourd (5.692 g/ 100 g) and the highest moisture content (97.23%) was found in cucumber. The highest carotenoids (9.30 mg /100 g), flavonoid (5.5g) and anthocyanin (0.153 mg /100 g) were recorded from pumpkin. The highest antioxidant was found in bitter gourd and that was the lowest in sponge gourd and teasle gourd. The overall observation indicates that cucurbitaceous vegetables are rich in nutrients.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

The cucurbitaceae or cucurbit family (also commonly referred to as the cucumber, gourd, melon, or pumpkin family) is a medium-sized plant family, primarily found in the warmer regions of the world. Cucurbitaceae family includes about 119 genera and 825 species. The family is distinct morphologically and biochemically from other families (Rai, 2008).

Cucurbitaceous are distributed mainly in tropical and subtropical regions of the world. Some of its largely represented genera along with their number of approximately reported species include *Momordica* (45) e.g. Bitter gourd, *Cucumis* (25) e.g. Cucumber, muskmelon, *Cucurbita* (15) e.g. pumkin, gourd, squash, *Lagenaria* (6) e.g. Bottle gourd and *Luffa* (6) e.g. Sponge gourd (Anisuzzaman, 2008).

Cucurbitaceous is the largest group of summer vegetables crops. These include cucumber, bottle gourd, bitter gourd, pumpkin, snake gourd, teasle gourd, wax gourd, sponge gourd, pointed gourd and ridged gourd. The fruits of cucurbits are very useful in terms of human health, i.e. purification of blood, remove of constipation, good for digestion, and give energy. Cucurbits (Cucurbitaceous) are among the most important plant families supplying humans with edible products and useful fibers (Rahman, 2006).

Vegetable is important for nutritional, financial, and food security in Bangladesh. However, the availability of vegetable is only about 1/5th of the recommended require amount of 200 g/person/day (Kalloo, 1998).

The area under vegetable farming increased from about 1,71,830 ha to about 1,95,951 ha during 2000-2007. Likewise, the production of vegetable also increased from about 1.09

million tons to about 1.29 million tons during that period. However, summer vegetable cultivation is constrained by adverse climate and pest attacks. The major summer vegetables are pumpkin, bitter gourd, teasle gourd, ribbed gourd, ash gourd etc. (BBS, 2007).

The local name of bottle gourd is panilau and scientific name is *Lagenaria siceraria.* It is cultivated throughout our country. The fruits are eaten as vegetable. The fruits are cooling and very much useful to human health in summer season. White pulp of fruit is cooling, emetic, purgative, diuretic and antibilious. Oil from the seeds is cooling and used to relieve headache (Anisuzzaman, 2008).

Seeds are nutritive and diuretic bottle gourd (lau) is generally a winter crop, *Lageneria vulgaris*, possibly tropical or sub-tropical in origin, rich in carotene, calcium and vitamin C. In Bangladesh it is cultivated in about 10,000 ha, producing about 62,000 m tons; grown by direct sowing or transplanting 15 to 20 day old seedlings; crops are ready for harvest within 55-60 days; yield ranges from 35-40 m tons/ha. Some varieties of bottle gourd are BARI Lau1, Khetlau and Hazari (BARI, 2010).

The local name of pumkin is mistikumra and scientific name is *Cucubrita maxima.* It is a popular summer and rainy season vegetable, good source of carbohydrate, vitamin A and C, and minerals. It is grown in Bangladesh in an area of about 14,000 ha. Pumpkin is thought to be native to Northern and Southern America. It may be grown by sowing seeds directly or transplanting two weeks old seedlings. Fully ripened pumpkins are harvested within 90 days after sowing. Two local varieties of pumpkin are Bikrampuri and Baromashi. The average yield is 20-25 m tons/ha. Leaves, vines, flower and fruits are edible as vegetable (BARI, 2008).

The local name of ash gourd is chalkumra and scientific name is *Benincasa hispida.* It is popularly known as chalkumra, is possibly a native of the subcontinent. It can be grown in any type of soil but loamy to sandy loamy soil is preferred. The optimum time for

sowing seeds is February to March; green fruits are ready for harvest within 45-60 day; matured ones coated with powdery substance are harvested between 80 and 90 day after sowing. Plants are grown from local varieties namely Sachi kumra and Dimi kumra; yield ranges from 20-30 m tons/ha (Rahman, 2006).

The local name of bitter gourd is karala and scientific name is *Momordica charantia.* It is cultivated throughout the country for its fruits which are eaten as vegetable. The fruits (*Ucchya or Karala*) are primarily a summer vegetable, possibly a native of India or South-East Africa. The crop is rich in carotene, calcium and iron; can be grown in any type of soil but loamy to sandy loamy soils are preferred for better growth and quality fruit. Seeds are directly sown in the field. Sometimes seedlings are raised and 15-20 day old seedlings are transplanted in the main field during March to May. Ucchya, the smaller ones, has no specific local variety but the larger one, Karala, has a local variety known as Gaj Karalla. The yield of Ucchya is about 5 m tons/ha and Karala 15-18 m tons/ha (Somanath, 2008).

The local name of teasle gourd is kakrol and scientific name is *Momordica cochinchinensis.* Teasle gourd (*Momordica dioica* Rox.) locally called kakrol belongs to the family Cucurbitaceae. It is relatively small, oval, and grown in summer, is possibly a native of this sub-continent. The fruits are eaten as vegetable. It nutritive components are good for health. Fruits and leaves are used in external application for lumbago, ulceration and fracture of bones. Among the summer vegetables it has high food value. It is rich in protein, carotene, carbohydrate, vitamins (vit C) and minerals, 33 mg Ca, 42 mg P, 4.6 mg Fe and 1620 µg carotene. Some of the local varieties are Manipuri, Amli, Sabuj Tampu, and Barna Tampu; yield ranges from 10-12 m tons/ha (Yousuf, 2001).

The local name of Ridged gourd is Jhinga and scientific name is *Luffa acutangula* , a minor cucurbitaceous vegetable,; originated in India, rich in carbohydrate and calcium. March-April is the optimum time for cultivation; immature fruits are used as vegetable and are ready for harvest after 6 weeks. Fruits contain protein (0.5%), carbohydrate (3%),

carotene (37 mg) and vitamin C (18 mg) per 100 g of edible portion (Anisuzzaman, 2008).

The local name of snake gourd is chichinga and scientific name is *Trichosanthes cucumerina.* It belongs to the family Cucurbitaceae and it is an important summer vegetable in Bangladesh, but it may grow throughout the year except extreme winter. It is a popular vegetable with moderately high nutritive value. It is smooth, greenish white, sometimes stripped, long, slender and cylindrical, often twisted fruit. Fruit length varies from 30-100 cm. It contains fair amount of vitamin A, C and calcium (Yusuf, 2007).

The local name of pointed gourd is patal and scientific name is *Trichosanthes dioica Roxb.* The fruits are 5-9cm, oblong or nearly spherical acute and smooth (Kirtikar and Basu, 1956). The fruits are an affluent source of protein and minerals and are used in conventional system of medicine since ancient times (Sharma et al., 1989; Singh, 1989).

The local name of sponge gourd is dhundul and scientific name is *Luffa cylindrica.* It is a summer vegetable and a native of South Africa. It is a good source of vitamin A, C, iron, and calcium. The immature fruit is ready for harvest as a vegetable after 8 weeks; yields range from 10 to 15 m tons/ha (Azad, 1994).

The local name of Cucumber is Khira or Sasha and scientific name is *Cucumis sativus.* The fruits are edible and very much used as salad. Its fruits are also removed human constipation and good for digestion. The fruits are much used during summer as a cooling food (Rahman, 2006).

The cucurbitaceous crops are extremely important for vegetable production. They are important fresh and processing crops which are increasing in consumption. They are well suited to the climate of this area (Rashid, 1976).

Bangladesh is one of the over populated country in the world where most of the people live below the poverty line. It is difficult to fulfill their nutritional demands. To meet the nutritional demand of the people of Bangladesh, Cucurbit crops can play a vital role as a source of vitamins, minerals and other nutrients. As it grows easily in our country, so it is possible to take it at a cheap rate. The climate of Bangladesh is suitable for Cucurbit crops production and it is cultivated widely (Azad, 1994).

By determining the physical and chemical characteristics of these vegetables it can be possible to obtain its nutritive value and other characteristics. Such types of findings will be used to increase the production of it by inspiring the farmers and other concern people.

The discussion made above indicated that giving attention to increase the production of Cucurbit crops in Bangladesh is very essential to fulfill people's nutritional demand. Unfortunately, the number of mentionable experiment on these vegetables is very few in our country.

So, the present study was undertaken with the following objectives:

- To study the physico-chemical properties of Cucurbitaceous vegetables.
- To assess the antioxidant activity of the selected Cucurbitaceous vegetables.
- To select the better Cucurbitaceous vegetable based on their physico-chemical properties.

CHAPTER II

REVIEW OF LITERATURE

The Cucurbitaceae is a family of medium size, consisting of approximately 120 genera and about 850 species distributed predominantly in the tropical and subtropical regions of the new and old World (Stevens, 2007). Over 90% of the species are found in three main areas: Africa and Madagascar, Central and South America, Malaysia and Southeast Asia (Jeffrey, 1990). Species of the Cucurbitaceae are grown widely around the world as crops. The family is comprised of about 118 genera and 825 species that are primarily cold-sensitive, annual vines (Jeffrey, 1990). Liberty Hyde Bailey coined the term 'cucurbit' in reference to cultivated species in the Cucurbitaceae (Robinson and Decker-Walters, 1997).

Most of the Cucurbits are perennial, herbaceous vines (rarely shrubs or trees) that usually climb by means of branched or unbranched tendrils. Shoot growth is monopodial (Bugnon, 1956; Kumazawa, 1964; Lassnig, 1997). Cucurbits are among the economically most important vegetable crops worldwide and are grown in both temperate and tropical regions (Pitrat *et al.*, 1999; Paris, 2001).

Cucurbitaceae is an important family comprising one of the most genetically diverse groups of food plants. Most of the plants belonging to this family are frost sensitive and drought-tolerant (Whitaker & Bohn, 1950). Some important Cucurbit family members include; gourd, melon, cucumber, squash and pumpkin (Robinson & Decker-Walters, 1999). These are indigenous to both arid and temperate regions of the earth and require long periods of warm, dry weather for their optimal growth (Whitaker & Davis, 1962). The fruits from Cucurbitaceae species are valued for nutritional and medicinal purposes (Jeffrey, 1990).

Cucurbitaceous vegetables are grown throughout Bangladesh; it is extensively grown in some districts such as Khulna, Satkhira Jessore, Dinajpur and Rangpur etc (Rashid *et al.,* 1987).

Although Cucurbitaceous vegetables are most important vegetables but a little study has so far been done on physico-chemical characteristics and developed products of these vegetables in the world.

A review of the available information relating to the present study has been presented below:

Snake gourd:

The plant is well adapted to growth in high rainfall areas. It does not withstand dry soil conditions and requires a plentiful reserve of moisture in the soil; hence it grows in limited areas of the tropics and is often classified as minor cucurbitaceous vegetable (Martin, 1987).

It is a plant with creeping stems and tendrils. The fruits are cylindrical, very long and narrow at both ends, green to white as much as 1.2m long and about 5 – 7 cm in diameter (Dupriez and De-Leener, 1989).

The seeds are flat, grey-brown, sculptured, and narrow at one end and about 1.7cm long (Tindall, 1983).

The edible part of the immature fruit is 86 – 98% per 100g edible portions, it contains water 94g, protein (0.6g), fat (0.3g), carbohydrate (4g), fibre (0.8g), Ca (26mg), Fe (0.3mg), P (20mg), Vitamin B1 (0.02mg), Vitamin B2 (0.03mg), Niacin (0.3mg), Vitamin C (12mg), energy value 70kJ (Siemonsma and Piluck, 1993).

Cucumber:

Cucumber may grow from 1 to 36 inches (2.5 to 91 centimeters) long (Mendoza, 2003). Cucumbers are warm – season plants that grow best from 21-32 °C (70-90°F). Freezing kills the plants and cool weather below 16 °C (60 °F) slows or stops the

growth. Cucurbit seed germinate and emerge in as little as 4 days at a soil temperature of 25 °C (77 °F) and from 6 to 12 days at 20 °C (68 °F) (Mendoza, 2003).

Today, cultivated cucumbers are distributed throughout most temperate and tropical climates and are the fourth most widely grown vegetable crop behind tomato (*Lycopersicon esculentum* Mill.), cabbage (*Brassica oleracea* var. *capitata* L.), and onion (*Allium cepa* L.) (Tatlioglu, 1993).

Teasle gourd:

Teasle gourd (Momordica dioica Roxb.) is a cucurbitaceous vegetable of Indo Malayan origin (Rashid, 1976 and Singh, 1990). It has high food value, contain highest amount of carotene (1620 µg/100g of edible portion) among the cucurbitaceous vegetable (Gopalan *et al.,* 1982). Teasle gourd may be cheap source of vitamins and minerals (Azad, 1944 and Bhuiya *et al.,* 1977).

Pointed gourd:

The fruits are 5-9cm, oblong or nearly spherical acute and smooth (Kirtikar and Basu, 1956). Light green fruit with 10-11 white stripe, Fruit length 11-12 cm, and Average fruit weight 25g, (BARI, 2007).The fruits are an affluent source of protein and minerals and are used unconventional system of medicine since ancient times (Sharma et al., 1989; Singh, 1989).

Pumpkin:

Pumpkin is from genus *Cucurbita* of the family Cucurbitaceae. It includes squash and cucumbers which are grown throughout the tropical and sub tropical countries. There are three common types of pumpkin world-wide, namely *Curcurbita pepo*, *Curcurbita maxima* and *C. moschata* (Lee *et al.,* 2003). Pumpkins are important horticultural crops worldwide which has been used traditionally (Bezold *et al.,* 2003; Loy, 2004). Pumpkin encompasses a wide range of fruit types with regard to size (Tatum *et al.,* 2006).

high nutritive value especially ascorbic acid and iron (Behera, 2004). Deep green fruit color, average fruit weight 100g, Fruit length 17-18cm (BARI, 2006).

The fruit contains 2.1 g of protein, 1.8 mg of iron, 20 mg of calcium, 88 mg of vitamin C, 55 mg of phosphorus and 210 I.U. of vitamin A in 100 g of edible portion (Longman, 1995).

Ash Gourd:

Ash gourd also known as winter melon, white gourd or fuzzy melon is an annual vine grown and eaten as a vegetable. There are a variety of gourds where ash gourd is one variety which is almost round or oval in shape. It is the only member of the genus *Benincasa*. Light green attractive fruit, Fruit length 18-20 cm, cm in diameter , Average fruit weight1.0 to 1.2 kg (edible weight) (BARI, 2006). Ash gourd contains plenty of moisture and petite amounts of fat, protein, fibre and carbohydrates, apart from calcium, phosphorous, iron, riboflavin, thiamine, niacin and Vitamin C.

Sponge gourd:

In commercial fruits, the average length was 0.90 m, the top diameter average was 6.23 cm, the middle diameter average was 8.17 cm, the average basal diameter was 10.63 cm and the diameter uniformity was 1.30 (Siqueira and Gonçalves, 2007). Dhundul is a good source of vitamin A, C, iron, and calcium (Monowar & Matiar, 2006).

Ridged Gourd:

Early to main season variety (summer), attractive deep green color, large elongated fruit, average fruit weight 125 g (BARI, 2008). Leaves are scabrous, 5-angled or shallowly lobed. Flowers are solitary, yellowish in color. Fruits are elongate or club-shaped. Young tender fruits are used as vegetables. Fruit is demulcent, diuretic and nutritive (Rahman, 2006). Fruits contain protein (0.5%), carbohydrate (3%), carotene (37 mg) and vitamin C (18 mg) per 100 g of edible portion.

Ridge gourd is originated in India. It is cultivated in the tropics for its tender edible fruits both on commercial scale and in kitchen gardens throughout India. It is popular vegetable both as springsummer and rainy season crop. It is cultivated in India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka and Taiwan. Wide genetic variation for various morphological fruit characteristics is observed in different parts of India. (Jitendrakumar, 2005).

It is essentially old world genus, consisting of two cultivated and two wild species besides only one wild new world species. It is rather difficult to assign with accuracy the indigenous areas of *Luffa* species. They have a long history of cultivation in the tropical countries of Asia and Africa. The name *Luffa* or Loofah is of Arabic origin, because sponge characteristic has been described in Egyptian writings and Chinese name Szkua-dish cloth gourd or towel gourd signifies its early mention in Chinese literature (Doijode, 2002).

From the above review of literature it is revealed that a wide variation is found in respect of physico-chemical characteristics of Cucurbitaceous vegetables but less number of research works has been done on these vegetables in Bangladesh. Therefore the present study was undertaken to evaluate the physico-chemical properties of twelve cucurbits vegetables available in the south western region of Bangladesh.

CHAPTER III

MATERIALS AND METHODS

Physico-chemical characteristics of Cucurbitaceous vegetables were carried out during the period from August, 2011 to February, 2012. In the study 12 vegetables were studied which were collected randomly from south western region of Bangladesh. The collected vegetables were brought to the Molecular Horticulture Laboratory of the Agrotechnology Discipline of Khulna University, Khulna. In the laboratory the vegetables were studied to determine their physico-chemical characteristics.

3.1 Experimental design

The experiment was laid out in Completely Randomized Design (CRD) with three replications. After collecting the vegetables were kept in ambient temperature for the study of physico-chemical characteristics.

3.2 Experimental materials

The mature Cucurbitaceous vegetables were selected as the experimental materials for the investigation. These vegetables were collected from different places of south western region of Bangladesh.

3.3 Methods of studying parameters

By using the following methods physical and chemical parameters of the collected Cucurbitaceous vegetables germplasm were studied.

3.3.1 Physical parameter

3.3.1.1 Shape of vegetables

Different vegetables shape was found, such as ovate, oblate, round, long etc by using manual books.

3.3.2.2 Determination of total soluble solids (TSS)

Equipment:

Hand refractometer

Procedure

A drop of juice from the pulp of vegetables was placed on the prism of the refractometer and percentage of total soluble solid was obtained from direct reading. Temperature correction was made as described by Ranaganna (1979).

3.3.2.3 Determination of titratable acidity in vegetables pulp

Vegetables contain organic and inorganic acids. Only phosphoric acid among inorganic acids is present in vegetables. These acids are important constituents in vegetables as together with sugars, they determine quality and taste of the vegetables. Maturity of many vegetable for their harvest is also judged from their level of acids along with sugars or the soluble solids.

Reagents:

A. Sodium hydroxide (NaOH): 0.1normality (N).

B. Indicator: Phenolphthalein ($C_{20}H_{14}O_4$) [approx. 0.5 % in 80% ethanol (W/V)].

Equipment:

Ten milliliter pipette, 25 ml burette, small glass funnel, dropper, blender, 250 ml measuring cylinder, burette stand and beaker.

Procedure:

- A known amount of tissue sample by weight was taken. This was extracted with distilled water by through crushing in blender. Extract was filtered and the filtrate was made up to 100 ml with distilled water.

- A known amount of aliquot was taken into a conical flask. Three to four drops of phenolphthalein solution were added to this aliquot and shaken well.
- A burette was filled with the sodium hydroxide solution after washing and rinsing.
- Titration was done and end point was determined by the appearance of pink color and its persistence for at least 10 to 15 seconds.

Calculation

In term of citric acid 1 ml of 0.1N NaOH solution can neutralize 0.064 g of citric acid. Therefore percentage of titratable acidity in the sample as equivalent of citric acid

$$\% \text{ Titrable acidity} = \frac{d \times 0.064 \times c}{a \times b} \times 100$$

Where,

a = Weight of sample.

b = Volume of aliquot taken for examination.

c = Volume made with distilled water.

d = Average burette reading for sample.

Observation Chart

Serial No	Initial burette reading	Final burette reading	Volume of alkali consumed
1			
2			
3			

3.3.2.4 Determination of vitamin C (ascorbic acid) content

Apparatus: Volumetric flask 250 ml, conical flask 250 ml, beaker 150 ml, blender, burette 250 ml and pipette.

Reagents used for the estimation of vitamin C content

3% meta phosphoric acid (HPO_3): 3 percent in distilled water (w/v).

2,6-dicholorophenol indophenol (C12H6C2NNaO2): 2,6- dicholorophenol indophenol ($C_{12}H_6NNaO_2$, $2H_2O$) solution 0.025 percent [50 mg 2,6- dicholorophenol indophenol is weighted and taken in a beaker.42 mg sodium bicarbonate (Na2 HCO3) is added to it. It is then dissolved in little amount of distilled water and the volume is made up to 200 ml with distilled water].

Preparation of standard ascorbic acid solution: 0.01 percent in 3 percent met phosphoric acid (w/v).

Standardization of dye solution: The dye solution is needed to be standardized simultaneously. For this 5 ml of standard ascorbic acid solution was taken in a clean beaker to which 5 ml of 3% meta phosphoric acid solution was added with the help of a pipette. This solution was titrated against the dye till a faint pink color was obtained which persisted for more than 15 seconds.

Estimation of ascorbic acid

A known amount of vegetables flesh was weighed and blended it with equal weight of 3% meta phosphoric acid for 3 to 4 minutes. A known amount of this slurry was used in a 100 ml volumetric flask and volume was made by adding 3% meta phosphoric acid. This juice was filtrated through a fast filter paper (Whatman No. 42).

Titration

The burette was filled with standardized 2, 6-dichlorophenol, indophenols dye reagent.10 cc of filtered solution was taken in a conical flask and titrated immediately against standard dye solution, till faint pink color was observed which persisted for not less than 15 seconds.

Observation Chart

Serial No.	Initial burette reading	Final burette reading	Volume of alkali consumed (ml)
1			
2			
3			
Mean			

Calculation:

The dye factor (d) = 0.5/Average burette reading for standardization of dye solution vitamin-C content in the sample is determined by the following formula

$$\text{Vitamin-C (mg per 100 gm)} = \frac{e \times d \times b}{c \times a} \times 100$$

Where,

a = Weight of sample

b = Volume made with meta phosphoric acid

c = Volume of aliquot taken for estimation

d = Dye factor

e = Average burette reading for sample

3.3.2.5 Determination of carotenoids of vegetables pulp

Materials

Acetone AR grade 80%

Procedure

1. A known amount of finely cut vegetables sample was weighed by an electric balance.

2. The vegetables sample was mixed well into a clean mortar.

3. The tissue sample was grinded to a fine pulp with addition of 20 ml of 80 % acetone.

4. It was centrifuged at 5000 rpm for 5 minutes and transferred the supernant to a 100ml of volumetric flask.

5. The residue was grinded with 20ml of 80% acetone, centrifuged and transferred the supernant to the same flask.

6. The procedure was repeated until the residue was colourless. The pestle and mortar were washed thoroughly with 80 % acetone and the clear washing was collected in the flask.

7. The volume was made to 100 ml with 80% acetone.

8. The absorbance was read at 510 nm and 480 nm against blank.

Calculations

$$\text{mg carotenoids / g tissue} = 7.6(A.480) - 1.49(A.510) \times \frac{V}{1000 \times 10}$$

Where,

A= Absorbance of the specific wave length.

V=Final Volume of the carotenoids in 80% acetone

W= Fresh weight of the tissue extracted

3.3.2.6 Determination of anthocyanin of vegetables pulp

Principle

Anthocyanin is extracted with ethanolic-hydrochloride and the intensity of the color appeared is measured calorimetrically. From the reading, the amount of the pigment present is determined.

Reagents

(A) Ethanol: 95%

(B) Hydrochloric acid (HCl): 1.5 N.

(C) Ethanol -hydrochloric acid mixture: It was prepared by mixing 85 parts of reagent A and 15 parts of regent B by volume.

Procedure

1. A known amount of tissue sample by weight was taken. This was extracted with ethanol hydrochloric acid mixture. It was allowed to stand overnight at a temperature of about 4°C.

2. After extraction, the mixture was filtered through filter paper (Whatman No.1). The extraction was repeated for maximum recovery of the pigment.

3. The extract was then made up to 15 ml with the solvent.

4. 15 ml of aliquot from the above extract was taken. It was filtered through fine (milli-pore) filter paper.

5. The filtered aliquot was maintained in darkness for about 2 hours with cover of the container.

6. This was then made up to 25 ml with the solvent (for colour measurement). The optical density (O.D.) value of the solution was then measured through 535nm wavelength in a colorimeter against blank.

Calculation

$$\text{Total asbsorbance value of the sample (per 100g)} = \frac{e \times b \times c}{d \times a} \times 100$$

Where,

a = Weight of sample

b = Volume made for color measurement

c = Total volume made

d = Volume of aliquot taken for estimation

e = Volume for 535 nm

Anthocyanine (mg/100g) = total absorbance/98.2

3.3.2.7 Determination of moisture content of vegetables pulp

Preparation of the material

Comminute material for analysis blender for 1 to 2 minute. It should not be over heated and it will be passed through No. 60 sieve and it should be put in air light container.

Procedure

3 g sample in duplicate in pre-dried and pre-weight 7 cm. dai. aluminium dishes would be taken. The dish cover would be removed and put them in vacuum over and dry for 6 hours at 70 degree celcious and 26-28 inch vacuum. During this process, a slow current of air 92 bubbles per second) dried by passing H_2SO_4 should be admitted to oven. The cover should be replaced, cooled it in desiccators and weighted again.

Calculations

% Moisture =loss in weight ×100 /weight of sample

3.3.2.8 Determination of flavonoids of vegetables pulp

Reagent

(A) 80% methanol.

Procedure

1. 10g of sample was taken and crushed finely.
2. 100 ml of 80% methanol was added and kept it in a water bath for 10 hours at 40^0C.
3. The whole solution was filtered through a filter paper.
4. The filtrate was transferred to a crucible and then evaporated to dryness over a water bath at room temperature.
5. The final finding was weighed as flavonoids.

3.3.2.9 Determination of antioxidant of vegetables pulp

Antioxidant is the type of molecule that neutralizes harmful compounds called free radicals that damage living cells, spoil food, and degrade materials such as rubber, gasoline, and lubricating oils. Antioxidants can take the form of enzymes in the body, vitamin supplements, or industrial additives. They are routinely added to metals, oils, foodstuffs, and other materials to prevent free radical damage.

During investigation both qualitative & quantitative analysis was performed.

3.3.2.9. A Qualitative assay

Principle

A Suitably diluted (methanol used as solvent) stock solutions were spotted on pre-coated silica gel TLC plates and the plates were developed in solvent systems of different polarities (polar, medium polar and non-polar) to resolve polar and non-polar components of the extract. The plates were dried at room temperature and were sprayed with 0.02% 1, 1-diphenyl-2-picryl hydrazyl (DPPH) in ethanol. Bleaching of

DPPH by the resolved bands was observed for 10 minutes and the color changes (yellow on purple background) were noted. DPPH forms deep pink color when it is dissolved in ethanol. When it is sprayed on the chromatogram of the extract, it forms pale yellow or yellow color which indicates the presence of antioxidants.

3.3.2.9. B Thin layer chromatography (TLC) technique

Apparatus used

- TLC plates containing fluorescent material.
- TLC jar.
- Fine capillary tube.
- Spirit lamp.
- Spray gun
- Hot plate.
- Filter paper

Reagents used

- DPPH (0.02 % w/v) solution in ethanol
- Distilled water.
- Methanol.
- Chloroform.
- Ascorbic acid (as standard substance)

Table: Solvent system used

Groups	Solvent system	Ratio
Polar	$CHCl_3$: CH_3OH : H_2O	40:10:1

Methods

TLC plate preparation

Commercially available TLC plate is cut into appropriate size of 10 cm long and 7 cm wide.

Sample application

- A fine capillary tube was used as spotter for sample application in the TLC plates.
- A very little amount of plant extract was taken in a small vial and diluted suitably with methanol.
- The sample was spotted in uniform size (about 0.3 cm) on TLC plates.
- The sample was applied several times in each spot to get better chromatogram.
- Each spot was dried before applying another volume of solution to the same spot.
- Solvent front was scratched by a knife.
- Two plates were spotted in such a manner.

Development of chromatogram

- The chromatogram was developed by ascending technique.
- These plates were then kept in a jar containing a solvent system of chloroform and methanol and water (40:10:1).
- A Filter paper was kept into the jar by wetting with solvent system to keep jar saturated and the jar was closed tightly.
- The plates were placed in the jar in such a manner that the sample spots were just above the solvent surface.
- The solvent were allowed to move up the plates by capillary action until they have traveled a distance of about 7-8 cm from the point of application of the sample on a 10 cm plate.
- The plates were then removed from the jar and dried with a current of air suitably.

Antioxidant positive components detection

- Two plates from polar solvent systems were observed visually under UV light and various regions were marked.
- After these plates ware sprayed with 0.02% DPPH.

Observation

After applying DPPH on the TLC plate, yellow color on purple background was observed which indicated the presence of antioxidant components in the methanolic extract of twelve cucurbitaceous vegetables

(Chloroform: Methanol: Water= 40:10:1)

Quantitative analysis:

Radical-scavenging activity of antioxidants

Apparatus used

- Test tubes
- Beakers
- Magnetic stirrer
- Thermometer
- UV spectrophotometer (double beam)
- Electronic balance

Reagents used

- Methanol
- 0.004% DPPH methanolic solution
- Ascorbic acid (as positive control)

Method

- At first 10 test tubes were taken to make aliquots of 9 conc. (1.57, 3.13, 6.25, 12. 5, 25, 50, 100, 200 and 400) µg/ml for plant extract & 7 test tubes were taken to make aliquots of 7 conc.(1.57, 3.13, 6.25,12.5, 25, 50,100) µg/ml for ascorbic acid.
- Plant extract and ascorbic acid were weighed 3 times and dissolved in ethanol to make the required concentrations by dilution technique. Here ascorbic acid was taken as positive control.
- DPPH was weighed and dissolved in ethanol to make 0.004% (w/v) solution. To dissolve homogeneously magnetic stirrer was used.
- After making the desired concentrations, 6 mL of 0.004% DPPH solution was applied on each test tube by pipette and then 2 mL of different concentrations was mixed in each test tube.
- Test tubes were kept for 30 minutes in dark to complete the reactions.
- DPPH was also applied on the blank test tubes at the same time where only 2mL ethanol was taken as blank.
- After 30 minutes, absorbance of each test tube was determined by UV spectrophotometer at 517 nm.

- % of inhibition was calculated as-

% inhibition = [(Blank absorbance - Sample absorbance) / Blank absorbance] X 100.

- IC_{50} was determined from % inhibition vs. concentration graph.

3.3.2.10 Iron content in vegetables pulp and water

Reagents

1. Conc. H_2SO_4

2. Saturated potassium persulphate solution: 3.5-4.0g of iron frees potassium persulphate and mix in 50 ml of water in a Stoppard glass bottle was taken, kept under refrigeration and shakes it well before use.

3. 3N potassium thiocyanate solution: dissolve 73 g of potassium thiocyanate in water and made the volume 250ml and filter. Added 5-10 ml of acetone for prolonged use.

4. Standard iron solution: 0.351 g of ferrous ammonium sulphate was dissolved in 50 ml water. Added 3-5 ml cone.H_2SO_4, heat slightly and add cone. KMnO4 continuously till a single drop make the solution colored. This solution was transferred to one liter volumetric flask and makes the volume. It becomes 0.1 mg Fe per ml solution.

Procedure

Three cylinder viz, one for blank to which 5 ml water, 0.5 ml cone.H_2SO_4 2 ml potassium persulphate and 4 ml of potassium thiocyanate are added; second for standard, to which 1 ml standard solution ,4 ml H_2O, 0.5ml cone.H_2SO_4, 2 ml potassium persulphalc and 4 ml potassium thicnyanate are added and third cylinder to which 5 ml of sample, 0.5 ml cone H_2SO_4, 2 ml potassium persulphate and 4 ml potassium thiocyanate are added and the absorbance of each is measured at 480 nm setting the blank at 100% transmitted.

Calculation

%Fe= (Absorbance of sample×0.1×Volume of sample×100)/ (Absorbance of standard ×5×weigt of sample).

3.4 Statistical Analysis

The collected data from experiment were statistically analyzed by analysis of variance (ANOVA). Duncan's Multiple Range Test (DMRT) was used to compare the means of different parameters and the means were calculated by using "MSTATC" programmed in computer.

gourd (29.97 cm), ridge gourd (29.67 cm), pumpkin (23.47cm) and bitter gourd (Karala) (20.68 cm). Bitter gourd (Ucche) was found the shortest vegetable (10.03 cm) preceded by pointed gourd (10.70 cm) which was statistically similar to teasle gourd (10.90 cm). Various length of vegetable occurred due to the variation of vegetable shape and size (Table 1).

4.1.1.3 Width of vegetables

Significant variation was found in respect of width among the 12 vegetables (Appendix 1). The broadest vegetable (24.93 cm) was found in pumpkin followed by ash gourd (13.00 cm) and bottle gourd (8.9cm). The narrowest (3.311 cm) was measured from snake gourd which was statistically similar to pointed gourd (3.589 cm), bitter gourd (Ucche) (4.067cm), ridge gourd (4.11cm), bitter gourd (Karala) (4.467 cm), cucumber (Shasa) (5.167 cm) and sponge gourd (5.2 cm) (Table 1).

4.1.1.4 Weight of non-edible portion

There was found significant variation among the 12 vegetables in relation to weight of non- edible portion (Appendix I). The maximum weight of non-edible portion (263.7 g) was found in bottle gourd followed by pumpkin (149.4 g), sponge gourd (104g) and ridge gourd (81.85g). The minimum weight (7.62 g) was measured from teasle gourd preceded by the pointed gourd (8.927 g), snake gourd (9.327g) and cucumber (Khira) (10.36g). Therefore, there was no non-edible portion in bitter gourd (Karala) (Table 1).

4.1.1.5 Weight of edible portion

Significant difference was found among the 12 vegetables in respect of weight of edible portion (Appendix I). It was observed from the data that the maximum weight of edible portion (1306 g) was found in bottle gourd which was followed by pumpkin (1219 g) and ash gourd (1101 g). The minimum weight (38.49 g) was measured from bitter gourd (Ucche) which was statistically similar to the pointed gourd (46.70 g), teasle gourd (112.5 g), ridge gourd (165.8 g) and snake gourd (193.5 g) (Table 1).

Table 1. Physical characteristics of Cucurbitaceous vegetables

SL No	Name of vegetables	Weight (g)	Length (cm)	Width (cm)	Skin Color	Skin weight (g)	Skin Thickness (mm)	Weight of edible part (g)	Weight of non-edible part (g)
1	Sponge gourd	314.8 c	29.97 b	5.200 d	Green	104.0 a	1.573 a	210.7 bc	104.0 bc
2	Teasle gourd	120.1 c	10.90 cd	5.800 d	Light Green	0.0000 d	0.0000 e	112.5 bc	7.622 c
3	Ridge gourd	247.6 c	29.67 b	4.111 d	Deep Green	81.85 ab	1.357 b	165.8 bc	81.85 bc
4	Pointed gourd	55.62 c	10.70 cd	3.589 d	Green with white stripe	8.927 cd	0.7200 d	46.70 c	8.927 c
5	Bitter gourd (Karala)	213.7 c	20.68 bcd	4.467 d	Deep Green	0.0000 d	0.0000 e	213.7 c	0.0000 c
6	Snake gourd	202.8 c	47.10 a	3.311 d	Green/White	9.327 cd	0.0000 e	193.5 bc	9.327 c
7	Cucumber (Shasa)	267.5 c	17.80 bcd	5.167 d	Light Green	13.23 cd	0.6333 d	254.3 bc	13.23 c
8	Bitter gourd (Ucche)	49.50 c	10.03 d	4.067 d	Green	0.0000 d	0.0000 e	38.49 c	11.01 c
9	Cucumber (Khira)	333.9 c	17.67 bcd	6.300 cd	Brown	29.93 cd	0.6200 d	323.5 b	10.36 c
10	Bottle gourd	1570 a	14.02 cd	8.900 c	Green	114.0 a	0.7733 d	1306 a	263.7 a
11	Pumkin	1355 ab	23.47 bc	24.93a	Brown	110.1 a	1.170 c	1219 a	149.4 b
12	Ash gourd	1152 b	19.18 bcd	13.00 b	Light Green	50.56 bc	0.5867 d	1101 a	50.56 bc
Level of significance		0.01	0.01	0.01		0.01	0.01	0.01	0.01
C.V		25.76%	24.29%	17.35%		42.19%	13.65%	24.07%	73.60%

Note: In a column figures having similar letters do not differ significantly whereas figures having dissimilar letters differ significantly as per DMRT.

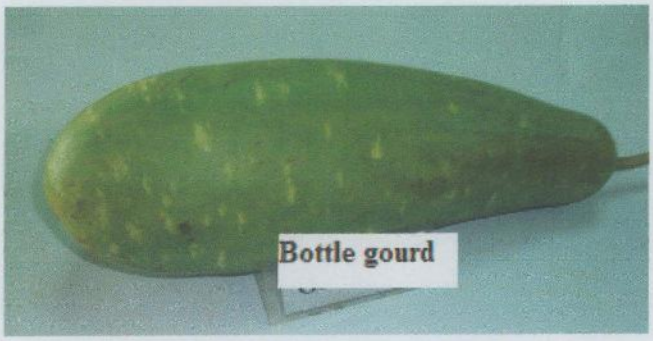


Plate 10.Maximum weight (Bottle gourd)

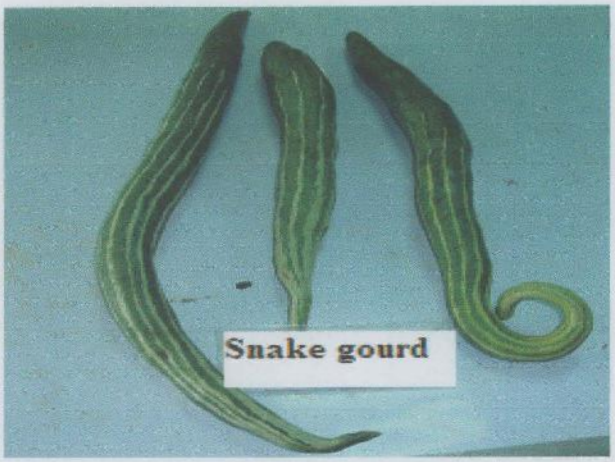


Plate 06. Longest Cucurbit crops (Snake gourd)

Plate 11. Broadest cole crop (Pumpkin)

4.1.2 Chemical characteristics of Cucurbitaceous vegetables

4.1.2.1 pH of vegetables pulp

There was a significant variation among the 12 vegetables in respect of pH (Appendix II). The highest pH value (6.803) was found in teasle gourd which was statistically similar to sponge gourd (6.52), ridge gourd (6.50) and pumpkin (6.277). The lowest pH value (4.86) was found in cucumber (Shasa) preceded by bottle gourd (5.023), ash gourd (5.057), cucumber (5.47), snake gourd (5.52) and bitter gourd (Karala) (5.67) (Table 2).

4.1.2.2 Total soluble solids of vegetable pulp

The difference of total soluble solids was significant among the 12 vegetables (Appendix II). The highest percentage of TSS (7.40%) was observed from pumpkin followed by ridge gourd (4.7%) and sponge gourd (4.1%). The lowest percentage of total soluble solids (1.80%) was observed from cucumber (Shasa) which was statistically similar to bottle gourd (2.20%), snake gourd (2.53%) and cucumber (Khira) (3.033%) (Table 2). Increase in total soluble solid may be attributed to increase in soluble sugar, soluble pectin, soluble organic acids etc.

4.1.2.3 Titratable acidity of vegetable pulp

The titratable acidity showed significant variation among the 12 vegetables (Appendix II). The highest percentage of titratable acid (18.82%) content was found in bitter gourd (Karala) which was statistically similar to bitter gourd (Ucche) (18.56%), teasle gourd (15.79%) and ash gourd (14.29%). The lowest percentage of titratable acid (1.664%) content was recorded from bottle gourd which was statistically similar to snake gourd (2.026%) and sponge gourd (2.638) (Table 2).

4.1.2.4 Vitamin C (Ascorbic acid) content of vegetable pulp

There was a significant variation among the 12 vegetables in respect of vitamin C content (Appendix II). The highest vitamin C (196.1 mg /100 g) was found in bitter gourd (Karala) followed by bitter gourd (Ucche) (173.8 mg /100 g), teasle gourd (149.0 mg /100 g), ash gourd (137.8 mg/100g) and pointed gourd (102.7 mg/100g). The lowest amount of ascorbic acid (17.34 mg /100 g) was observed from bottle gourd which was statistically similar to snake gourd (21.12 mg /100 g), sponge gourd (27.49 mg /100 g), cucumber (Shasa) (33.72 mg/100g), ridge gourd (40.02 mg/100g) and cucumber (Khira) (40.46 mg/100g) (Table 2).

4.1.2.5 Carotenoids content of vegetable pulp

Carotenoids content of vegetable pulp showed significant difference among the 12 vegetables (Appendix II). The maximum amount of carotenoids (9.30 mg /100 g) was found in pumpkin followed by teasle gourd (1.10 mg /100 g), bitter gourd (Karala) (0.2190 mg/100g), ridge gourd (0.2137 mg/100g) and pointed gourd (0.1853 mg/100g). The minimum amount of carotenoids (0.0110 mg /100 g) was observed from cucumber (Khira) (Table 2).

4.1.2.6 Flavonoid content of vegetable pulp

From the 12 vegetables, highest flavonoid observed in pumpkin (5.5g) followed by teasle gourd (3.24 g), pointed gourd (2.76 g), sponge gourd (2.74g) and bitter gourd (Ucche) (2.615g). The lowest found in ridge gourd (0.86 g) preceded by bottle gourd (0.95 g), snake gourd (0.996 g), cucumber (Khira) (1.235 g) and cucumber (Shasa) (1.424) (Table 2).

4.1.2.7 Anthocyanin content of vegetable pulp

The difference of anthocyanin content of vegetable pulp was significant among the 12 vegetables (Appendix II). The highest amount of anthocyanin (0.153 mg /100 g) was observed from Pumpkin followed by bitter gourd (Karala) (0.1356 mg /100 g) and bitter gourd (Ucche) (0.113 mg/100g). The least amount of anthocyanin (0.05767 mg /100 g) was observed from cucumber (Khira) which was statistically similar to

cucumber (Shasa) (0.063 mg /100 g), bottle gourd (0.067 mg/100g) and ridge gourd (0.067 mg /100 g) (Table 2).

4.1.2.8 Iron content of vegetable pulp

The highest Iron was found in sponge gourd (5.692 g/ 100 g) followed by pointed gourd (3.687 g/ 100 g) and pumpkin (3.401 g/ 100 g). The lowest iron was found in cucumber (Khira) (2.325g/100g) preceded by cucumber (Shasa) (2.33 g/100 g), ridged gourd (2.441 g/100g), snake gourd (2.505 g/100 g), bottle gourd (2.661 g/100g), teasle gourd (2.722 g/100g), bitter gourd (Ucche) (2.743 g/100g) and bitter gourd (Karala) (2.791 g/100g) (Table 2).

4.1.2.9 Moisture content of vegetable pulp

The highest moisture (97.23 g /100g) was found in cucumber (Khira) followed by cucumber (Shasa) (97.10 g/100g), ash gourd (96.67 g /100g), bottle gourd (96.40 g /100g) and ridged gourd (96.13 g/100g). The lowest moisture (89.3 g /100g) found in teasle gourd which was statistically similar to pumpkin (90.17 g /100g), bitter gourd (Karala) (91.50 g /100g), bitter gourd (Ucche) (93.30 g/100g) and snake gourd (93.40 g/100g) (Table 2).

4.1.2.10 Anti oxidant content of vegetable pulp

After applying DPPH on the TLC plate, yellow color on purple background was observed which indicated the presence of antioxidant components in the methanol extract of twelve cucurbitaceous vegetables

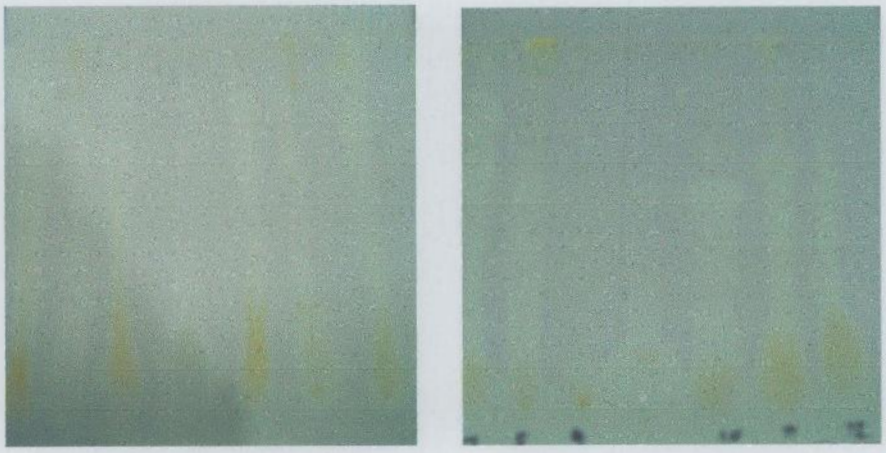


Figure 1. TLC plate for 12 vegetables after applying DPPH

Table 3.1 Absorbance of blank solution

Blank	1st reading	2nd reading	3rd reading	Average
solution	0.78	0.79	0.79	0.787

Table 3.2 Absorbance of ascorbic acid (standard) at different concentration

Concentrations	1st reading	2nd reading	3rd reading	Average	Inhibition (%)
1.57 µg/ml	0.59	0.6	0.61	0.6	23.76111817
3.13 µg/ml	0.53	0.54	0.55	0.54	31.38500635
6.25 µg/ml	0.49	0.5	0.48	0.49	37.73824651
12.5 µg/ml	0.36	0.37	0.35	0.36	54.2566709
25 µg/ml	0.14	0.14	0.14	0.14	82.21092757
50 µg/ml	0.088	0.086	0.087	0.087	88.94536213
100 µg/ml	0.068	0.069	0.07	0.069	91.23252859
200 µg/ml	0.05	0.051	0.053	0.051333333	93.47734011
400 µg/ml	0.041	0.042	0.043	0.042	94.66327827

Table 3.3 Absorbance extract of sponge gourd (Dhundul)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.7	0.731	0.71	0.713666667	9.318085557
3.13µg/ml	0.69	0.68	0.689	0.686333333	12.79119017
6.25 µg/ml	0.683	0.679	0.681	0.681	13.46886912
12.5 µg/ml	0.671	0.669	0.67	0.67	14.86658196
25 µg/ml	0.667	0.661	0.664	0.664	15.62897078
50 µg/ml	0.606	0.605	0.606	0.605666667	23.04108429
100 µg/ml	0.54	0.47	0.51	0.506666667	35.62049979
200 µg/ml	0.39	0.4	0.39	0.393333333	50.02117747
400 µg/ml	0.29	0.35	0.32	0.32	59.33926302

Table 3.4 Absorbance extract of teasle gourd (Kakrol)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.74	0.75	0.758	0.749	4.786107582
3.13µg/ml	0.69	0.68	0.69	0.687	12.74883524
6.25 µg/ml	0.66	0.67	0.65	0.660	16.13722999
12.5 µg/ml	0.63	0.62	0.63	0.627	20.37272342
25 µg/ml	0.57	0.58	0.57	0.573	27.14951292
50 µg/ml	0.51	0.52	0.51	0.513	34.7734011
100 µg/ml	0.43	0.43	0.44	0.433	44.93858535
200 µg/ml	0.36	0.37	0.39	0.373	52.56247353
400 µg/ml	0.31	0.32	0.31	0.313	60.18636171

Table 3.5 Absorbance extract of ridge gourd (Jhinga)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.72	0.73	0.725	0.725	7.878017789
3.13µg/ml	0.64	0.637	0.639	0.639	18.84794579
6.25 µg/ml	0.59	0.6	0.61	0.600	23.76111817
12.5 µg/ml	0.55	0.558	0.562	0.557	29.26725964
25 µg/ml	0.51	0.519	0.515	0.515	34.60398136
50 µg/ml	0.46	0.465	0.469	0.465	40.95722152
100 µg/ml	0.37	0.36	0.37	0.367	53.40957222
200 µg/ml	0.31	0.32	0.29	0.307	61.0334604
400 µg/ml	0.25	0.26	0.25	0.253	67.81024989

Table 3.6 Absorbance extract of pointed gourd (Patal)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.73	0.735	0.74	0.735	6.607369759
3.13µg/ml	0.67	0.675	0.674	0.673	14.48538755
6.25 µg/ml	0.63	0.63	0.628	0.629	20.03388395
12.5 µg/ml	0.58	0.59	0.59	0.587	25.45531554
25 µg/ml	0.52	0.53	0.535	0.528	32.86742906
50 µg/ml	0.47	0.475	0.48	0.475	39.64421855
100 µg/ml	0.41	0.415	0.425	0.417	47.05633206
200 µg/ml	0.35	0.358	0.36	0.356	54.76493011
400 µg/ml	0.28	0.285	0.29	0.285	63.78653113

Table 3.7 Absorbance extract of Cucumber (Shasa)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.65	0.658	0.66	0.656	16.6454892
3.13µg/ml	0.589	0.59	0.595	0.591	24.86234646
6.25 µg/ml	0.54	0.548	0.539	0.542	31.08852181
12.5 µg/ml	0.48	0.485	0.49	0.485	38.37357052
25 µg/ml	0.439	0.443	0.445	0.442	43.79500212
50 µg/ml	0.409	0.411	0.414	0.411	47.73401101
100 µg/ml	0.364	0.365	0.366	0.365	53.62134689
200 µg/ml	0.334	0.338	0.34	0.337	57.13680644
400 µg/ml	0.259	0.258	0.258	0.258	67.17492588

Table 3.8 Absorbance extract of snake gourd (Chichinga)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.668	0.672	0.675	0.672	14.65480729
3.13µg/ml	0.661	0.663	0.664	0.663	15.79839051
6.25 µg/ml	0.649	0.651	0.653	0.651	17.28081321
12.5 µg/ml	0.623	0.625	0.627	0.625	20.58449809
25 µg/ml	0.575	0.576	0.577	0.576	26.81067344
50 µg/ml	0.521	0.522	0.523	0.522	33.67217281
100 µg/ml	0.379	0.398	0.399	0.392	50.1905972
200 µg/ml	0.29	0.305	0.31	0.302	61.66878441
400 µg/ml	0.25	0.256	0.26	0.255	67.55612029

Table 3.9 Absorbance extract of bitter gourd (Karala)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.64	0.648	0.65	0.646	17.91613723
3.13µg/ml	0.55	0.558	0.56	0.556	29.3519695
6.25 µg/ml	0.47	0.478	0.475	0.474	39.72892842
12.5 µg/ml	0.43	0.435	0.44	0.435	44.72681067
25 µg/ml	0.393	0.395	0.397	0.395	49.8094028
50 µg/ml	0.354	0.355	0.357	0.355	54.84963998
100 µg/ml	0.275	0.278	0.28	0.278	64.71833969
200 µg/ml	0.237	0.239	0.241	0.239	69.63151207
400 µg/ml	0.26	0.267	0.27	0.266	66.24311732

Table 3.10 Absorbance extract of cucumber (Khira)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.712	0.708	0.715	0.712	9.572215163
3.13µg/ml	0.64	0.645	0.659	0.648	17.66200762
6.25 µg/ml	0.59	0.597	0.592	0.593	24.65057179
12.5 µg/ml	0.525	0.528	0.53	0.528	32.95213892
25 µg/ml	0.47	0.475	0.479	0.475	39.68657349
50 µg/ml	0.41	0.415	0.412	0.412	47.60694621
100 µg/ml	0.35	0.358	0.354	0.354	55.01905972
200 µg/ml	0.28	0.285	0.279	0.281	64.25243541
400 µg/ml	0.219	0.219	0.219	0.219	72.17280813

Table 3.11 Absorbance extract of bitter gourd (Ucche)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.66	0.665	0.67	0.665	15.50190597
3.13µg/ml	0.59	0.598	0.589	0.592	24.73528166
6.25 µg/ml	0.5	0.502	0.508	0.503	36.04404913
12.5 µg/ml	0.46	0.462	0.468	0.463	41.12664125
25 µg/ml	0.419	0.421	0.422	0.421	46.54807285
50 µg/ml	0.383	0.384	0.386	0.384	51.16476069
100 µg/ml	0.342	0.344	0.345	0.344	56.33206269
200 µg/ml	0.291	0.293	0.294	0.293	62.81236764
400 µg/ml	0.201	0.202	0.204	0.202	74.29055485

Table 3.12 Absorbance extract of bottle gourd (Lau)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.66	0.667	0.672	0.666	15.33248623
3.13µg/ml	0.59	0.598	0.6	0.596	24.26937738
6.25 µg/ml	0.53	0.538	0.532	0.533	32.23210504
12.5 µg/ml	0.49	0.497	0.499	0.495	37.06056756
25 µg/ml	0.44	0.443	0.448	0.444	43.62558238
50 µg/ml	0.38	0.385	0.379	0.381	51.5459551
100 µg/ml	0.315	0.318	0.308	0.314	60.14400678
200 µg/ml	0.275	0.272	0.278	0.275	65.05717916
400 µg/ml	0.23	0.235	0.228	0.231	70.6480305

Table 3.13 Absorbance extract of pumpkin (Mistikumra)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.671	0.673	0.674	0.673	14.52774248
3.13µg/ml	0.665	0.669	0.67	0.668	15.12071156
6.25 µg/ml	0.648	0.65	0.651	0.650	17.45023295
12.5 µg/ml	0.615	0.617	0.618	0.648	17.66200762
25 µg/ml	0.566	0.567	0.568	0.567	27.95425667
50 µg/ml	0.565	0.566	0.565	0.565	28.16603134
100 µg/ml	0.457	0.459	0.46	0.459	41.71961033
200 µg/ml	0.356	0.359	0.35	0.355	54.89199492
400 µg/ml	0.248	0.25	0.254	0.251	68.14908937

Table 3.14 Absorbance of extract of ash gourd (Chalkumra)

Concentrations	1st reading	2nd reading	3rd reading	Average	% inhibition
1.57 µg/ml	0.72	0.724	0.727	0.724	8.047437526
3.13µg/ml	0.67	0.673	0.679	0.674	14.35832274
6.25 µg/ml	0.61	0.615	0.618	0.614	21.93985599
12.5 µg/ml	0.56	0.566	0.562	0.563	28.50487082
25 µg/ml	0.51	0.517	0.513	0.513	34.7734011
50 µg/ml	0.45	0.456	0.459	0.455	42.18551461
100 µg/ml	0.38	0.385	0.38	0.382	51.50360017
200 µg/ml	0.3	0.308	0.298	0.302	61.62642948
400 µg/ml	0.23	0.235	0.24	0.235	70.13977128

Sponge gourd (Dhundul)

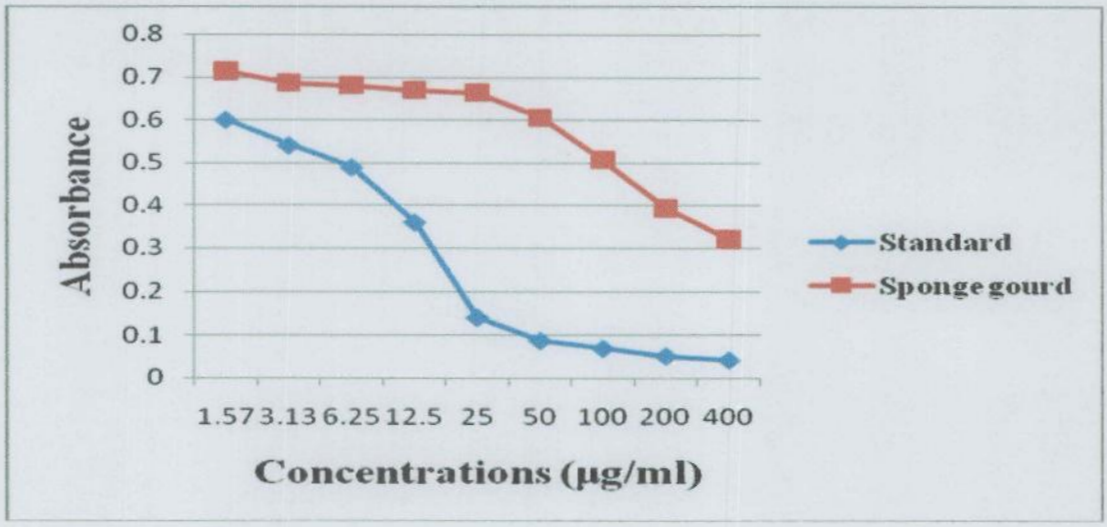


Figure 2. Absorbance against concentration of sponge gourd

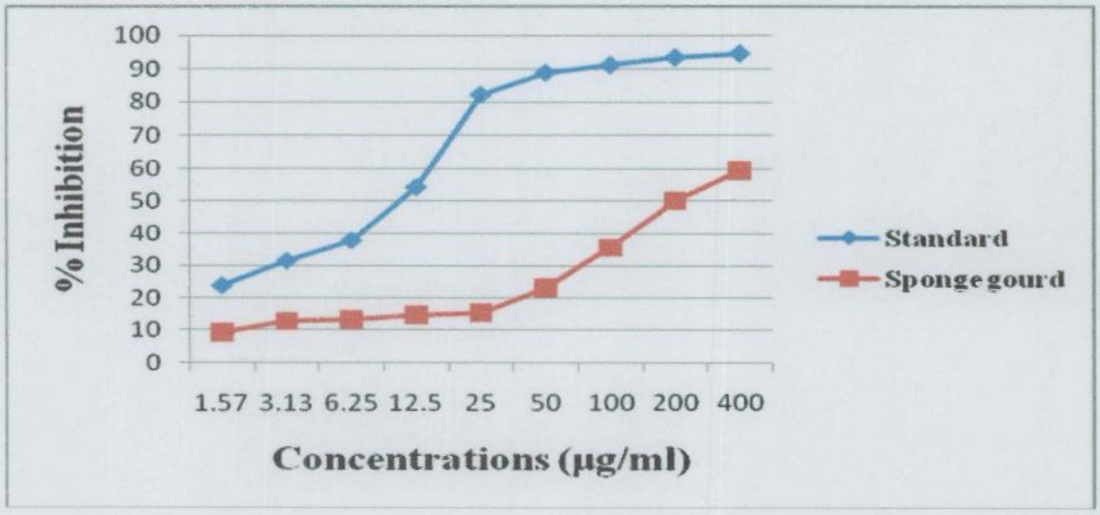


Figure 3. % inhibition against concentration of sponge gourd

In the quantitative assay, Sponge gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 200 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 11 µg/mL(approx).

Teasle gourd (Kakrol)

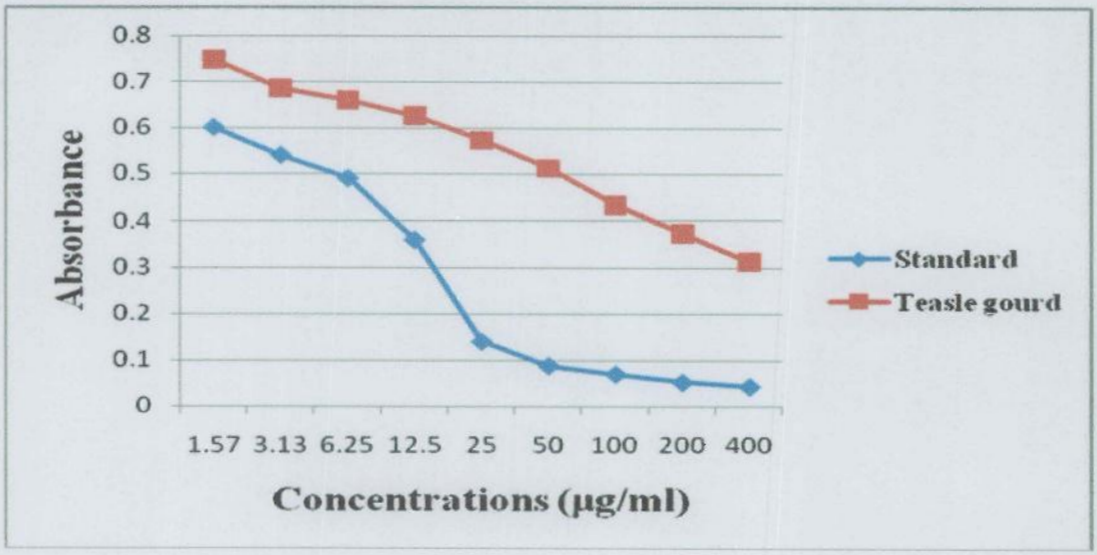


Figure 4. Absorbance against concentration of teasle gourd

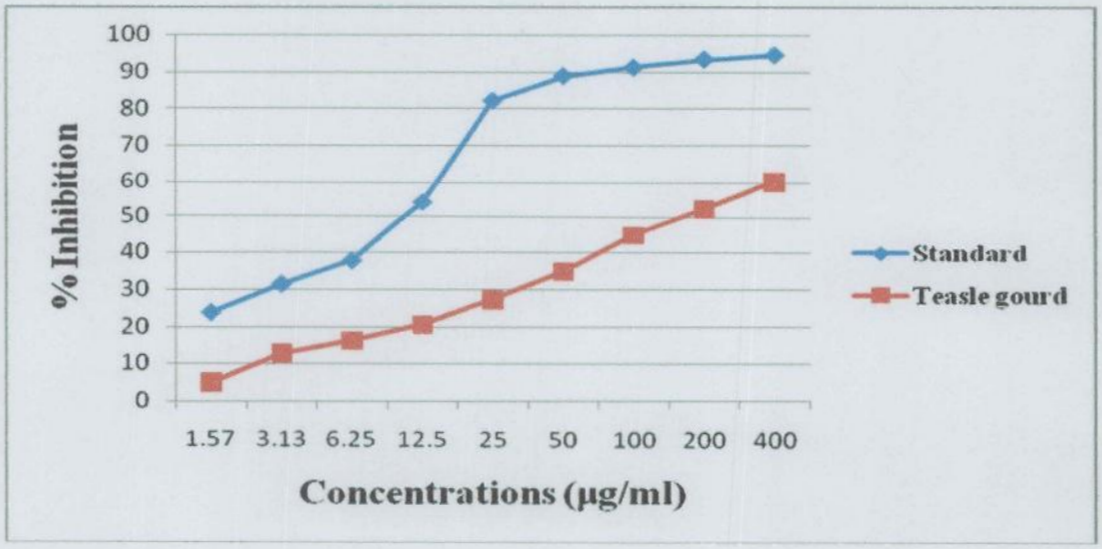


Figure 5. % inhibition against concentration of teasle gourd

In the quantitative assay, teasle gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 200 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 11 µg/mL(approx).

Ridge gourd (Jhinga)

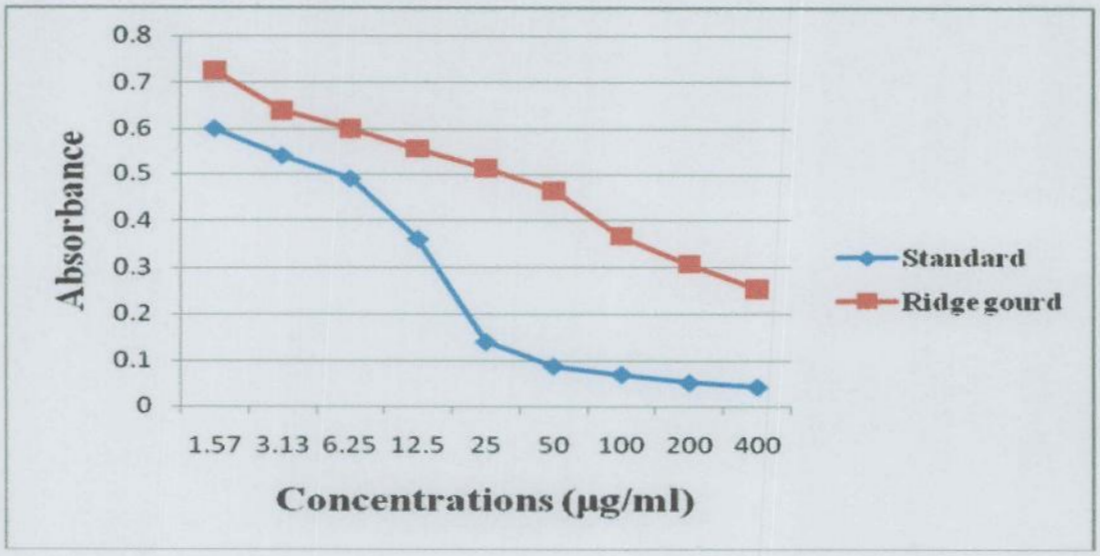


Figure 6. Absorbance against concentration of ridge gourd

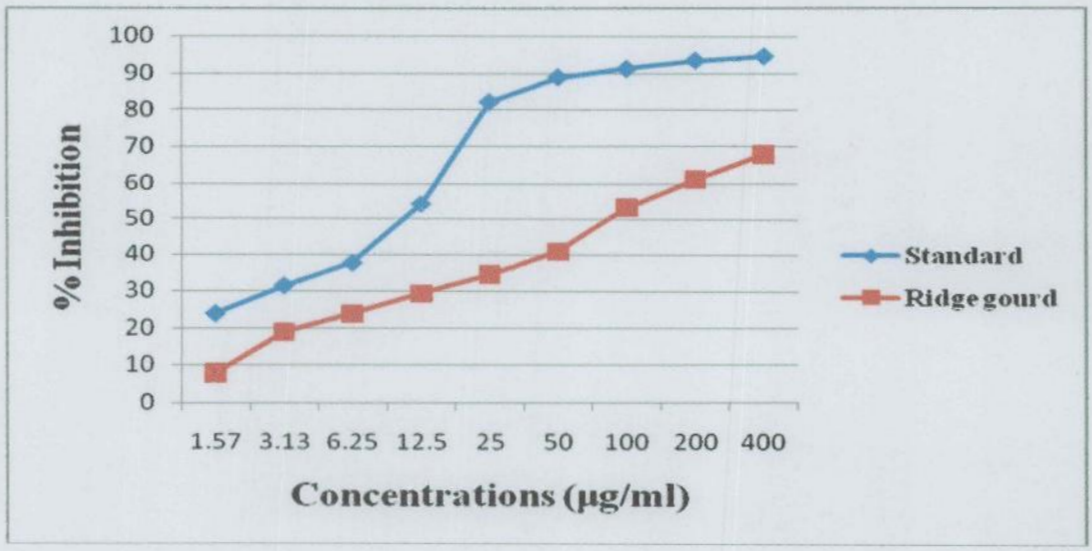


Figure 7. % inhibition against concentration of ridge gourd

In the quantitative assay, ridge gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 100 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 12.5 µg/mL(approx).

Pointed gourd (Patal)

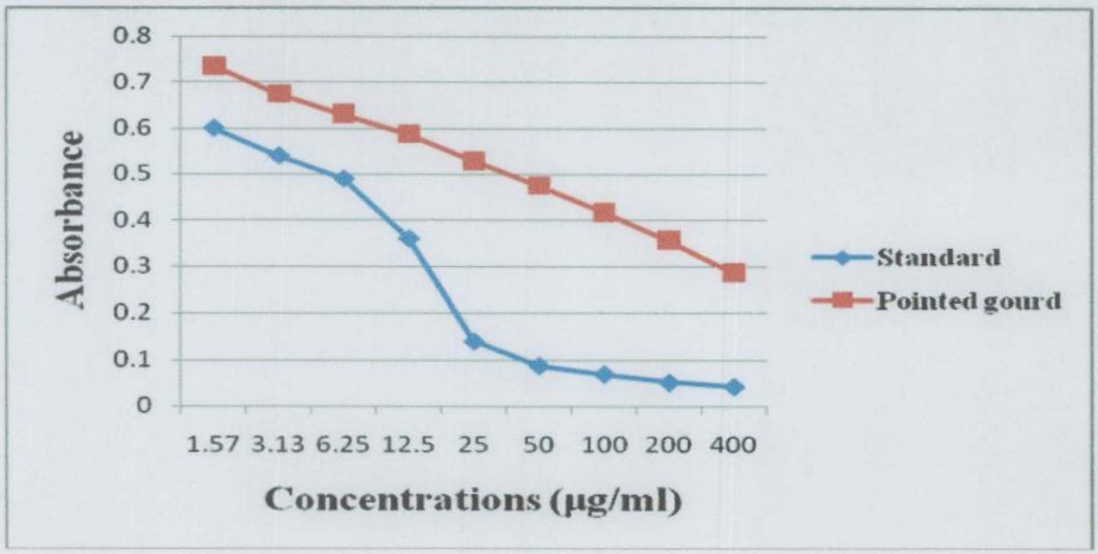


Figure 8. Absorbance against concentration of pointed gourd

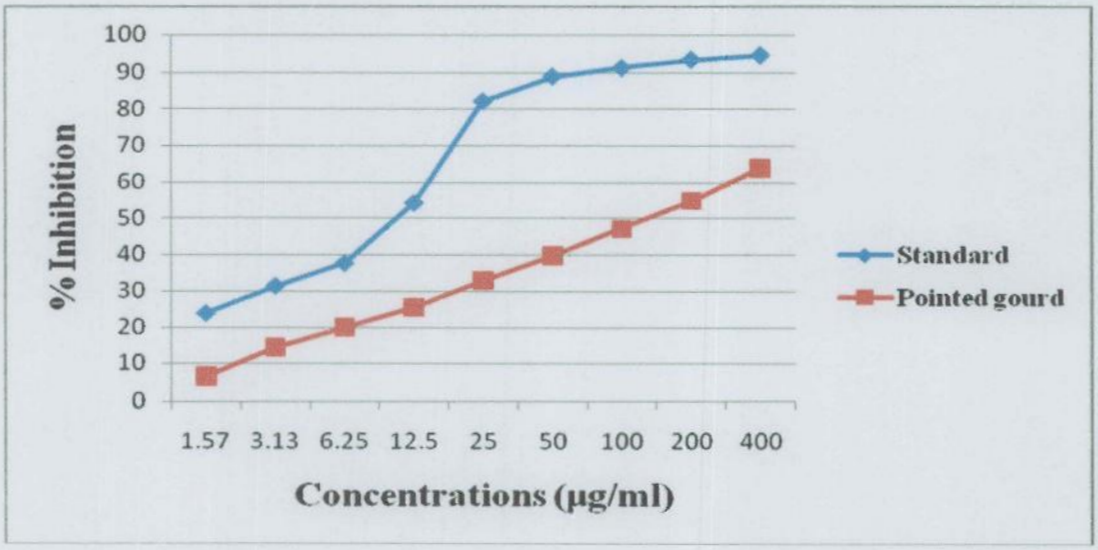


Figure 9. % inhibition against concentration of pointed gourd

In the quantitative assay, pointed gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 125 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 12.5 µg/mL(approx).

Cucumber (Shasa)

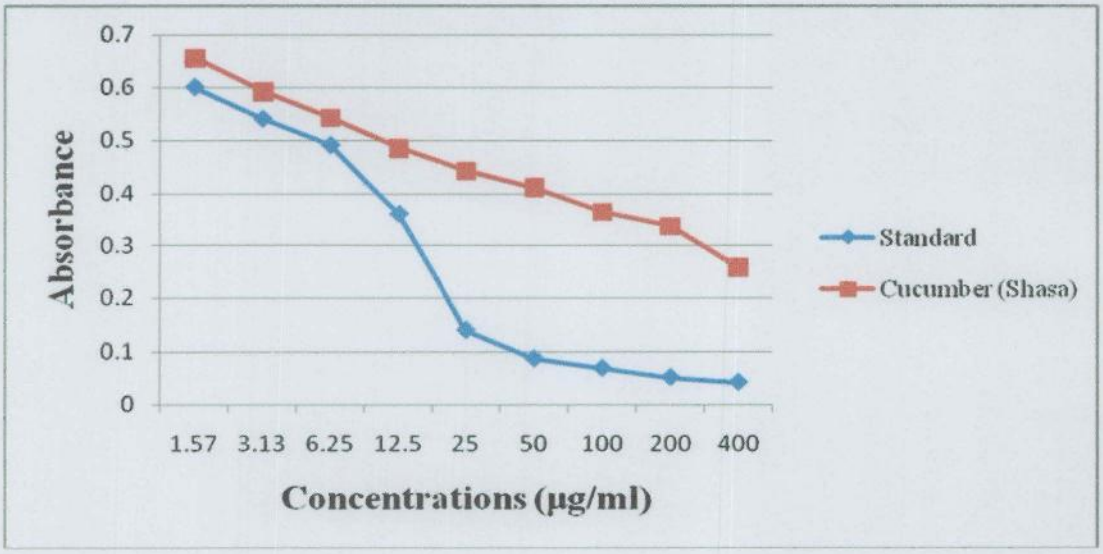


Figure 10. Absorbance against concentration of cucumber (Shasa)

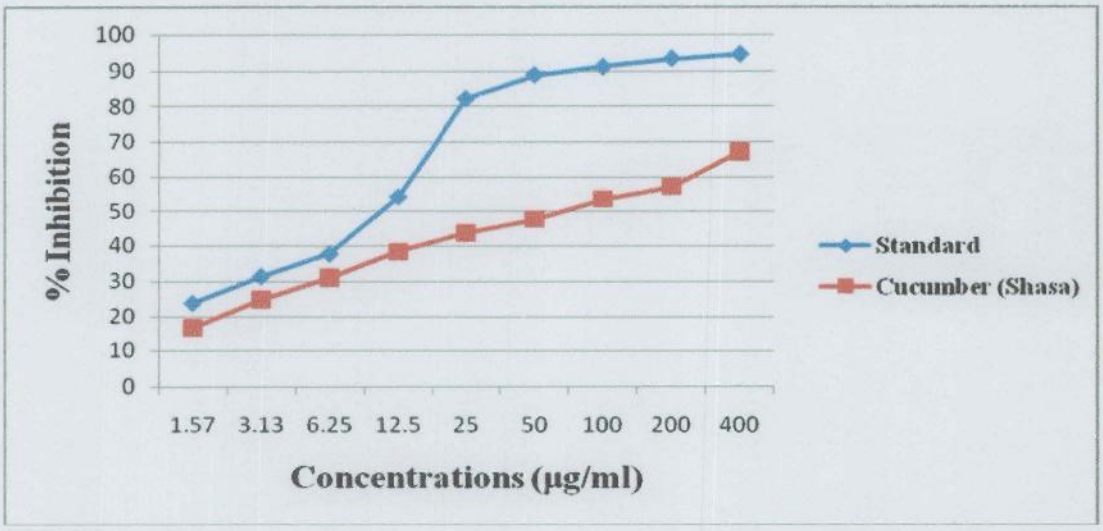


Figure 11. % inhibition against concentration of cucumber (Shasa)

In the quantitative assay, cucumber (Shasa) fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 130 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 11 µg/mL(approx).

Snake gourd (Chichinga)

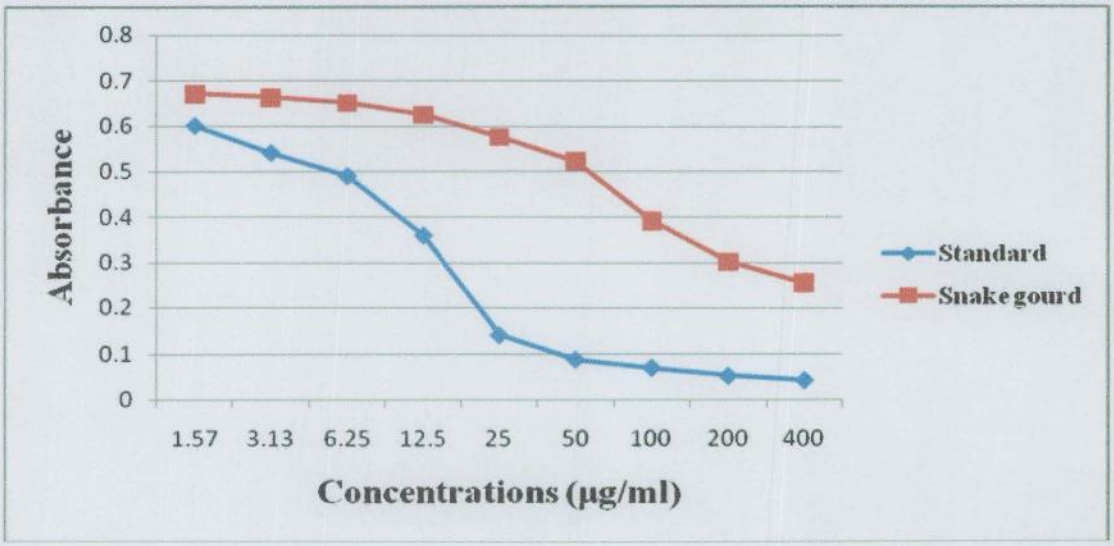


Figure 12. Absorbance against concentration of snake gourd

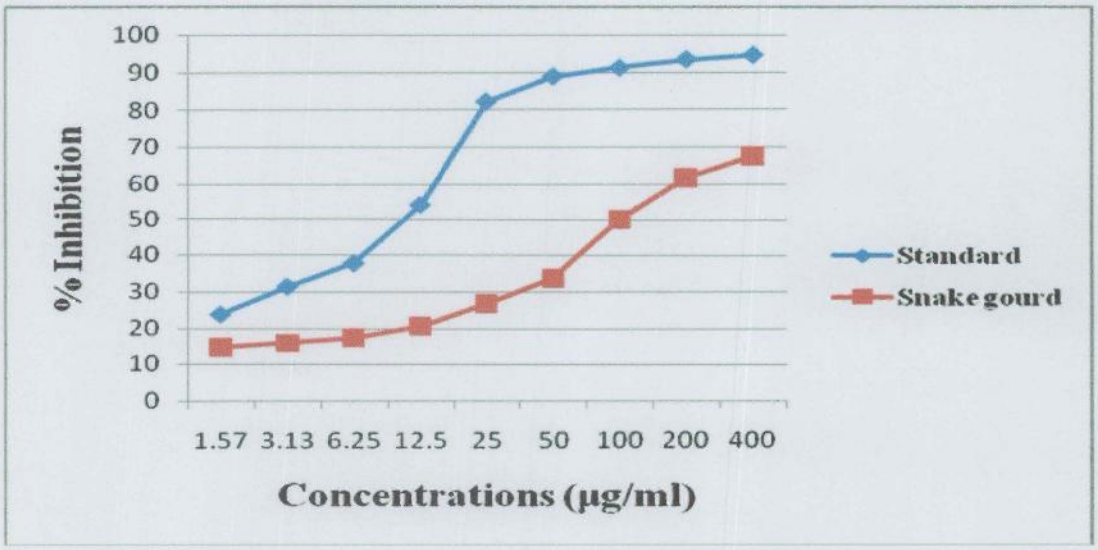


Figure 13. % inhibition against concentration of snake gourd

In the quantitative assay, snake gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 100 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 11.2 µg/mL(approx).

Bitter gourd (Karala)

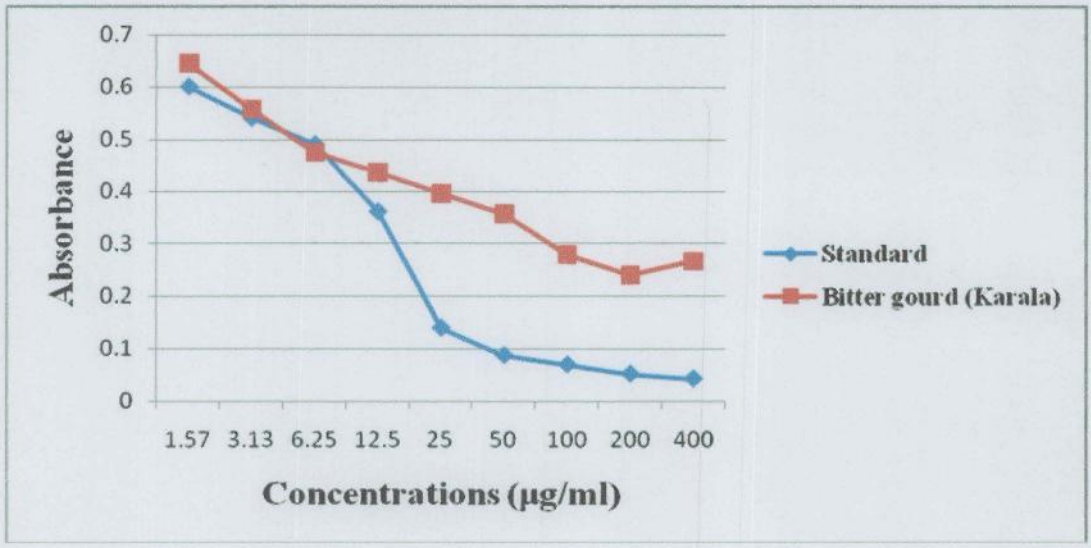


Figure 14. Absorbance against concentration of bitter gourd (Karala)

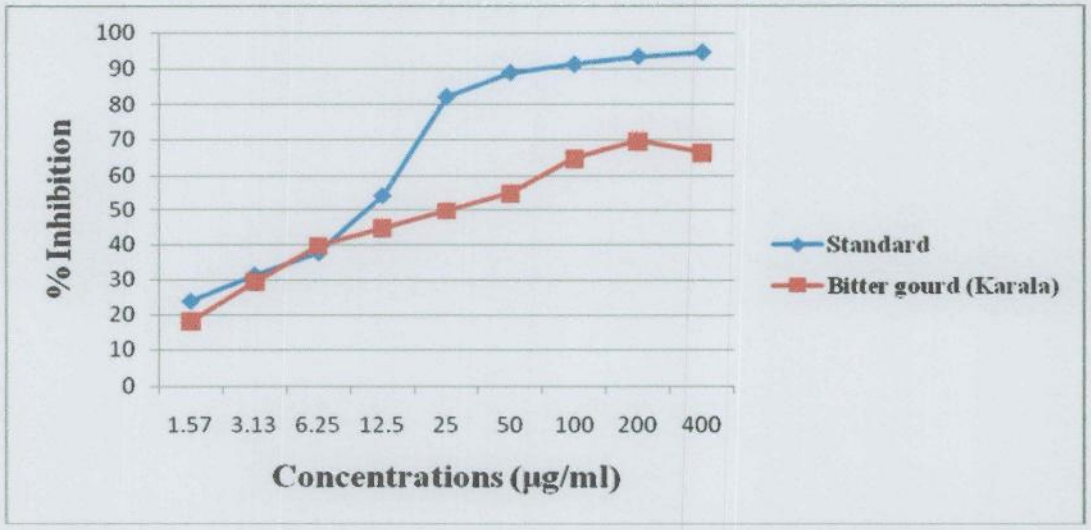


Figure 15. % inhibition against concentration of bitter gourd (Karala)

In the quantitative assay, bitter gourd (Karala) fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 25 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 11.1 µg/mL(approx).

Cucumber (Khira)

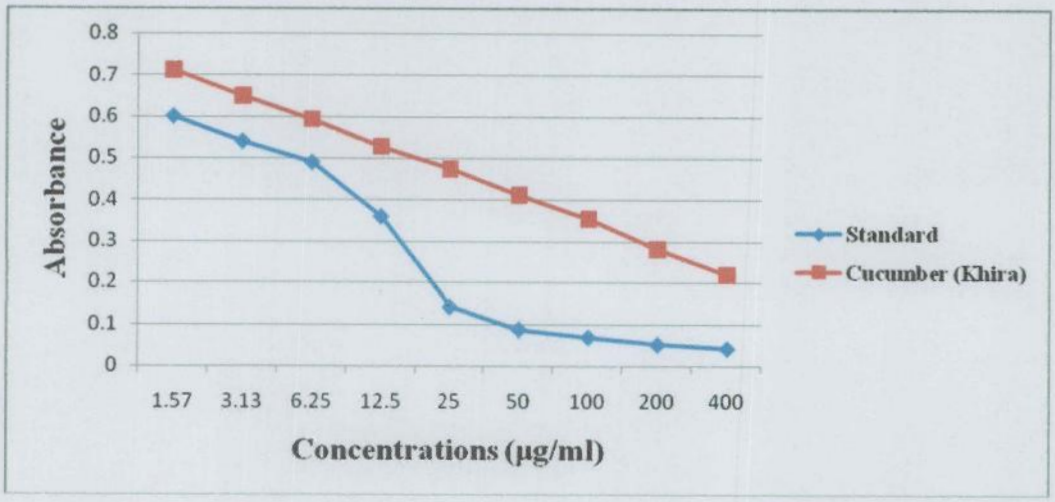


Figure 16. Absorbance against concentration of cucumber (Khira)

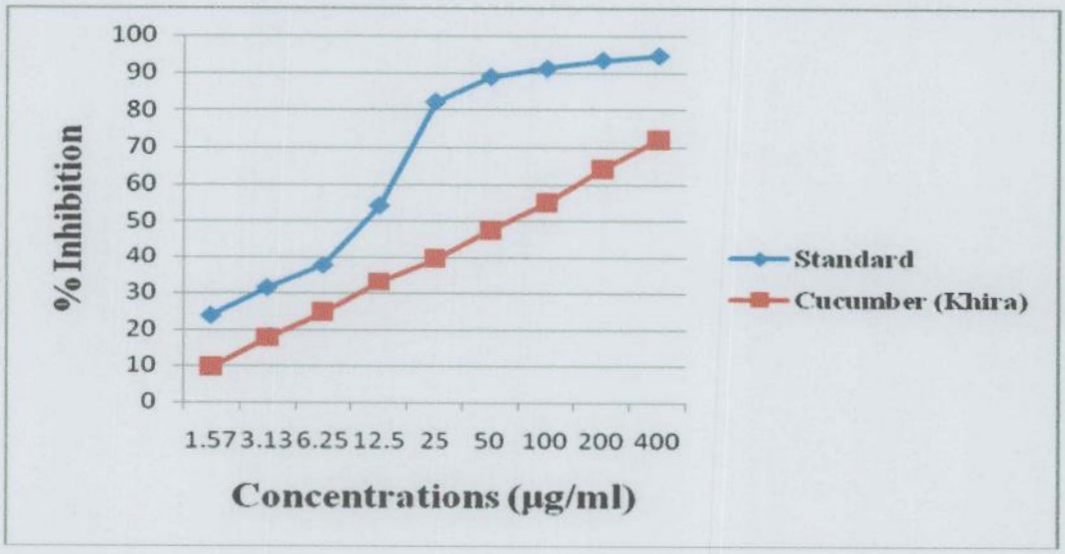


Figure 17. % inhibition against concentration of cucumber (Khira)

In the quantitative assay, cucumber (Khira) fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 70 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 11 µg/mL(approx).

Bitter gourd (Ucche)

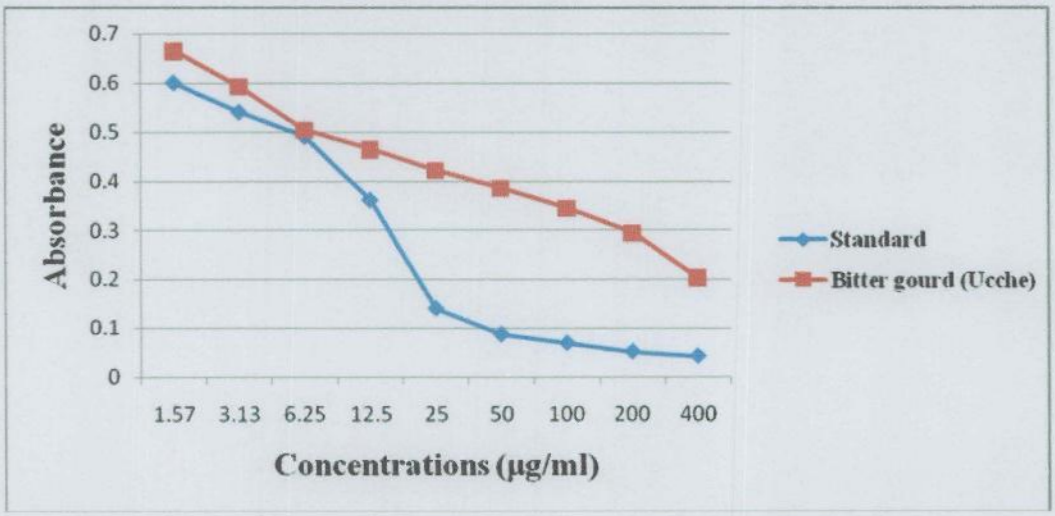


Figure 18. Absorbance against concentration of bitter gourd (Ucche)

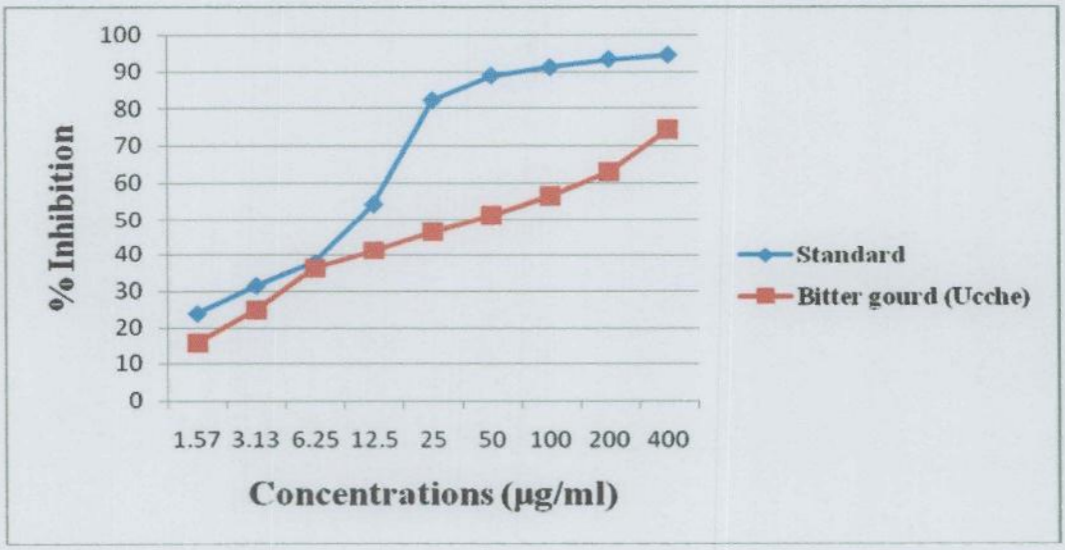


Figure 19. % inhibition against concentration of bitter gourd (Ucche)

In the quantitative assay, bitter gourd (Ucche) fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 50 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 10.7 µg/mL(approx).

Bottle gourd (Lau)

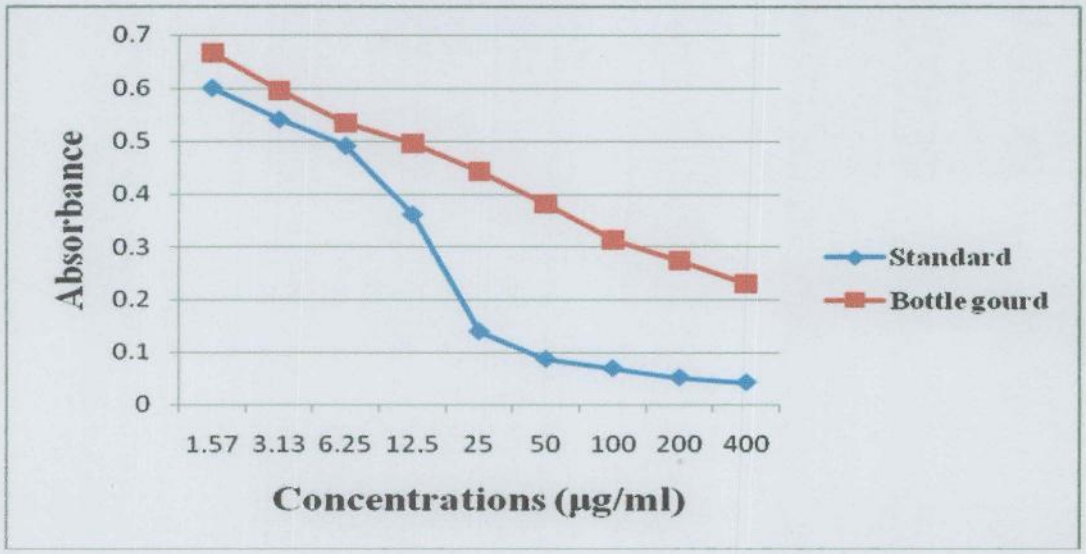


Figure 20. Absorbance against concentration of bottle gourd

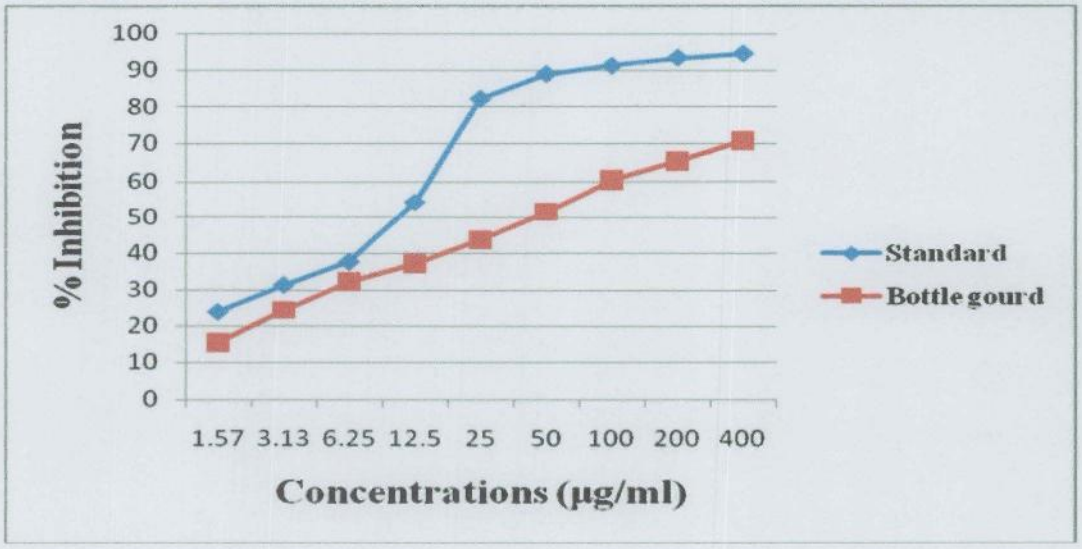


Figure 21. % inhibition against concentration of bottle gourd

In the quantitative assay, bottle gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 50 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 10.5 µg/mL(approx).

Pumpkin (Mistikumra)

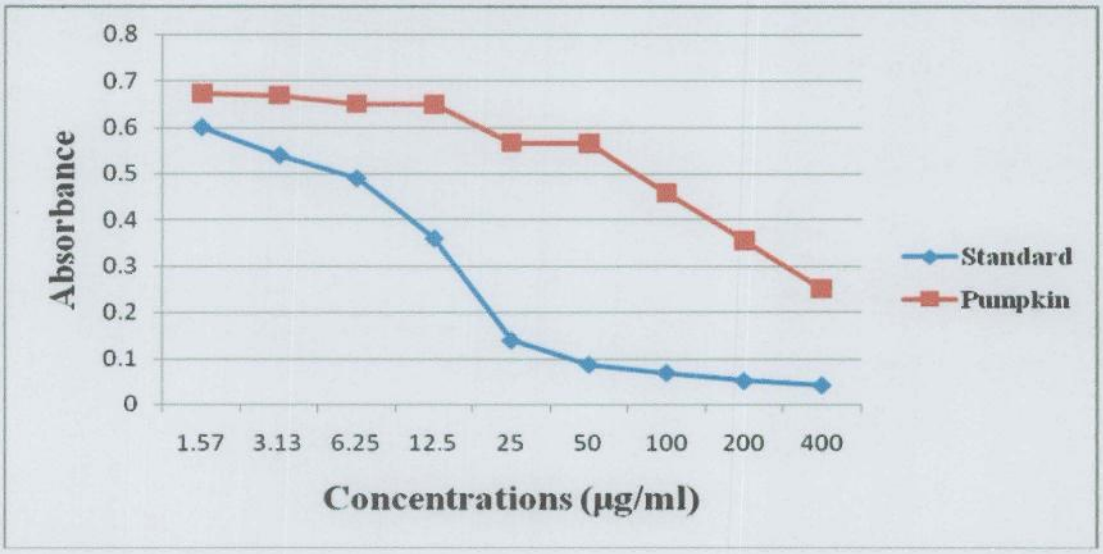


Figure 22. Absorbance against concentration of pumpkin

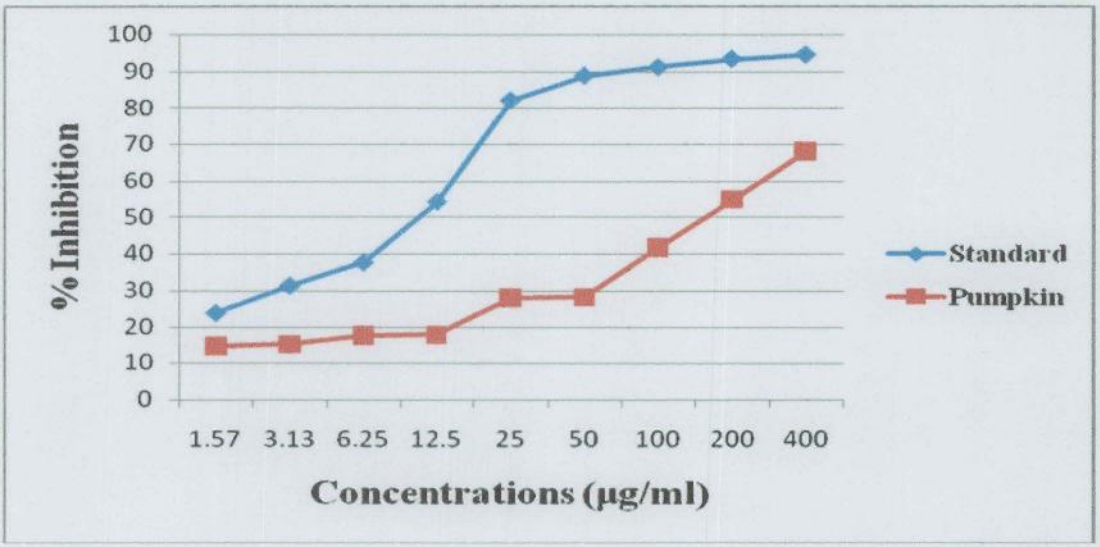


Figure 23. % inhibition against concentration of pumpkin

In the quantitative assay, pumpkin fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 170 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 9.9 µg/mL(approx).

Ash gourd (Chalkumra)

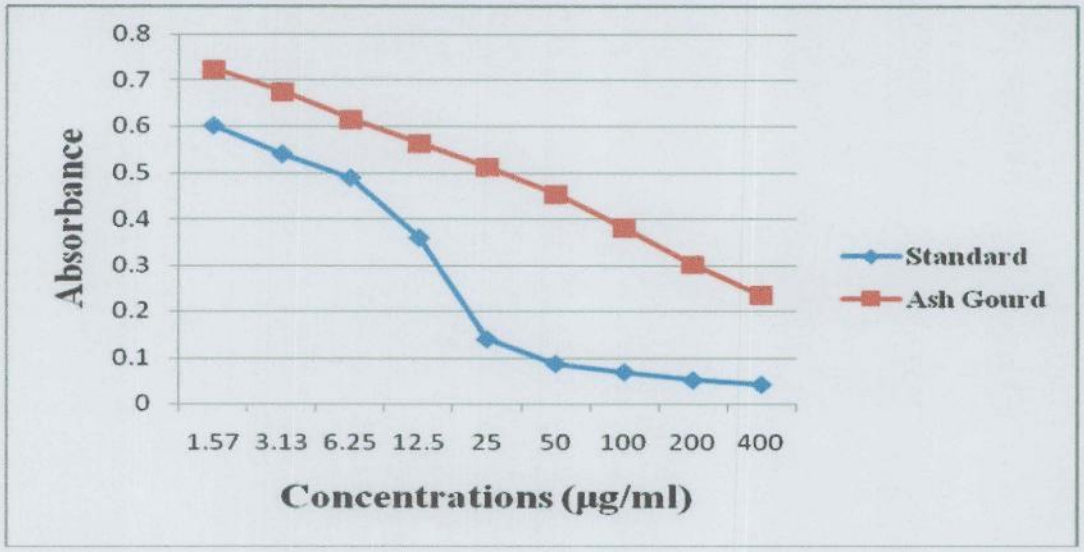


Figure 24. Absorbance against concentration of ash gourd

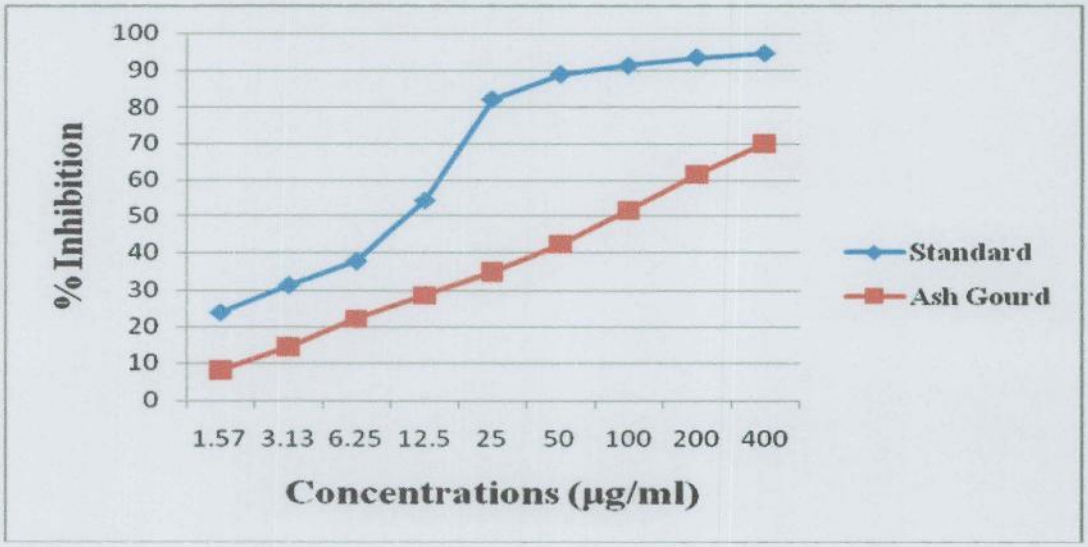


Figure 25. % inhibition against concentration of ash gourd

In the quantitative assay, ash gourd fruit displayed a free radical scavenging activity in the DPPH assay and the IC_{50} value was 100 µg/mL (approx) where the IC_{50} value of ascorbic acid (standard antioxidant) was 9.8 µg/mL(approx).

CHAPTER V

SUMMARY AND CONCLUSION

A study on the physico-chemical characteristics of 12 vegetables of Cucurbitaceous crops was carried out during the period from August 2011 to February, 2012. The Cucurbits crops were selected from south western region of Bangladesh. The collected vegetables were brought to the Molecular Horticulture Laboratory of the Agrotechnology Discipline of Khulna University, Khulna. In this laboratory, the vegetables were kept in ambient temperature to determine their physico-chemical characteristics

The study was laid out in completely randomized design (CRD) with three replications. Twelve vegetables of Cucurbits were selected as the experimental materials for the investigation of the experiment. After completing the experiments collected data were recorded and statistically analyzed to study the variabilities among these local Cucurbit crops.

Physical characteristics of Cucurbit crops were determined under quantitative characters such as weight of fruit, length of fruit, width of fruit, and weight of edible and non-edible part. Chemical characteristics of selected vegetables were estimated based on some parameters that were pH, total soluble solid, T-acidity, vitamin C, carotenoids, anthocyanin, Iron, moisture content of vegetables pulp and anti oxidant content.

The better values were found by Bottle gourd in respect of total weight and edible part among the 12 selected vegetables. On the basis of width of the fruits better was observed from Pumpkin. The highest weight of non edible portion results from bottle gourd and snake gourd was better in respect of the length.

Maximum weight of fruit (1570 g) was observed from bottle gourd and minimum weight (49.50 g) from bitter gourd (Ucche). The highest weight of edible portion (1306 g) was recorded from bottle gourd and the lowest weight of edible portion (38.49 g) from bitter gourd (Ucche). The highest weight of non-edible portion (263.7 g) was found in bottle gourd and that was the lowest in teasle gourd (7.62 g).

It was observed from the data of chemical analysis of Cucurbit vegetables that teasle gourd was found better in respect of highest pH value. On the basis of highest TSS, anthocyanin and Flavonoids content was found in pumpkin. The better performance was recorded from Bitter gourd (Karala) in respect of vitamin C content. In respect of carotenoids pumpkin was found superior. Moisture content of cucumber (Khira) was found highest. In terms of iron sponge gourd was found better and for T-Acidity bitter gourd (Karala) showed high value.

Maximum pH value (6.803) was found in teasle gourd and the minimum pH value (4.86) was recorded from cucumber (Shasa).

The highest percentage of TSS (7.40%) was observed in pumpkin and lowest percentage of TSS (1.80%) was found in cucumber (Shasa).

The highest percentage of T-acidity (18.82%) was found in bitter gourd (Karala) and that was the lowest (1.664%) in bottle gourd.

The maximum vitamin C (196.1 mg /100 g) was recorded from bitter gourd (Karala) and the minimum vitamin C (17.34 mg /100 g) observed from bottle gourd.

The maximum carotenoids (9.30 mg /100 g) content of individual vegetable pulp was found in pumpkin and that was the lowest in cucumber (Khira) (0.0110 mg/100 g).

The maximum flavonoid observed in pumpkin (5.5g) followed by teasle gourd (3.24g). The lowest found in ridge gourd (0.86 g) followed by bottle gourd (0.95 g) and snake gourd (0.996 g).

The highest amount of anthocyanin (0.153 mg /100 g) was observed from pumpkin and the least amount of anthocyanin (0.05767 mg /100 g) was recorded from cucumber (Khira).

The highest iron content was found in sponge gourd (5.692 g/ 100 g) and that was the lowest in cucumber (Khira) (2.325g/100g).

The highest moisture (97.23 g /100g) was found in cucumber (Khira) and the lowest (89.3 g /100g) was found in teasle gourd.

The highest IC_{50} value (200 μg/mL) was found in sponge gourd and teasle gourd and that was the lowest in bitter gourd (Karala) (25 μg/mL). IC_{50} value determines the inhibition concentration standard. Low IC_{50} value indicates the highest antioxidant content where as the highest IC_{50} value determines the lowest. Bitter gourd (Karala) & bitter gourd (Ucche) showed highest antioxidant and lowest was observed in sponge gourd.

At the concluding point it can be said that the criteria for the selection of the Cucurbit vegetables may be weight, length, width and edible portion of the vegetable. Most of the physical characters were superior in Bottle gourd and Pumpkin. By considering chemical characteristics content of vegetable pulp of Bitter gourd, Bottle gourd and Pumpkin were mostly superior. Besides the characteristics which were experimented in this investigation some other characteristics such as reducing and non-reducing sugar, riboflavin content of the vegetable pulp of the above mentioned vegetables is needed for the selection, consumption as well as cultivation.

REFERENCES

Anisuzzaman, M., Rahman A.H.M.M., Ahmed F., Islam A.K.M. R. and Naderuzzaman A.T.M., 2008. Study of nutritive value and medicinal uses of cultivated Cucurbits. *Journal of Applied Sciences Research*, INSInet Publication, 4(5): 555-558.

Azad, F.M.S. 1994. Crop nutrition of cucurbitaceous vegetables. Training materials for in service Training on summer and all season vegetables. Developed by Horticulture Research and development project, P. 6.

BBS. 2004. Monthly Statistical Bulletin, Bangladesh (October). Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, p. 52.

BBS. 2007. Monthly Statistical Bulletin, Bangladesh (January). Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, p. 47.

Behera, T.K. 2004, Heterosis in bitter gourd. *J. New Seed,* 6(2/3): 217-222.

Bezold, T.N., Loy J.B. and Minocha S.C. 2003. Changes in the cellular content of polyamines in different tissues of seed and fruit of a normal and hull-less seed variety of pumpkin during development. *Plant sci.,* 164:743-752.

Bhuiya, M.R.H., Hasib A.K.M.A. and Rashid M.M., 1977. Control and loss of Vitamin C in vegetables, Bangladesh Hort., 5:1-6.

Criswell, A. 2008. Screening cucumber (*Cucumis sativus* L.) for resistance to downy mildew caused by *Pseudoperonospora cubensis.* MS thesis Paper, North Carolina State University. pp. 5-13.

Djutin, K.E. 1991. Pumpkin: nutritional properties. Potatoes and Vegetables, 3: 25 - 26.

Dupriez, H. and De-Leener, P. 1989. Land and Life. African Garden and Orchard. Growing Vegetables and Fruits. *Macmillan Publishing Ltd*, London and Basingstoke. pp. 1-11.

Doijoide, S. D. 2002. Storage of Horticultural Crops, *CBS Publishers and Distributors*, Darya Ganja, New Delhi, pp. 296-297.

Gopalan, C., Rama B.V. and Balasubramanian S.C. 1982. Nutritive Value of Indian Foods. *Indian council of Mad. Res. Natl. Inst. Of Nutr.*, pp. 9-16.

Jeffrey, C. 1990. An Outline Classification of the Cucurbitaceae. *Comstock*, Cornell University Press, Ithaca, pp. 449-463.

Jitendrakumar, 2005. Studies on seed production and post-harvest techniques in Ridge gourd (*Luffa acutungula* L. Roxb). PhD Thesis, University of Agricultural Sciences, Dharwad-5800 005, pp: 11-12.

Kalloo, G., 1998. Vegetable research in India. *Indian Agricultural Sciences*, 68 (8):15-26.

Kirtikar, K.R. and Basu, B.D., 1956. Indian Medicinal Plants. Allahabad, India.pp:19-23.

Kirtikar, K. R. and Basu M. D. 1933. Indian Medicinal Plants. II: pp 1130-1133.

Kpongor, D.S. 2003, Agricultural Science and Resource Management in the Tropics and Subtropics- *Lagenaria siceraria* (Bottle Gourd). Bonn. Germany, pp. 31-35.

Kumazawa, M. 1964. Morphological interpretations of auxiliary organs in the Cucurbitaceae. Phytomorphology, 14: 287– 298.

Lee, Y.K, Chung WI and Ezura H. 2003. Efficient plant regeneration via organogenesis in winter squash (*Cucurbita maxima*). *Plant Sci.*, 164: 413 - 418.

Longman, O. 1995. Indian Medicinal Plants. Volume 4, Orient Longman Publication Ltd. p.7.

Loy, J.B. 2004. Morpho-physiological aspects of productivity and quality in squash and pumpkins. *Critical reviews in Plant sciences,* 23 (4):337-363.

Martin, F.W. 1987. CRC Handbook of Tropical Food Crops. Florida CRS Press Inc., pp. 210 – 221.

Mendoza, A.R. 2003. Agricultural Science and Resource Management in the Tropics and Subtropics- *Cucumis sativus L. (Cucurbits).* Bonn. Germany, pp. 60-63.

Paris, H.S. 2001. Characterization of the *Cucurbita pepo* collection at the new year research center, Israel. Plant Genet. Res. News, 162:41-46.

Pitrat, M., Chauvet M. and Foury C. 1999. Diversity history and production of cultivated Cucurbits. *Acta Hort.*, 492: pp 21-28.

Rahman, A.H.M.M., Anisuzzaman M., Alam M.Z., Islam A.K.M.R. and Zaman A.T.M.N. 2006. Taxonomic studies of the Cucurbits grown in the northern parts of Bangladesh. *Research Agri and Biolo Sciences*, InsInet Publication, 2(6): 299-302.

Rashid, M. M. 1976. Shabji Biggan (in Bangla). 1st ed., Bangla Academy, Dhaka. Bangladesh. p. 320.

Robinson, R.W. and Decker-Walters, D.S. 1997. What are In Cucurbits? *CAB International*, New York. pp. 1-22.

Robinson, R.W. and Decker-Walters D.S. 1999. Systematic of Cucurbits. *CAB International*, Wallingford, Oxford, UK. pp. 1-3.

Sequeira, Rosileyde and Goncalves. 2007. Growth and nutrient accumulation in Sponge gourd (*Luffa Cylindrica*). Master's. Thesis, Federal University, Brazil. pp. 1-9.

Sharma, G., Sarkar, A., Pachori, S.B. and Pant, M.C. 1989. Biochemical evaluation of raw *Trichosanthes dioica* whole fruit and pulp in normal and mild- diabetic human volunteers in relation to lipid profile. Indian Drugs, 27:24-28.

Siemonsma, J. S. and Piluck, K. 1993. Plant Resources of South East Asia No 8 Vegetable. Pudoc Scientific Publishers, Wageningen. pp. 6-9.

Singh, K. 1989. Pointed ground. *Indian Horticulture*. pp. 33-37.

Singh, N., Tyagi, S. D. and Agarwal, S. C. 1989. Effects of long term feeding of acetone extract of *Momordica charantia* (whole fruit powder) on alloxan diabeti Albino rats. *Indian Journal of Physiology Pharmacology*, 33 (2): 97-100.

Sing, A.K. 1990. Cytogenesis and evolution in the Cucurbitaceae. Comstock Publishing Associate, Connell Univ. Press Ithaca, New York and London. PP: 10-28.

Singh, N.J., Khattra, A.S. and Thakur, J.C. 2001. Studies on heterosis in bitter gourd (*Momordica charantia* L.). *Haryana J. Hortic. Sci.*, 30(3-4):224-227.

Somanath C. Agasimani. 2008. Stability analysis of some promising Bitter gourd (*Momordica charantia* L.) Hybrids. Master's Thesis, University of Agricultural Sciences, Dharwad, India, PP: 8-9.

Stevens P. C. 2007 onward. Angiosperm Phylogeny Website, version 8, Website http://www.mobot.org/MOBOT/research/APweb/.

Tatum, T.C., Nunez L., Kushad M.M., Rayburn A.L. 2006. Genome size variation in pumpkin (Cucurtiba sp.). Ann. Appl. Biol., 149:145–151.

Tatlioglu, T. 1993. Genetic Improvement of Vegetable Crops. Pergamon Press, New South Wales, Australia. pp. 3-7.

Tindall, H. D. 1983. Vegetables in the Tropics. Macmillan Press, London. p.5.

Weinstein, J.S., Vogt T.M., Gerrior S.A. 2004. Healthy eating index scores are associated with blood nutrient concentrations in the third National Health and Nutrition Examination Survey". *Journal of the American Dietetic Association,* 104: 576-584.

Whitaker, T. W., and Davis G. N. 1962. Cucurbits. Leonard Hill, London. p.13.

Whitaker, T.W. and Bohn D.W. 1950. The taxonomy, genetics, production and the uses of the cultivated species of *cucurbita. Economic Botany*, 4: 52-81.

Whitaker. T.W. and Davis G.N. 1962. Cucurbits - Botany, Cultivation, Utilization. Interscience Publishers, Inc., New York. p. 249.

Yusuf, A. A., Folarin O. M. and Bamiro, F. O. 2007. Chemical composition and functional properties of snake gourd (*Trichosanthes cucumerina*) seed flour. University of Agriculture, Abeokuta, *Nigerian Food Journal*, 25: 36.

APPENDIX I

Analysis of variance of the data in respect of physical characteristics of Cucurbitaceous vegetables

Sources of Variation	Degrees of Freedom	Mean square						
		Vegetable weight (g)	Vegetable length (cm)	Vegetable width (cm)	Skin wt (g)	Skin Thickness (mm)	Weight of non-edible part (g)	Weight of edible part (g)
Germplasm	11	870795.563**	339.455	113.556**	6473.228**	0.907**	714492.629**	19240.833**
Error	24	15942.224	25.856	1.650	336.771	0.007	10038.361	1896.172
Total	35	-	-	-			-	-

** Significant at 1% level of probability.

APPENDIX II

Analysis of variance of the data in respect of chemical characteristics of Cucurbitaceous vegetables

Sources of Variation	Degrees of Freedom	Mean Square								
		pH	TSS (%)	T- acidity (%)	Vitamin C (mg/100 g)	Carotenoids (mg/100 g)	Flavonoid	Anthocyanin (mg/100 g)	Iron mg	Moisture (g/100 g)
Germplasm	11	1.222**	6.287	135.475**	12696.912	0.031**	5.398**	0.003**	2.656**	22.931
Error	24	0.001	0.008	1.621	5.668	0.000	0.001	0.000	0.043	0.063
Total	35	-	-	-	-	-		-		

** Significant at 1% level of probability.

APPENDIX III

Given List Cucurbit vegetables with English name, Bengali name, Scientific name and area of collection

SL. No.	English Name	Bengali Name	Scientific name	Area of collection
1	Sponge gourd	Dhundul	*Luffa cylindrica*	Koyabazar, Botiaghata, Khulna
2	Teasle gourd	Kakrol	*Momordica cochinchinensis*	Gollamari bazar, Botiaghata, Khulna
3	Ridge gourd	Jhinga	*Luffa acutagula*	Zilerdanga, Dumuria, Khulna
4	Pointed gourd	Patal	*Trichosanthes dioica*	Chuknagar, Dumuria, Khulna
5	Bitter gourd	Karala	*Momordica charantia*	Koyabazar, Botiaghata, Khulna
6	Snake gourd	Chichinga	*Trichosanthes anguina*	Khornia, Dumuria, Khulna
7	Cucumber	Shasa	*Cucumis sativus*	Keshabpur, Jessore
8	Bitter gourd	Ucche	*Momordica charantia*	Mongolcote, Jessore
9	Cucumber	Khira	*Cucumis anguina*	Keshabpur, Jessore
10	Bottle gourd	Lau	*Lagenaria siceraria*	Dhandia, Tala, Satkhira
11	Pumpkin	Mistikumra	*Cucurbita maxima*	Maddobiswas para , Dumuria, Khulna
12	Ash gourd	Chalkumra	*Benincasa hispida*	Moikhali, Dumuria, Khulna