

**STANDARDIZATION AND CHARACTERIZATION OF  
VALUE ADDED ASH GOURD (*Benincasa hispida*)  
READY-TO-SERVE BEVERAGE**

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# 1. INTRODUCTION

India is the second largest producer of fruits and vegetables which are reservoir of vital nutrients. Being highly perishable, 20-40 per cent of the total production of fruits and vegetables goes waste from the time of harvesting till they reach consumers. Hence it is always necessary to make them available for consumption throughout the year in the processed form and to sizable amount of nutrient losses.

The production and consumption of vegetables has expanded dramatically in last year, with a global growth in production of more than 50 per cent in last decade registering the rate of increase that is much higher than other plant commodities. Vegetables constitute important components of healthy diet and provide significant amount of vitamins, minerals and antioxidants which help in preventing the diseases, thus contributing to quality of life.

The Gourd Family includes hundreds of species of vines bearing coiled, climbing tendrils and some of the most unusual fruits in the world. The total number of species may exceed 700, with at least 100 different genera. Ash gourd (*Benincasa hispida*) belongs to Cucurbitaceae family, which is a single species of tender annual vine, believed to have originated in Java. At first glance, ash gourd looks like a prickly form of bottle gourds which are smooth while this type is a fuzzy melon, which plays a significant role in the diet (Plate 1). In India it has been grown in 2497 ha with an annual production of 15326 tones (<http://www.agrsci.unibo.com>).

The other names of ash gourd include *Kushmanda*, wax gourd, winter melon, white gourd, white pumpkin and ash pumpkin. Many of these names allude to powdery white flakes on fruit surface. Round, grey coloured, well matured waxy fruits measures 8-12 cm in length, 3-5kg in weight and 7-10mm long seeds. 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. Plants take five months from seed to produce a mature fruits which are ready for harvest within 45 to 60 days. Matured ones coated with powdery substance are harvested between 80 and 90 days after sowing. Each plant yields nearly 50-60 fruits. A well matured, non injured ash gourd fruit has shelf life of 6 to 12 months. The fruit is best kept on shelves or hung in net sacks, in a dry and cool atmosphere.

Ash gourd is valued for its medicinal properties which has been explored by Ayurvedic practioners. It has special potency as nervine tonic. It alleviates nausea (*Vatta*) and acidity (*pitta dosha*). The properties of fruit changes according to stage of ripening. It is interesting to note that the tender fruits alleviates acidity, medium ripened fruit alleviates cough, where as fully ripened fruit alleviates all of them. (Herbal cure <http://www.herbalcureIndia.com>)



**Plate 1. Ash gourd fruits in the field**

In Chinese medicine, the rind of the ash gourd fruit is used to treat urinary dysfunction and seeds are used for preventing vaginal discharge. The fruit is used to treat summer fever, epilepsy, lung diseases, asthma, cough and internal hemorrhage. The rind is also used to treat diabetes and seeds to expel tapeworms (<http://www.indianetzone.com>). The juice extracted from matured ash gourd is effective in case of mercury poisoning and snake bites. Being extremely low in calories, ash gourd juice is also used in treating of obesity.

Ash gourd is composed of higher amount of moisture 96.50 per cent, low calories 10 K cal, protein 0.40g, fat 0.1g, carbohydrates 1.9g, ascorbic acid 1mg, fiber 0.80g, ash 0.39, iron 0.8 mg and 30 mg of calcium (Gopalan *et al.*, 1997).

The Ash gourd is cut into pieces, peeled and boiled in sugar syrup to make *Petha*, a sweet dish which is very famous as *Agra petha*. In the southern part of India, the matured ash gourd fruit and seeds are used to prepare a dehydrated product *Sandige*, along with the other spices. The fruit is also used as a vegetable in curry as well as in the *sambar*.

Individuals on bland diet and those who prefer to consume uncooked foods, have found that, the raw flesh can be liquefied and drunk as herbal juice either alone or combined with other flavors. Immature fruits are used to make *halwa* and *tuti* fruit in several regions of India (<http://www.wikipedia.com>).

Both matured and immature fruits are bland in taste. Chunks of matured fruits are used to prepare soup, which is sometimes canned. Young wax gourds are preferred for cooking as vegetables and are simply peeled and cut into pieces, boiled alone or with meat and served seasoned with salt or pepper. In addition to fruit, flowers, young leaves and seeds are also edible (Yang and Walter 1992).

Under the present scenario it is believed that the future of agriculture is safe in increasing the productivity, diversification and value addition to horticultural crops.

The value addition to ash gourd products fetches higher prices, also able to extend the shelf life and made available throughout the year.

Limited information on value addition and processing of ash gourd has been documented. In view of this rationale, the present investigation is directed to add value to ash gourd in terms of Ready-To-Serve (RTS) beverage with the following objectives.

1. To document the availability of ash gourd and its products in the local markets.
2. To document the utility of ash gourd fruit in the urban and rural households as well as in the Ayurvedic Health Care Centers.
3. To determine the physical and chemical composition of ash gourd.
4. To standardize the protocol for preparation of ash gourd Ready-to-Serve (RTS) beverage and
5. To characterize the ash gourd RTS beverage in terms of sensory attributes, nutrient profile and shelf life.

## 2. REVIEW OF LITERATURE

Medicinal properties of the ash gourds (*Benincasa hispida*) are highly potent in curing various diseases. Literature search indicates that there is limited research work on various aspects of Ash gourd fruit, particularly with respect to processing and preservation of its products and their storage stability. There is limited work documented on use of ash gourd in the product development. Thus this chapter attempts to give an overview of literature available and applicable to the present study along with the processing aspects of the related fruits and vegetables.

### 2.1 Medicinal importance of ash gourd

The ash gourd has been extensively used in the Ayurvedic medicines. Chopra (1986) reported that the ash gourd fruit and seed possess number of pharmacological properties mainly as laxatives, diuretics and used during epilepsy, internal hemorrhages and nervous disorders. In Ayurvedic medicine ash gourd has been recommended for the management of peptic ulcers, hemorrhages from internal organs and for other nervous disorders. Ash gourd possessed acid neutralizing and ulcer healing properties Sharma (1986) and Warriar (1994).

According to medical encyclopedia, the ash gourd is effective against diabetes, diseases related to liver and leucorrhoea. It is also good for the detoxification of minerals, removal of fever and to strengthen the function of bladder and intestine (Choi *et al.*, 2001). Seed extract of ash gourd is known to facilitate mucus secretion and thus has an expectorant effect (Grover *et al.*, 2000, 2001).

The methenolic extract of fruit of ash gourd was evaluated for its anti-diarrheal potential by Mathad *et al.* (2005) against castor oil induced diarrhea in rats. Results showed that there has been significant reduction in incident as well as severity of diarrhea in experimental models.

An *in vitro* Study conducted by Lee *et al.* (2005) revealed that the seed extract of ash gourd decreased endothelial cell proliferation and tube formation in a dose-dependent manner with no cytotoxicity and showed potent inhibitory effect on angiogenesis *in vivo*.

Seed extract of ash gourd supports its anti-angiogenic property through inhibition of endothelial cell proliferation. Rachchh *et al.* (2008) observed anti-ulcer and anti-gastric mucosal activity of ash gourd over gastric ulcer induced rat models. It was found that extract of *B.hispida* may be attributed to the reduction in the free radical generation, vascular permeability and lipid peroxidation along with strengthening of mucosal barrier.

Roy *et al.* (2008) studied the dose dependent effect of water extract of *B.hispida* pulp on Alzheimer's disease induced rat model. About 400 mg of ash gourd per Kg body weight was found to be effective against Alzheimer's disease and the same dose of extract elicits the highest antioxidant activity.

An intervention study conducted at Shree Satya Sai University, Ananthpur, India, revealed a significant reduction in serum cholesterol, triglycerides and blood glucose levels in diabetic subjects who were given ash gourd juice for a period of 21 days. In the similar study, serum LDL and VLDL were also reported to reduce by consumption of ash gourd juice. Ash gourd juice is known to reduce 4-9 per cent enzymatic activity (Super oxide dismutase and Catalase) which is caused due to increase in serum cholesterol levels (Satyanarayana, *et al.*, 2010).

Desert Medicine Research Centre, Jodhpur, India, investigated the impact of ash gourd juice on serum mineral levels of 15-45yrs old subjects. Ash gourd juice was provided in the morning empty stomach for a period of two months. About two months of intervention of ash gourd juice with empty stomach showed a significant increase in serum sodium, potassium and also hemoglobin levels (Satyanarayana, *et al.*, 2010).

### 2.2 Utility of ash gourd

The protocol for the preparation of commercial *petha* in India has been given by Lal *et al.* (1960). The peeled slices of ash gourd flesh is soaked for half an hour in one part of lime water to three parts of water, flesh is pricked with forks and cut into small chunks which are left in limewater overnight. Later, it is boiled till tender in a 2-3 per cent alum solution and

then rinsed in cold water. To retain a pure white colour, a small amount of sodium sulphite is added while cooking. The chunks were layered with half their weight of sugar and kept for 24 hours. To the syrup which forms, one ounce of citric or tartaric acid for each 100 lbs of sugar is added. Further fruit chunks are boiled in syrup for 10 minutes and then allowed to stand in it for 24 hours. Thereafter, the strength of the syrup is increased by 5°B, every other day until it reaches 70° B. After holding for 4 to 6 weeks, the product may be used as a sweet preserve or may be candied by draining the syrup off, rolling the pieces in powdered sugar and dried at room temperature to make a sweet called *Petha*.

In South East Asia, chunks of mature ash gourd are often candied and also used to prepare soup, where as particularly in India, chunks are cooked in curries. Chinese cooks prepare thick slabs of the raw fruit, slit them, insert thin slices of ham and then boil in salted water to tender. Similarly, small fruits are peeled, seeds and the flesh are scooped out, the hollow portion are stuffed with lotus seeds, mushrooms, cubed bamboo shoots, chopped pork, with a little cornstarch, pepper and ginger, and steamed for an hour (Morton *et al.*, 1971).

The inner soft portion of the ash gourd is used in the preparation of tomato ketchup. Tender leaves are used as any other green leafy vegetables in the preparation of *Bhaji*. Sections of peeled, immature fruit, free from seeds and fibre are stir fried, braised or steamed but are best used in highly spiced, seasoned soup. The rind is artistically carved for festive occasion. Mature ash gourds of fairly large size are favored by the Chinese as "soup pots". The stem-end is carefully cut to serve as a lid, the center cleaned out and the gourd is filled with a mixture of diced chicken, pork and ham which has been pre soaked in boiling water. The filled gourd is then steamed three to six hours till the flesh is soft, and served. In Nepal, the fruits are pickled, or cooked or, dried and then mixed together with mango fruit and formed into ball to fry later (Marr *et al.*, 2007).

## 2.3 Processing of fruits and vegetables

Processing is an important aspect in preservation of fruits and vegetables. Processing enhances palatability, digestibility as well as sensory appeal. Processing improves the storability of fruits and vegetables through heating, cooling, chemical and microbial applications.

### 2.3.1 Blanching of vegetables

The term 'blanching' is used to designate the heat treatment in the processing of vegetables, which prevents the deteriorative changes that occur in the foods if untreated.

Blanching is necessary process, frequently applied to vegetables prior to processing to enhance the shelf life of the product Recheighe (1982). It helps to clean the material, eliminate micro organisms, inactivates enzymes, removes disagreeable flavor and retain original color of the product (Karla 1990).

Mosha *et al.* (1995) studied the effect of blanching on anti nutritional factors of selected vegetables (Cabbage, Turnip, Sweet potato and Peanut leaves). It was found that levels of some of the anti nutritional factors like tannic acid and phytic acid were significantly reduced by conventional as well as microwave blanching. Blanching inactivated the enzymes which are responsible for undesirable changes in pumpkin, reduced the microbial load and eliminated the cellular gases (Brenman, 1996).

Jawahir *et al.* (2001) determined the effect of blanching on bitter principles of bitter gourd slices. The results revealed that blanching in 5 per cent sodium chloride at 100 °C for three mins was effective in removing the bitterness and also maintaining the firmness of the bitter gourd slices.

Pupponen *et al.* (2003) studied the effect of blanching on the retention of bioactive compounds in the vegetables. The results revealed that folic acid and ascorbic acid were turned out to be very sensitive to blanching with more than 50 per cent of the vitamins being lost, but carotenoids and sterols remained unaffected by the blanching.

Mao *et al.* (2007) investigated the quality of sugar cane juice with blanching. The peeled sugar cane stems were immersed in the boiling water (40:1 ratio of water to sugar cane stem) for five mins. Blanching was found effective in preventing the browning and

reduced the activities of polyphenol oxidase and sucrose neutral invertase enzymes in fresh sugar cane juice.

The sensory quality of the bottle gourd (*Lagenaria siceraria*) juice, extracted with and without blanching treatment was determined by Sawate *et al.* (2008). The bottle gourd fruit pieces were dipped in hot water at 80-85 °C, for three mins and allowed to cool. It was observed that, the colour of the juice without blanching was immediately blackened, whereas the bottle gourd juice with the blanching was found to be green and acceptable, which resembled the colour of the fresh fruit.

Singh *et al.* (2008) studied the effect of blanching on the bitter gourd slices with respect to enzymatic activity. Blanching of bitter gourd slices at 100°C for 1-6 mins inactivated the catalase enzyme.

### 2.3.2 Extraction and Clarification of juice from fruits and vegetables

The yield of the juice from fruits or vegetables depends on the extraction method adopted and equipments used for the extraction. The clarity of the juices is desirable attribute for maintaining quality and standards.

Lipitoa and Robertson (1977) reported that pectinolytic enzymes are used in extraction of juice from passion fruit pulp. The average yield of juice increased by 35 per cent without any deleterious effect on colour and flavour of the juice.

Doreyappa Gowda and Jalali (1995) extracted the juice from watermelon fruits by cutting the fruits into small cubes, removing the seeds and rind manually and by blending edible pulpy portion in electrical grinder. The extract was passed through 30 mesh steel sieve to remove the fibrous material.

Montenegro *et al.* (1995) made an attempt to extract the juice from guava pulp by treating with 600 ppm of a pectic enzyme at 45°C for 120 min. The pulp so-treated was pressed to give juice yield of 84.70 per cent.

Juice from pomegranate was extracted by washing the fruits in running cold water followed by peeling. The arils of the pomegranate were separated and passed through an apple grater and pressed to obtain juice (Waskar and Deshmukh, 1995).

Panesar *et al.* (2000) developed the technology for preserving Kinnow juice. The recovery of juice from Kinnow fruit was found to be 49.6 per cent by using screw extraction method in comparison to 47.2 per cent by Reamer extraction method.

The recovery of clarified ber juice was maximum (55.37%) in the juice treated with pectinase-III at 0.1g per Kg of fruit pulp for four hours, followed by pectinase-II at 4g per Kg of pulp for 24 hours (46.39%). Least recovery (19.30%) was observed in untreated juice (Devraju, 2001).

The juice extraction method from Indian gooseberry (*Emblica officinalis* Gaertn) has been standardized by Jain and Khurdiya (2004). The fruits were blanched, seeds were removed manually and segments were fed to the centrifugal juice extractor. The extracted juice was strained through muslin cloth to obtain clear juice.

Barwal *et al.* (2005 a) standardized the juice extraction method from bitter gourd. The bitter gourd juice extracted by basket pressing after grating yielded highest (50 %) followed by spiral pressing (30 %) and carrot grater (10 %).

Nath *et al.* (2005) reported that, juice from fruits like Kinnow mandarin and ginger rhizomes can be better extracted by screw type machine which can be filtered through muslin cloth.

Combination of household electrical grinder and pressing through muslin cloth yields higher quantity of bottle gourd juice was reported by Padvi and Pagar (2007).

Madhukar (2008) adopted home scale food processor to extract the juice from bottle gourd fruits, which was further pressed through muslin cloth to get clear bottle gourd juice.

### 2.3.3 Development of Ready-to-Serve beverages from fruits and vegetables

Fruit or vegetable juices are refreshing, thirst quenching, nutritive, invigorating and non-alcoholic beverages, which are very well accepted by mass. Juice may be squeezed directly from fruits or vegetables or may be extracted by water which can be used in their natural concentrations or in processed form.

Apple juice with low concentration of sorbic acid i.e less than 0.035 per cent was standardized by Ferguson and Powrie (1969), which was effective in preventing yeast fermentation in fresh as well as unpasteurized juice. Such juice was able to store without refrigeration for a period of two weeks with slight loss of fresh flavor.

Siddappa (1979) developed squash from Carambola fruit by pressing the ripe fruits in screw type extractor. Sugar was added to attain 55° Brix total solids. Citric acid (1%) and potassium meta bi sulphite (0.05%) were used as preservatives.

Nalwadi (1980) developed RTS beverage from muskmelon (*cucumis melo*) var. Mamordica. Fruit pulp and sugar were mixed (1:1) with addition of three parts of water, 20g citric acid and 610mg of potassium meta bi sulphite. The product was acceptable with good flavor of muskmelon and could be preserved for 2-5 months without spoilage.

West Indian cherry squash were developed with variation in total solids of 40, 45 and 50 per cent by Muthukrishnan and Palaniswamy (1992). The squash with 25 per cent juice, 50 per cent total solids and 1.5 per cent titrable acidity was highly accepted by the panelists.

Sethi *et al.* (1998) developed health drinks viz., aonla cocktail, apricot appetizer, beal squash, ber squash, black berry *sherbath*, custard apple cocktail, karonda spiced beverage, galgal-ginger squash, pomegranate appetizer from indigenous underexploited fruits which can be easily prepared at domestic level. The details of the method of preparation of the above value added products have been documented.

Banahatti (2000) utilized the bilimbi and carambola fruits for the preparation of *Sherbath*. The juice extracted from fruits was mixed with sugar and water in the proportion of 4:2:8 respectively. One per cent synthetic cardamom essence was used for bilimbi *sherbath*, whereas citric acid and cardamom essence was used at the rate of 0.5 per cent and one per cent, respectively for Carambola *sherbath*.

Shukla *et al.* (2003) ascertained that litchi juice could be blended up to 300g per liter of skim separated milk and 200g per liter of reconstituted skim milk to prepare highly acceptable and nutritious beverage.

The blended juice of lime-aonla at the ratio of 95:05 was used for the development spiced RTS beverage having 6 per cent juice, 10°Brix total solids, 0.3 per cent fortified with 2 per cent ginger juice, 0.4 per cent mint juice, 0.25 per cent cardamom and 0.1 per cent black pepper extracts along with 1 per cent salt (Dekha *et al.*, 2004).

An attempt was made to develop the refreshing, dietetic RTS beverage from bitter gourd (Barwal *et al.*, 2005b). The RTS composed of 10 per cent of bitter gourd juice with the total soluble solids adjusted to 12.5°Brix. The calorific value of the beverage was reduced by 80 per cent per serving by replacing the sucrose with the sorbitol.

Nutritionally rich and therapeutically value added herbal beverage was developed by Sahu *et al.* (2005). The beverage was prepared from 12 per cent mango pulp, 8 per cent sugar, 48 per cent water, 32 per cent whey and 1.5 per cent lemon grass distillate was found to be acceptable.

The RTS beverage formulated with the 15 per cent of bottle gourd juice. Total solids content was maintained at 15°Brix and acidity at 0.3 per cent for better acceptability.

Mujumdar *et al.* (2009) developed the juice from cucumber, litchi and lemon. Juice from the cucumber, litchi and lemon was optimized in the ratio of 65 per cent, 29.2 per cent and 5.8 per cent, respectively to obtain acceptable beverage.

### 2.3.4 Chemical composition of fresh juice

Chemical composition of the food product is necessary to know the quality of raw material, freshness and safety of the food at the time of consumption. The chemical

composition of fresh wood apple juice was reported by Patil (1991). Juice was composed of total soluble solids 7.5 °B, titrable acidity 1.8 per cent, total sugars 6.25 per cent and ascorbic acid 44.75 mg per 100 ml of juice.

Waskar and Deshmukh (1995) reported that per cent total soluble solids, acidity, total sugars and reducing sugars of pomegranate juice were 16.84, 0.38, 16.12 and 15.15, respectively and pH was reported as 5.10. Juice was found to be good source of anthocyanins and phenols i.e 54.40mg and 158mg, respectively.

Ahmed (1996) analyzed the fresh watermelon juice and reported the per cent total soluble solid as 6, acidity 0.06 and pH of the fresh juice was 6.05.

The edible portion of bottle gourd fruit juice constituted 0.12 per cent acidity, total soluble solid 3.5 °B and total sugars 3 per cent. The fruit contained appreciable amount of ascorbic acid which accounts 14mg per 100 g (Baber *et al.*, 1998).

Patil (2000) analyzed the chemical composition of fresh watermelon juice which was composed of total soluble solid 9.5-10.5 °B, acidity 0.11-0.13 per cent, total sugars 7.34 per cent, pH 5.5 and ascorbic acid 5.18 mg.

The juice obtained from kinnow fruit had total soluble solid 10°B, acidity 0.4 per cent, pH 4.41 and ascorbic acid 28.84mg (Panesar *et al.*, 2000). Khamrui and Pal (2004) recorded that fresh whey based Kinnow juice concentrate possessed 44.83 per cent total sugars, 39.12 per cent total carbohydrates, 1.15 per cent protein, 2.75 per cent titrable acidity and pH around 3.29.

### 2.3.5 Shelf life of processed juice

Shelf life of any product indicates its potential for being stored for a definite period of time without any deteriorating effects on its quality parameters. Storage life indirectly indicates the market life of the product. Carrot juice developed by acidifying with citric acid, pasteurized, subjected to light and dark storage at 4, 25 and 35 °C for three hours. It was noticed that the amount of lutein and carotenoids in carrot juice decreased with increase in storage temperature. The retention of carotenoids was better in dark storage (Chen *et al.*, 1996).

Mango juice was analyzed during storage of four months at ambient temperature, in order to follow the changes in the juice (Nemr *et al.*, 1998). Heat processing at 85°C for 10 min caused the reduction of all volatile fractions and ascorbic acid during bottling. Storage of bottled mango juice at room temperature resulted in the cloudy appearance because of ethyl fatty acids and selenic-11-ene-4-ol, in addition to a decrease in hydrocarbons and oxygenated components responsible for the flavour of mango juice.

About 19.6 per cent of vitamin C was lost in the frozen (-23 °C), unpasteurized polythene bottled orange juice during the storage of 24 months. Vitamin C declined from 40.6 mg to 32.8 mg per 100ml of the juice at the end of the storage period (Lee and Coats, 1999).

Drinks based on cashew and passion fruit juice drinks were aseptically filled in cartons, stored at 25±2°C. No significant changes in pH and acidity were observed during storage. The shelf life of cashew drink was limited to 60 days, whereas the passion fruit drink was stable up to 90 days, after which drinks attained sensory changes which were unacceptable (Alvese and Sarantopoulos, 2001).

Dhaliwal and Hira (2001) studied the effect of storage on physico-chemical and nutritional characteristics of carrot-beetroot and carrot-black carrot blended juices. The mean sensory scores of both juices decreased but non significant, during storage period of six months at ambient temperature (25±3°C). Similarly, no significant changes in pH, acidity, total solids, viscosity and mineral content of the juices were reported. Six months of storage period resulted in 71.26 to 80.28 per cent losses in ascorbic acid and 56.60 to 66.57 per cent losses in β-carotene contents.

The bitter melon RTS beverage with 10 per cent juice, 12.5° Brix total soluble solids, 0.5 per cent citric acid and 1000 ppm of potassium metabisulphite as a preservative was hot filled in sterilized glass bottles and pasteurized (100°C, 30 mins). Six months of storage at room temperature showed no significant changes in total soluble solids content but gradual increase in reducing sugars (4.09-4.47 %), decrease in titrable acidity (0.41-0.39 %), ascorbic

acid (8.84-76.7 mg/100g) and total sugars (9.98-9.61 %) was recorded. Highest taste scores were observed at the end of the storage period but overall acceptability decreased during the storage (Barwal *et al.*, 2005a).

Kumar and Manimegalai (2005) studied the storage stability of whey (10%) blended based papaya (10%) RTS beverage stored at refrigerated temperature for three months. During the storage period a periodic increase in acidity and reducing sugars were observed, where as decrease in pH, total sugars and ascorbic acid were also recorded. No change in the total soluble solids was observed. Sensory attributes were found to be highly acceptable even after storing for three months.

Kinetics of ascorbic acid degradation in citrus juice concentrates viz., orange, lemon and grape fruit juice during eight weeks of storage at 28, 34 and 45 °C were investigated by Bardurlu *et al.* (2006). Ascorbic acid in citrus juice concentrates decreased with increase in the storage temperature. Orange juice concentrate had lowest reaction rate at 28°C but lemon juice concentrate showed highest destruction at all the temperature.

RTS beverage prepared from stone apple (*Aegle marmelos*) stored for eight months at room temperature revealed that the pH, total sugars and ascorbic acid were reported to decrease during storage period. Increasing trends were observed for total soluble solids and titrable acidity (Rayguru *et al.*, 2008).

Nidhi *et al.* (2008) reported that total sugars, acidity and non enzymatic browning increased in RTS beverage prepared from blending bael and guava fruit which was stored for two months at room temperature. But pH, ascorbic acid and total phenolic content decreased gradually.

Majumdar *et al.* (2009) developed and studied the storage stability of cucumber, litchi and lemon blended beverage, which was bottled and stored for six months at room temperature (28±2°C). Acidity and pH of the blended juice during storage ranged from 0.25 to 0.30 per cent and 3.9 to 4.0 respectively. Changes in the total soluble solids and total sugar content reported to be marginal. About 74 per cent of the vitamin C was estimated to be lost, where as no major difference was noticed in the overall sensory attributes during the storage.

Santos *et al.* (2009) determined the levels of micro nutrients in bottled tomato pulp stored at room temperature (20±1.8°C) for a period of six months. Lycopene content had undergone no significant changes, where as levels of ascorbic acid, malic acid and citric acid were fallen significantly during the storage.

### 2.3.6 Microbial changes in juice during the storage

Assessment of microbial contamination indicates the sanitary quality of the food products. Micro organisms associated with the food products not only cause the spoilage, but also responsible for the food borne illness. Proper processing and storage conditions can control the growth of the micro organisms in the food products. Yeast, moulds and coliforms were not detected in unpasteurized, sweet orange juice stored in sterilized containers at refrigerated conditions (10±2°C) up to four days, there after juice exhibited presence of microbes except *Staphylococcus aureas*. Pasteurization and refrigeration inhibited the growth of microbes (Jain *et al.*, 2003).

Addition of 350 ppm of potassium meta bi sulphite in whey based kinnow juice concentrate was found to be effective in retarding the growth of yeast and mould counts during storage at refrigerated temperature (4±1°C, 80% RH) for nine months and at ambient temperature (15-35°C, 66-85 % RH) for four months were observed by Khamuraui *et al.* (2004).

Bacterial and yeast counts in bottled, pasteurized mandarin orange juice were negligible ( $1 \times 10^{-3}$ ) till 180 days of storage at ambient (30±5°C) and refrigerated temperature (7-8°C). After 180 days, fungal counts were detected at room temperature ( $6 \times 10^{-1}$ ) as well as at refrigerated temperature ( $1 \times 10^{-3}$ ), the counts being considerably higher at ambient conditions (Ladaniya *et al.*, 2004).

Full plate growth of micro flora was observed after 60 days of storage at room temperature in RTS beverage developed from bitter gourd fruit (Barwal *et al.*, 2005a).

The microbial analysis of stored whey based papaya juice for 90 days at refrigerated condition was studied by Kumar *et al.* (2005). A slight increase in colonies of bacteria ( $1-2 \times 10^{-6}$ ), yeast ( $1 \times 10^{-5}$ ) and fungi ( $1-2 \times 10^{-4}$ ) were observed, which are considered as safe for consumption.

Nirmal *et al.* (2006) found that in the wood apple RTS beverage with addition of sodium benzoate was found to be effective in controlling the growth of micro organisms, as no microbial growth was observed at 90 days of storage.

Standard plate count of bottle gourd juice treated with sodium benzoate (100 ppm) registered  $4 \times 10^{-3}$  and  $3 \times 10^{-3}$  counts during the storage of three months at room temperature ( $30 \pm 2^\circ\text{C}$ ) and at cold temperature ( $5 \pm 1^\circ\text{C}$ ), respectively (Madhukar, 2008).

Effect of thermal processing ( $92^\circ\text{C}$ , 2min) and high pressure treatment (500Mpa,  $25^\circ\text{C}$ , 10min) on microbial inactivation of tomato juice during refrigerated storage at  $4^\circ\text{C}$  for 28 days was investigated by Hsu, *et al.* (2008). It was reported that thermal processing produced microbial stable juice with total viable counts less than 1.0 cfu/ml, without any detection of yeast, moulds and *E.coli*. High pressure treatment also resulted in efficient inactivation of all micro organisms with the minimum loss of other nutrients.

## 2.4 Development of Value added products from fruits and vegetables

Attempts have been made by several investigators to add value to the fruits and vegetables and to standardize the protocol for the developed products. The rind obtained as waste product after preparation of watermelon juice was used as prepare preserves and candies, which were transparent, crisp with characteristic flavor. All the products were found to be highly acceptable (Burhanuddin *et al.*, 1982).

Wax gourd candy was prepared by using sucrose and high fructose syrup in proportion of 100:0, 75:25, 50:50, 25:75 and 100 per cent, fructose syrup at 30, 45, 60 and 75 °B. Candy prepared with 25 per cent sucrose and 75 °B fructose syrup proved the best for overall sensory parameters and storage life of product (Siddique *et al.*, 1990).

A process for converting the pumpkin pulp into a flavored sweet-sour pickle was given by Teotia (1992). The process includes chilling the pumpkin in the brine at  $4.4^\circ$  to  $7.2^\circ\text{C}$  for more than five hours followed by draining, rinsing, cooling and subsequently combining with sugar, vinegar and spices to achieve desired crispiness.

An attempt was made by Dhumai *et al.* (1996) to prepare acceptable toffee by using custard apple. Toffee was prepared by using 750 g sugar, 20g skim milk powder, 120g vanaspathi, 5g salt per kg of fruits and 2g of citric acid as preservative.

Baber *et al.* (1998) standardized the procedure for preparation of tuti-fruity from bottle gourd fruit. The tuti-fruity was developed by syruling with the addition of citric acid and calcium chloride at one percent which exhibited highest organoleptic scores.

Maciel *et al.* (1999) prepared jelly from an underexploited fruit acerola, with juice extracted by blanching and crushing the fruit. Jelly composed 50 per cent acerola juice, 49 per cent sucrose and 1 per cent pectin. The product stored at ambient temperature was stable up to 120 days.

Bilmbi and carambola preserves were developed by Banahatti (2000). Fruits were pricked with steel fork all over, immersed in slaked lime for three hours. Lime water was drained, washed under running water. The fruits were boiled in sugar syrup (25 °B) for 15 mins and drained. Drained syrup was boiled to attain 70 °B, fruits were readded to syrup. Two per cent citric acid was added to Carambola preserve to attain good acceptability.

Some of the value added preserved products viz., pickle, tuti-fruity, *vadiyams*, cheese etc. were prepared by using watermelon rind. All the products were highly acceptable when given for sensory evaluation by trained panelists (Devi and Madhuri, 2000).

Pumpkin *Kofta* has been standardized by Teotia *et al.* (2004), mixing with the 20-25 per cent of bengal gram flour. Further, *Kofta* was deep fried at  $130-140^\circ\text{C}$  for optimum taste, texture and other sensory attributes.

Chug (2009) standardized the value added products from fresh pumpkin as a major ingredient, viz., *Halwa*, *Kheer*, Jam, soup and *Burfi* which were highly acceptable. Instant soup powder (15 % pumpkin powder), *Vadi* (15 % pumpkin powder, 85 % green gram dhal and moth bean dhal), Biscuits (15 % pumpkin powder and 85 % refined flour) and *Ladoo* (25 % pumpkin powder) were also standardized by using dehydrates pumpkin powder.

From the above reviews, it can be concluded that value addition to ash gourd is very limited, where as common fruits and vegetables are utilized for the preparation of RTS beverage, preserve, candy, tuti-fruity and jelly in India and several parts of globe. Hence there is a tremendous scope for value addition of Ash gourd because of its medicinal and sensory characteristics.

### 3. MATERIAL AND METHODS

The present study on “Standardization and characterization of value added Ash gourd (*Benincasa hispida*) Ready-to-Serve (RTS) beverage” was carried out in department of Food Science and Nutrition, College of Rural Home Science, Dharwad, Karnataka, during the year 2009-10. The research procedure followed has been described in this section.

#### 3.1 Market Survey on availability of ash gourd

A survey was conducted to investigate the availability of ash gourd fruit among the vegetable vendors (N=10) of Dharwad city concentrating on the market area. Data on availability, place of procurement, method of storage, season of highest sale and cost of the fruits were collected by questionnaire (Appendix I).

#### 3.2 Availability of ash gourd products in the retail outlets

A survey was also carried out to document the availability of ash gourd products in randomly selected retail shops (N=10) located in Dharwad city by questionnaire (Appendix II). Availability of various ash gourd products, place of procurement, packaging material and cost of the products were recorded.

#### 3.3 Documentation of utility of ash gourd among urban and rural households

Dharwad was divided into five locations covering the areas, Hosayellapur, Murgamaath, Koppadakeri, Malamaddi and Srinagar. Six families from each locality were randomly selected for the documentation of the utility of ash gourd by using questionnaire (Appendix III).

Two villages viz., Rampur and Veerapur of Dharwad taluk, where ash gourd in commonly grown were purposively selected. A total of 15 families from each village were randomly selected to form a sample size of 30. Details about ash gourd, its utility, place of procurement, processing and storage were collected through personal interview using questionnaire (Appendix IV).

#### 3.4 Utility of ash gourd in the Ayurvedic Health Care Centers

A survey was carried out to elicit information on utility of ash gourd and its products for medicinal purpose in five randomly selected Ayurvedic health care centers of Hubli-Dharwad city. Information regarding medicinal utility of ash gourd, method of processing and mode of storage were collected using questionnaire (Appendix V).

#### 3.5 Physical parameters of ash gourd (N=50)

Physical parameters viz., size colour, length, breadth and circumference of 50 ash gourd fruits collected from 10 vegetable vendors (five fruits from each vendor) were studied.

#### 3.6 Composition of ash gourd

Fresh, well matured ash gourd fruits procured from local market of Dharwad city in the month of June was used for analysis. Edible portion of fruit was subjected to chemical analysis in triplicates, using standard procedures (Anon., 1990).

##### 3.6.1. Nutrient composition of ash gourd

###### 3.6.1.1 Moisture

To estimate the moisture content, 5g of the ash gourd pulp was dried in hot air oven at 60-70 °C till two concurrent readings were obtained. The per cent moisture was calculated using the formula,

$$\text{Moisture (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Weight of the sample}} \times 100$$

### 3.6.1.2 Protein

The total nitrogen content was estimated by using KelPlus Classic DX instrument. The total nitrogen of moisture free Ash gourd was estimated by micro Kjeldal method. Crude protein was calculated by multiplying the total nitrogen by factor 6.25.

$$\text{Nitrogen (\%)} = \frac{(\text{Titrated value of sample} - \text{Titrated value of blank}) \times 14 \times 0.02 \times 100}{\text{Weight of the sample}}$$

### 3.6.1.3 Crude fat

Crude fat was analyzed by using an instrument SocsPlus SCS-2. Crude fat from the moisture free sample was estimated using solvent extraction method with petroleum ether (60-80°C).

$$\text{Fat (\%)} = \frac{\text{Weight of ether extract}}{\text{Weight of the sample (2g)}} \times 100$$

### 3.6.1.4 Total ash and minerals

Moisture free sample (5g) was analyzed for ash content by charring and igniting the known weight of sample in silica crucible at 600 °C, for 3-5 hours and there by ash percentage was calculated by difference in the weight of crucible. The dry ash was converted into mineral solution. Total iron and zinc from the samples was estimated by injecting the mineral solution in Atomic Absorption Spectrophotometer (AAS Avanta GBC model).

$$\text{Ash (\%)} = \frac{\text{Weight of the ash}}{\text{Weight of the sample}} \times 100$$

### 3.6.1.5 Total carbohydrates

Per cent of total carbohydrate was computed by subtracting the sum of moisture, protein, fat, ash and crude fibre from 100.

### 3.6.1.6 Crude fibre

Crude fiber was estimated from moisture and fat free sample. The residue obtained after digestion with acid and alkali was dried in crucible. The difference in weight of crucible before and after ashing of the digested residue was taken as weight of crude fiber.

$$\text{Crude fibre (\%)} = \frac{\text{Loss in weight on ignition } (W_2 - W_1) - (W_3 - W_1)}{\text{Weight of the sample (3g)}} \times 100$$

## 3.6.2 Chemical composition of ash gourd

The edible portion of the ash gourd was analyzed for total soluble solids (TSS), titrable acidity, total sugars, pH and ascorbic acid content in triplicates by using standard procedures (Anon., 1995).

### 3.6.2.1 Total soluble solids (TSS)

TSS was measured by using Erma hand refractometer and was expressed as degree Brix.

### 3.6.2.2 Titrable acidity

The acidity of Ash gourd was determined by titrating against 0.1N NaOH and was expressed in terms of anhydrous citric acid. The per cent titrable acidity is calculated using formula,

$$\% \text{ Total acid} = \frac{\text{Titre Value} \times \text{N.alkali} \times \text{Volume Made up} \times \text{Equivalent wt of acid}}{\text{Weight of Sample (2 ml)} \times 1000} \times 100$$

### 3.6.2.3 Total sugars

The reducing, non reducing and total sugars of Ash gourd were estimated (Somogyi, 1955). Reducing sugar was estimated by colour change in alkaline solution and quantified based on amount of sugar present. Total sugars were estimated by acid hydrolysis of non reducing sugar.

### 3.6.2.4 Ascorbic acid

Ascorbic acid in Ash gourd was determined by 2,6 dichlorophenol indophenol visual titration method.

Ascorbic acid is calculated using formula.

$$\text{Ascorbic acid (Mg/100g)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{vol made up}}{\text{Aliquot of Extract} \times \text{Wt/vol. of Sample (2 g)}} \times 100$$

## 3.7 pH

pH of the ash gourd juice was recorded by digital pH meter.

## 3.8 Ash gourd residue analysis

The residue obtained after complete extraction of the juice was analyzed for nutrient composition in triplicates composition in triplicates, by using standard procedures as mentioned in 3.6.

## 3.9 Extraction of ash gourd juice

Matured fruits procured from local market were surface washed, cut into small cubes and seeds were removed by manual peeling. Cubes were further subjected to blanching. Ash gourd cubes were loosely tied in muslin cloth, dipped in boiling water (80°C) for 3-4 mins, and allowed to cool. Details of processing of Ash gourd into juice is shown in Fig. 1.

## 3.10 Stability of ash gourd juice

Stability of juice extracted from matured ash gourd without blanching was studied at laboratory level, by recording the changes occurred in sensory parameters in an every hour during the storage at ambient temperature (28±1°C) till the acceptability level. Sensory evaluation was carried out with nine point Hedonic scale by the investigators from the department of Food science and Nutrition.

## 3.11 Protocol for the preparation of ash gourd RTS beverage

The extract of the ash gourd was blended with different taste enhancers viz., sugar, common salt, rock salt and lemon juice which were further spiced with pepper and cumin seeds. Preliminary trials were conducted to study the permutations and combinations for most acceptable concentrations of taste enhancers with developed Ash gourd beverage which were organoleptically evaluated by trained panelists (N=10) by using nine point Hedonic scale. The most acceptable combination was further bottled and studied for shelf life.

### 3.11.1 Sensory evaluation of fresh ash gourd RTS beverage

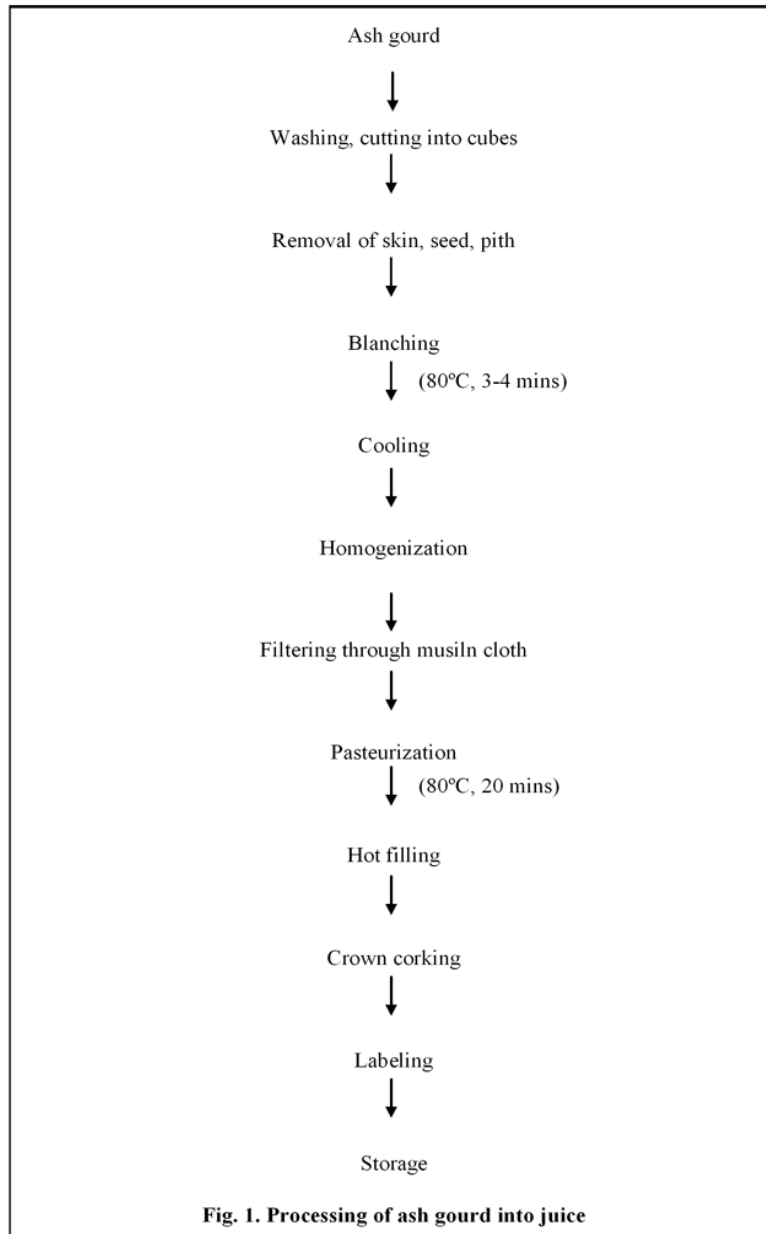
Fresh, ash gourd RTS beverage was evaluated organoleptically by trained panelists (n=10) with the help of nine point Hedonic scale.

### 3.11.2 Chemical composition of ash gourd RTS beverage

Developed ash gourd juice was chemically analyzed for total soluble solids, titrable acidity, pH, ascorbic acid, total and reducing sugars by using standardized procedures as discussed in 3.7.

### 3.11.3 Microbial quality of ash gourd RTS beverage

The fresh ash gourd RTS beverage was analyzed for total bacteria, fungi and yeast counts by employing serial dilution technique followed by pour plate method (Lakshmanan *et al.*, 1971).



**Fig. 1. Processing of ash gourd into juice**

### 3.12 Shelf life study of ash gourd RTS beverage

The ash gourd RTS beverage was hot filled in the sterilized glass bottles (200 ml capacity) and sealed by corking. The bottled RTS beverage was stored at ambient ( $28 \pm 2^\circ\text{C}$ ) and refrigerated temperature ( $5 \pm 2^\circ\text{C}$ ) for three months and studied for sensory and nutritional changes in regular interval during storage.

### 3.12.1 Sensory evaluation of ash gourd RTS beverage during storage

The developed RTS beverage was evaluated for organoleptic attributes at an interval of 15 days by trained panelists (N=10) using nine point Hedonic scale, till the acceptability status.

### 3.12.2 Quality evaluation of ash gourd RTS beverage during storage

Developed ash gourd RTS beverage was analyzed for change in its physico-chemical composition at an interval of 30 days using standard procedures discussed in 3.6.2.

### 3.12.3 Microbial quality of RTS beverage

The developed ash gourd juice stored at ambient and refrigerated temperature was analyzed for microbial quality, before and after storage period (Lakshmanan *et al.*, 1971). Composition of media is given in Appendix 8.

#### 3.12.3.1 Total bacterial counts

Ten ml of sample was transferred aseptically to a 90ml sterile blank, mixed thoroughly to obtain  $10^{-1}$  dilution which was further diluted up to  $10^{-3}$  using 9ml sterile water blanks.

One ml each of the aliquot of  $10^{-3}$  dilution was transferred on to sterile petriplate in triplicates about 20ml of warm nutrient agar was poured into each petriplate and gently rotated clockwise and anti clockwise thrice for proper mixing. On solidification, plates were incubated at  $37\pm 1^{\circ}\text{C}$  for a period of 24-48 hrs in inverted position and colony counts were recorded.

#### 3.12.3.2 Total fungi

Ten ml of sample was transferred aseptically to a 90ml sterile blank and mixed thoroughly to obtain  $10^{-1}$  dilution which was serially diluted up to  $10^{-3}$  using 9ml sterile water blank. One ml each of aliquot of  $10^{-3}$  dilution was transferred to sterile petriplates in triplicates.

About 20ml of warm ( $40^{\circ}\text{C}$ ) Rose Bengal agar was poured into each plate gently rotated clockwise and anti-clockwise for proper mixing. On solidification plates were incubated at  $37\pm 1^{\circ}\text{C}$  for a period of 24-48hrs in inverted position and colony counts were recorded.

#### 3.12.3.3 Total Yeast

Ten ml of sample was transferred aseptically to a 90ml sterile blank mixed thoroughly to obtain  $10^{-1}$  dilution which was further diluted up to  $10^{-3}$  using 9 ml sterile water blank.

One ml each of the aliquot of  $10^{-3}$  dilution was transferred on to sterile petriplate in triplicates about 20ml of warm MGYEP agar was poured into each petriplate and gently rotated clockwise and anticlockwise thrice for proper mixing. On solidification plates were incubated at  $37 \pm 1^{\circ}\text{C}$  for a period of 24-48hrs in inverted position and colony counts were recorded.

Colonies were counted and calculations were done to obtain the CFU (Colony Forming Units) per gram sample by the following formula,

$$\text{CFU/ml} = \frac{\text{Number of colonies} \times \text{dilution factor}}{\text{Weight of sample}}$$

### 3.13 Statistical analysis

The data obtained from sensory, chemical and microbiological analysis of the ash gourd RTS beverage was statistically analyzed using the Completely Randomized Design (CRD) to find out the significant difference during the storage period. The association of sensory parameters, chemical constituents and microbial load of the ash gourd RTS beverage with storage period was tested using correlation and students 't' test.

## 4. RESULTS

The findings of the present study on documentation of availability and utility of ash gourd and its products, standardization and characterization of value added ash gourd RTS beverage carried out during 2009-2010 are presented in the chapter.

### 4.1 Availability of ash gourd and its products

#### 4.1.1 Availability of ash gourd fruit in local market

Table 1 depicts the data on availability of ash gourd fruit among the vegetable vendors of Dharwad city. It was apparent that fruits were procured from the surrounding villages. The fruits were available throughout the year but highest sale was observed during summer (70.00%) and during some special occasions (30.00%) like marriages, generally 5-10 fruits were sold in a week. Cost of the fruits varied from 20 to 30 Rs per Kg. Fruits were placed in a wooden rack (60.00%) or sometimes hung (40.00%) to extend the shelf life (Plate 2). An average shelf life of the fruits was 6-8 months, when kept unopened. Damaged fruits were utilized as animal feed (80.00%) or sometimes simply discarded (20.00%).

#### 4.1.2 Availability of ash gourd products in the retail outlets

Availability of ash gourd products in retail outlets of Dharwad city is documented in Table 2. A dehydrated, traditional product *Sandige* was the only product available in the 40.00 per cent of retail outlets. *Sandige* was obtained from small scale cottage industries (50.00%) and self help groups (50.00%). Quantity of the product per unit pack varied with 200g (50%) to 250g (50%). The product was packed and sealed in high density polyethylene packs without labels and brands. Usually 4-6 unit packs of *Sandige* were sold in a month. Cost of per 100g of unit pack varied from 16-17 Rs.

### 4.2 Utility of ash gourd and its products

#### 4.2.1 Utility of ash gourd fruit in rural and urban households

The demographic profile of the urban and rural respondents is given in Table 3. It was found that 73.30 per cent of urban and 83.30 per cent of rural respondents belonged to the age group of 30-40 yrs, where as 16.60 per cent respondents from both the places belonged to the age group of 40-50 yrs. About 10.00 per cent of the urban respondents were between 50-60yrs of the age group.

Cent per cent of the urban and 26.60 per cent of the rural respondents were literate, where as 73.30 per cent of the rural respondents were found to be illiterate. Among the urban respondents 76.60 per cent were housewives, 23.40 per cent were government employees, where as 70.00 per cent of the rural respondents were agriculturists and 30.00 per cent were labourers.

About 93.30 per cent of the urban and 46.60 per cent rural respondents were living in the nuclear families, 6.60 per cent of urban and 53.30 per cent rural respondents were living in the joint families. Among the urban respondents, 30 per cent had small family size, 63.30 per cent medium family size and 3.30 per cent large family size. A reverse trend was evident in the counterpart that, about 10 per cent of rural respondents had small family size, 43.30 per cent had medium family and 36.60 per cent had big family.

Among the total urban respondents, 93.30 per cent belonged to Hindu and 6.60 per cent belonged to Muslim religion. Similar pattern was observed in rural community also.

Table 4 elicits the information regarding the utility of ash gourd and its byproducts among the rural and urban households. About 53.30 per cent of rural and 50.00 per cent of urban population used matured Ash gourd for the preparation of *Sandige*. Urban people procured the fruit from the local vegetable vendors, where as people from the villages grow in the kitchen garden.

About 13 per cent of urban and 25 per cent of rural respondents preferred to consume *sandige* monthly, 86.6 per cent of urban and 75 per cent of rural population preferred to use occasionally.

**Table 1: Availability of ash gourd among the vegetable vendors**

Sl. No.	Particulars	Content	Frequency (N=10)	Per cent
1	Place of procurement of ash gourd	Surrounding villages	10	100
2	Season of availability	Throughout year	10	100
3	Season of highest sale	Summer Special occasions	7 3	70 30
4	Fruits sold (per week)	5-10	10	100
5	Selling cost (per Kg)	20-30/-	10	100
6	Method of storage	Placed in wooden rack Hanging with rope	6 4	60 40
8	Period of storage	6-8 months 8-10 months	8 2	80 20
7	Utilization of damaged fruit	Animal feed Discarded	8 2	80 20



**Ashgourd fruit hung in rope**



**Ash gourd fruit placed on wooden rack**

**Plate 2. Method of storage**

**Table 2: Availability of ash gourd products in retail outlets**

Sl. No.	Particular	Frequency (N=10)
1	Ash gourd products available in retail outlets	4 (40)
2	Product <i>Sandige</i>	4 (40)
3	Place of procurement Self Help Group Cottage industry	2 (50) 2 (50)
4	Details of the Product Unbranded Unlabelled	4 (100) 4 (100)
5	Packaging material High Density Poly Ethylene (HDPE)	4 (100)
6	Cost (per 100g)	16-17/-
7	Frequency of sale (per unit pack) Monthly	4-6 packs
8	Period of storage 4-8 months	4(100)

Note: Figures in the parenthesis indicate percentage

**Table 3: Demographic profile of urban and rural respondents**

Sl. No.	Particulars	Urban (N=30)		Rural (N=30)	
		Frequency	Per cent	Frequency	Per cent
1	Age 30-40 yrs 40-50 yrs 50-60 yrs	22 5 3	73.30 16.60 10.00	25 5 -	83.30 16.60 -
2	Education Literate Illiterate	30-	100.00 -	8 22	26.60 73.30
3	Occupation Housewife Agriculturist Labor Govt. Employee	23 - - 7	76.60 - - 23.40	- 21 9 -	- 70.00 30.00 -
4	Type of Family Nuclear Joint	28 2	93.30 6.60	14 16	46.66 53.30
5	Family Size Up to 4 (Small) 5-7 (Medium) > 8 (Large)	9 19 2	30.00 63.30 3.30	3 13 11	10.00 43.30 36.60
6	Religion Hindu Muslim	28 2	93.30 6.66	28 2	93.30 6.66

**Table 4: Utility of ash gourd fruit at urban and rural households**

Sl. No.	Particulars	Contents	Urban (N=30)		Rural (N=30)	
			Frequency	Per cent	Frequency	Per cent
1	Utility of ash gourd fruit		15	50	16	53.3
2	Form	Mature	15	100	16	53.3
3	Place of procurement	Vendors	15	100	-	-
		Kitchen garden	-	-	16	100
4	Products prepared	<i>Sandige</i>	15	100	16	100
		Others	-	-	-	-
5	Frequency of	Monthly	2	13.3	4	25
	Consumption of products	Occasionally	13	86.6	12	75

The method of preparation and ingredients of *Sandige* varied with religion. Hindu Lingayat people prepare *Sandige* by grinding the soaked black gram dhal along with spices like green chilly, garlic, cumin seeds and salt, further grated Ash gourd along with seeds was mixed with ground paste and sundried.

People from Brahmin and Maratha community prepare *Sandige* by mixing the grated Ash gourd with spice mix (Cumin seeds, Salt, Green chilli, Asafoetida) and slightly soaked puffed rice and sundried. *Sandige* was stored for 6-8 months in the air tight aluminum or plastic box with or without polythene cover.

By products of the ash gourd fruit viz., peel, seed and pith were used as feed for animals in the rural areas, where as they were discarded in urban sectors. It was also noticed that people from both the places were unaware about the therapeutic values of ash gourd fruit.

#### 4.2.2 Utility of ash gourd in Ayurvedic Health Care Centre

Ayurvedic health care centers of the Hubli-Dharwad city were surveyed to elicit the utility of ash gourd to treat the diseases or disorders (Table 5). About 60 per cent of health care centers utilized the ash gourd fruit in the form of the juice during acidity, nausea, and epilepsy and obesity treatment. About 50-100ml of juice was prescribed twice in a day with or without any taste enhancers.

The protocol followed for the extraction of the juice from the ash gourd fruit was as follows: Matured fruit were washed, cut into small cubes, seeds and pith of the fruit were separated manually. Juice from the peeled fruit was extracted in the electrical grinder and strained through muslin cloth. Extracted juice was stored in refrigerator.

### 4.3 Physical parameters of ash gourd

The physical parameters of the ash gourd fruits are documented in Table 6. The fruit was medium green in colour, which darkens with maturity. The shape of the fruit varied from round to cylindrical. The thin, tough skin of the fruit was found to be coated with a preservative layer of white, chalky wax. The flesh was snow white, crisp and juicy with mild flavour. Small fruits on an average weighed less than 1Kg, with the registered length of 17cm, breadth 18.75cm and circumference 30.37cm, where as medium fruits possessed an average weight of 2-3Kg, with varied length from 22-24cm, breadth 21-22cm and circumference 31-37cms. Physical parameters of fruit increased with the size of the fruit. The average weight of large fruit was recorded more than 3Kg, with length 28-30 cm, breadth 27-30cm and circumference 34-37cm (Plate 3).

### 4.4 Chemical composition of matured ash gourd

Matured Ash gourd fruit was analyzed for crude protein, fat, crude fiber, ash, and mineral content as per the standard procedures and presented in Table 7. The edible portion of the matured fruit documented 96 per cent of moisture, 0.58g of protein, 0.28g of fat, 1.68 per cent of carbohydrates and 0.6 per cent of ash. The crude fiber accounted for 1.0g per 100g. The fruit possessed negligible amount of iron 0.73mg, copper 0.036 mg and zinc 0.14mg per 100g. The fresh fruit was composed of total soluble solids 2.5°B, acidity of 1.20 per cent, total sugars 0.98 mg while reducing sugars 0.69 mg and 11.04 mg of ascorbic acid per 100g.

Residue of the ash gourd fruit was composed of moisture 95 per cent, ash 0.4 per cent, crude fibre 4.0g, iron 1.0 mg, copper 0.048 mg and zinc 0.16 mg per 100g (Table 8).

**Table 5: Utility of ash gourd in Ayurvedic Health Care Centers**

Sl. No.	Particulars	Frequency (N=5)	Per cent
1	Utility of ash gourd	3	60.0
2	Diseases /Disorders		66.6
	Nausea	2	60.0
	Acidity	3	60.0
	Epilepsy	3	60.0
	Obesity	3	60.0
3	Prescribed form		60.0
	Juice	3	
4	Frequency		60.0
	Twice in a day	3	
5	Quantity		60.0
	50-100 ml	3	

**Table 6: Physical parameters of ash gourd**

Sl. No.	Size	Shape	Colour	Weight (kg)	Length (cm)	Breadth (cm)	Circumference (cm )
1	Small ( < 1 kg )	Round	Medium green	1.0±0.20*	17.37 ± 2.35	18.75 ± 2.30	30.37 ± 1.88
2	Medium (1-3 Kg )	Cylindrical	Medium green	2.03 ± 0.36	22.51 ± 2.83	21.46 ± 2.93	31.45 ± 6.33
3	Large ( > 3 Kg )	Cylindrical	Medium green	3.2 ± 0.59	28.13 ± 2.25	27.34 ± 3.50	34.8 ± 3.90

Values are mean ± SD of 50 fruits



**Mature ash gourd fruit**



**Cut opened ash gourd fruit**

**Plate 3. Matured and cutopened ash gourd fruit**

**Table 7: Chemical composition of ash gourd**

	Parameters	Content
I	Proximate principles (g/100g)	
	Moisture	96.0±1
	Protein	0.58±0
	Fat	0.28±0
	Ash	0.60±0.01
	Crude fiber	1.00±0.12
	Carbohydrates	1.68±0
II	Minerals (mg/100g)	
	Iron	0.73±0.02
	Copper (mg/100g)	0.036±0.03
	Zinc (mg/100g)	0.14±0.02
III	Vitamin	
	Ascorbic acid (mg/100g)	11.04±0.02
IV	Others	
	Total soluble solids (°B)	2.50±0
	Titration acidity (% citric acid )	1.20±0.32
	Total sugars (mg/100g)	0.98±0.035
	Reducing sugars (mg/100g)	0.69±0.21
	pH	4.90±0.11

Values are mean ± SD

**Table 8: Chemical composition of ash gourd residue**

Parameters	Content
Moisture (g/100g)	95.0±0.80
Ash ( g/100g )	0.40±0.2
Crude fibre (g/100g)	4.01±0.8
Iron (mg/100g)	1.01±0.7
Copper (mg/100g)	0.048±0.85
Zinc (mg/100g)	0.16±0.4

Values are mean ± SD

#### 4.5 Stability of ash gourd extract at ambient temperature

Stability of ash gourd extract was assessed in terms of changes in sensory parameters stored at ambient temperature ( $28\pm 1^{\circ}\text{C}$ ) is presented in Table 9. The extract was scored between liked moderately to dislike by the expert panelists. The mean colour scores of ash gourd extract decreased significantly ( $P\leq 0.05$ ) from 8.20 to 5.8, as the colour of extract darkened during storage period. Change in the colour was more prominent during last two hours. The mean scores for consistency showed declining trend from 7.0 to 6.2, which was more prominent during last three hours of storage. Consistency of the extract decreased significantly from 7.0 to 6.2. Rate of decrease was slightly higher during last three hours of storage. A significant decrease ( $P\leq 0.05$ ) in the aroma from 7.0 to 5.0 was observed throughout the storage period. The fresh aroma of the ash gourd extract was retained during first two hours, thereafter extract tends to lose fresh aroma with the progress of storage. The mean scores for the taste decreased gradually from 7.0 to 5.0 which was found to be significant ( $P\leq 0.05$ ). Gradual development of sour taste contributed to the unacceptability of the Ash gourd extract. The overall acceptability of the ash gourd extract decreased significantly ( $P\leq 0.05$ ) from 7.0 to 4.6 throughout the storage period. The total scores of the extract decreased from 36.42 to 26.0 with the corresponding acceptability indices from 80.93 per cent to 57.77 per cent during subsequent storage.

#### 4.6 Development and evaluation of ash gourd RTS beverage

Preliminary trials were conducted to study the acceptability of the ash gourd RTS beverage with different concentrations of taste enhancers. Ash gourd RTS beverage with different taste enhancers was evaluated by expert panelists ( $n=10$ ). The details of the trials are presented in the Table 10. The ash gourd extract was cream-yellow and translucent with optimum sweet taste after the addition of sugar (1.75 %). Further addition of the pepper (0.2, 0.3 and 0.4 %) changed the colour and consistency. Strong spicy flavour was observed at the higher concentration of pepper. Addition of the cumin seed powder (0.2, 0.3 and 0.4 %) has not affected the colour, consistency and flavour. The extract mixed with sugar (1.75%) and different concentrations of pepper and cumin seed powder (0.2, 0.3, and 0.4 %) was found to be unacceptable by the experts as the extract was not blending with the any of the taste enhancers properly. Addition of rock salt (0.5 %) resulted in the brown coloured, semi clear ash gourd extract with unique flavour. Further addition of the pepper (0.2, 0.3 and 0.4 %) darkened the colour, with the strong appealing spicy flavour. The colour and characteristic aroma of the rock salt contributed to the unacceptability of the extract by the panelists.

**Table 9: Stability of ash gourd extract**

Storage hours (≠)	Parameters					Total scores (Max 45)	Acceptability Index
	Colour	Consistency	Aroma	Taste	Overall acceptability		
0	8.0±0.70 <sup>¥</sup>	7.10±0.04	7.2±0.20	7.04±0.04	7.04±0.40	36.42	80.93
1	8.2±0.83	7.2±0.2	7.0±0	7.0±0	7.1±0.1	36.20	80.44
2	8.0±0.70	7.2±0.1	6.2±0.2	6.8±0.44	6.2±0.2	33.80	75.11
3	7.8±0.44	7.0±0	6.0±0	6.0±0	6.0±0	32.80	72.88
4	7.2±0.44	6.4±0.54	5.8±0.44	5.8±0.44	5.6±0.54	30.80	68.44
5	6.0±0.70	6.2±0.44	5.8±0.44	5.4±0.54	5.8±0.44	29.20	64.88
6	5.2±0.44	6.2±0.44	5.0±0	5.0±0.70	4.6±0.54	26.00	57.77
'F' value	19.13*	4.04*	30.8*	11.36*	22.45*		
CD (0.05)	0.73	0.48	0.30	0.53	0.43		

Note: 1. <sup>¥</sup>-Values are Mean ± SD  
2.\*Significant at 0.05 level  
3.≠ Stored at ambient temperature (28 ±1°C)

**Table 10: Preliminary trials for the development of ash gourd RTS beverage**

Ingredients	Variations	Descriptive characteristics*
Sugar and pepper powder	Sugar (1.75%)	Cream-yellow colour, translucent, prominent sweet taste (Unacceptable)
	Sugar (1.75%) + Pepper (0.2%)	Light brown colour, semi clear, sweet and sensible spiced flavour (Unacceptable)
	Sugar (1.75%) + Pepper (0.3%)	Light brown colour, semi clear, sweet and moderate spiced flavour (Unacceptable)
	Sugar (1.75%) + Pepper (0.4%)	Dark brown, semi clear, strong spicy flavour (Unacceptable)
Sugar and Cumin seed powder	Sugar (1.75%) + Cumin seed (0.2%)	Cream-yellow colour, clear sweet with no spiced flavour (Unacceptable)
	Sugar (1.75%) + Cumin seed (0.3%)	Cream-yellow colour, clear, sweetish without spicy flavour (Unacceptable)
	Sugar (1.75%) + Cumin seed (0.4%)	Cream-yellow colour, clear, moderately sweet and spiced flavour (Unacceptable)
Rock salt and Pepper powder	Rock salt (0.5%)	Brown colour, semi clear, unique aroma and taste (Unacceptable)
	Rock salt (0.5%) + Pepper (0.2%)	Dark brown colour, unclear, distinct flavour (Unacceptable)
	Rock salt (0.5%) + Pepper (0.3%)	Dark brown colour, unclear, strong spicy flavour (Unacceptable)
	Rock salt (0.5%) + Pepper (0.4%)	Dark brown colour, unclear, Pungent flavour after taste (Unacceptable)
Rock salt and Cumin seed powder	Rock salt (0.5%) + Cumin seed powder (0.2%)	Brown colour, semi clear, distinct aroma without spicy flavour (Unacceptable)
	Rock salt (0.5%) + Cumin seed powder (0.3%)	Brown colour, semi clear, unique aroma with moderate spicy mouth feel (Unacceptable)
	Rock salt (0.5%) + Cumin seed powder (0.4%)	Brown colour, semi clear, distinct aroma with strong spicy flavour (Unacceptable)
Plain salt and Pepper Powder	Plain salt (0.5%)	Cream-yellow, transparent, plain salty taste (Unacceptable)
	Plain salt (0.5%) + Pepper (0.2%)	Cream-yellow, transparent, optimum salt-spicy flavour (Acceptable)
	Plain salt (0.5%) + Pepper (0.3%)	Light brown, transparent, strong spicy flavour (Unacceptable)
	Plain salt (0.5%) + Pepper (0.4%)	Dark colour, semi clear, biting spicy flavour (Unacceptable)
Plain salt and Cumin seed powder	Plain salt (0.5%) + Cumin seed powder (0.2%)	Light brown, transparent, plain taste with no spicy flavour (Unacceptable)
	Plain salt (0.5%) + Cumin seed powder (0.3%)	Light brown, transparent, strong spicy flavour (Unacceptable)
	Plain salt (0.5%) + Cumin seed powder (0.4%)	Light brown, clear, strong, pungent mouth feel after taste (Unacceptable)

\*as judged expert panelist

Addition of the cumin seed powder (0.2, 0.3 and 0.4 %) along with the rock salt (0.5%) also found to be unacceptable, as the ash gourd extract was dark brown, semi clear with aroma and spicy mouth feel. Ash gourd extract was further blended with plain salt (0.5 %), pepper and cumin seed powder (0.2, 0.3, and 0.4 % respectively). Addition of pepper (0.2%) resulted in the cream-yellow coloured, clear extract, with the optimum spicy flavour, hence judged as acceptable by the judges. Addition of higher amount of the pepper (0.3 and 0.4 %) found to be spicy. Addition of the cumin seed powder (0.2 and 0.3 %) has not changed the colour, consistency and flavour of the extract, but at the higher concentration (0.4 %) the extract was found to be pungent after taste and hence it was not acceptable. Thus, 0.5 per cent of plain salt and 0.2 per cent of pepper was found to be acceptable combination of the taste enhancers for the development of ash gourd RTS beverage.

#### 4.6.1 Sensory evaluation of fresh ash gourd RTS beverage

Sensory quality attributes of fresh ash gourd RTS beverage evaluated by nine point Hedonic scale by 10 trained panelists are given in Table 11. The extract was liked moderately by the panelists as the RTS beverage obtained mean scores for colour, consistency, aroma, taste and overall acceptability were 7.4, 7.9, 7.0, 7.1 and 7.2 respectively. Colour of the RTS was not much affected by the addition of pepper. The RTS beverage possessed optimum salt-spicy flavour spiced flavour which was acceptable by the panelists.

#### 4.6.2 Chemical composition of fresh ash gourd RTS beverage

The data pertaining to the chemical composition of ash gourd RTS beverage are presented in Table 12. The RTS beverage recorded total soluble solids as 2.5°B, acidity (as % citric acid) 1.28 per cent. RTS beverage was found to be good source of ascorbic acid which was recorded as 10.8mg per 100 ml. Total and reducing sugar of the developed RTS beverage were found to be 0.5 mg and 0.75 mg respectively. Although fresh RTS beverage was not sour, pH was recorded as 5.14.

### 4.7 Shelf life of ash gourd RTS beverage

The RTS beverage was filled in sterilized glass bottles (200ml capacity) pasteurized (80°C, 20 mins) and sealed by corking. Bottled RTS beverage was stored at ambient (28±2°C) and refrigerated temperature (5±2°C) and studied for changes in the sensory and chemical profile.

#### 4.7.1 Sensory evaluation of ash gourd RTS beverage stored at refrigerated temperature

The stability of RTS beverage during storage at refrigerated temperature is illustrated in Fig.2 (Plate 4) and also Table in Appendix IX. The mean scores for colour of the RTS beverage ranged between 7.0 and 7.4 during 60 days of storage period. A slight decrease was observed in colour scores with the progress of the storage period which was statistically not significant ( $P \leq 0.05$ ). The colour of the RTS beverage darkened after 30 days of storage onwards.

The mean scores for consistency decreased from 7.9 to 7.8 but remained on par with scores obtained when RTS beverage was fresh. A significant reduction ( $P \leq 0.05$ ) in aroma from 7.0 to 6.3 was noticed. The fresh aroma of RTS beverage was lost during the entire course of storage period. The mean scores for taste of the RTS beverage exhibited a declining trend which was found to be significant ( $P \leq 0.05$ ). RTS beverage turned to be sour during the 30 days of storage onwards. The mean scores for overall acceptability of the RTS decreased from 7.2 to 6.7 during 60 days of storage at refrigerated temperature.

Whereas the RTS beverage stored at ambient temperature was found developed sour taste within two days of storage. However there was no visual growth of moulds.

Effect of storage period on acceptability indices of ash gourd RTS beverage are presented in the Table 13. Total scores of the RTS beverage gradually decreased from 36.60 to 29.70 and corresponding acceptability indices from 81.33 to 66.0 per cent during 60 days of refrigerated storage.

**Table 11: Sensory evaluation of fresh ash gourd RTS beverage**

Parameters	Scores*	Descriptive characters
Colour	7.4 ±0.96	Light cream-yellow colour, clear, mild salt-spicy flavour.
Consistency	7.9 ±0.87	
Aroma	7 ± 0.94	
Taste	7.1 ±0.73	
Overall acceptability	7.2 ± 0.6	

Note: 1.Values are Mean ± SD  
2.\*Ratings on 9 point Hedonic scale

**Table 12: Chemical composition of fresh ash gourd RTS beverage**

Parameters	Content
Total soluble solids (°B)	2.50±0
Titration acidity (%)	1.28±0.2
Ascorbic acid (mg/100ml)	10.8±1.0
Total sugars (mg/100g)	2.93±0.10
Reducing sugars (mg/100g)	0.75±0.19
pH	5.14±0.01

Values are Mean ± SD

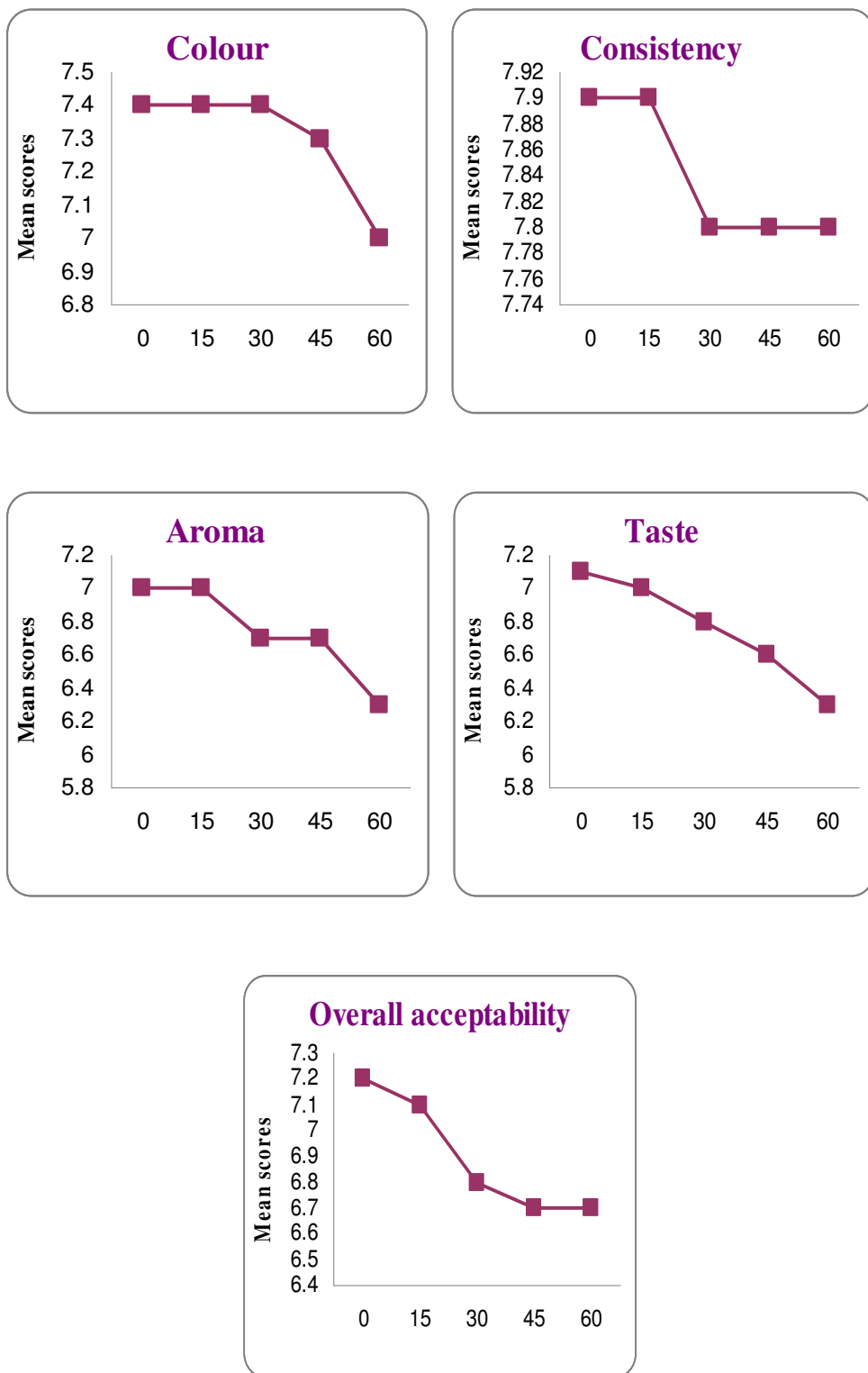
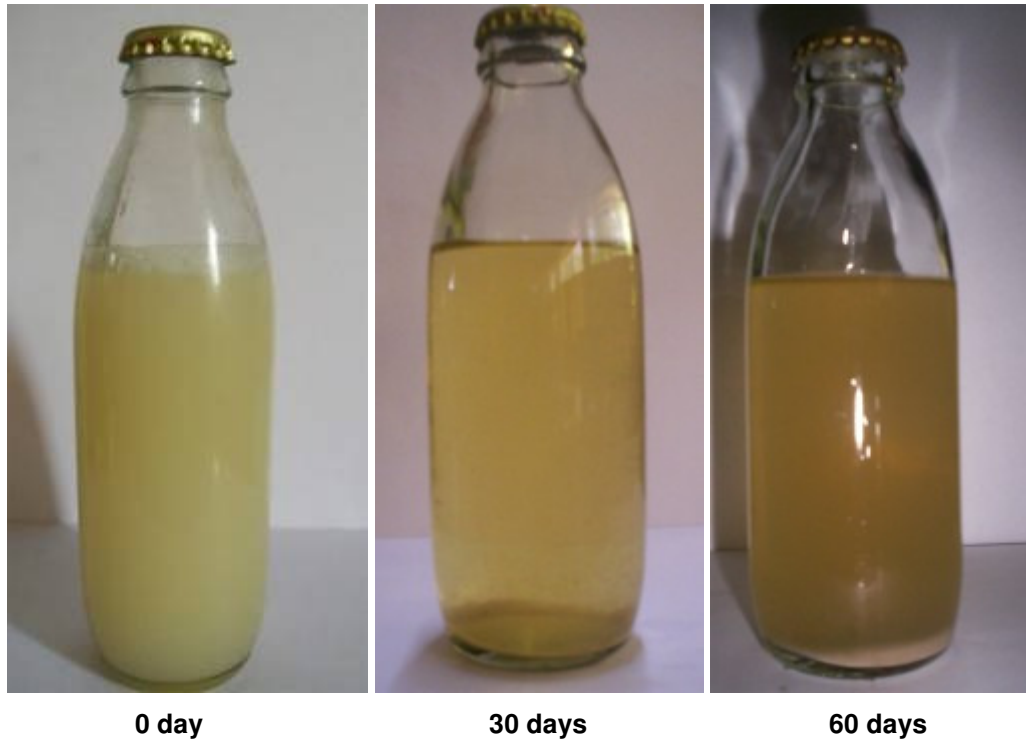


Fig. 2. Changes in the sensory parameters of ash gourd RTS beverage during storage



**Plate 4. Effect of storage on appearance of ash gourd RTS beverage**

**Table 13: Effect of storage period on acceptability indices of the ash gourd RTS beverage**

Storage period (Days)	Total scores (Max 45)	Acceptability Index (%)
0	36.60	81.33
15	37.90	84.22
30	35.45	78.77
45	35.10	78.00
60	29.70	66.00

**Table 14: Correlation co-efficient between sensory parameters and storage period of ash gourd RTS beverage**

Parameter	'r'
Color	- 0.792*
Consistency	- 0.944*
Aroma	- 0.948*
Taste	- 0.852*
Overall Acceptability	- 0.921*

\*- Significant at 0.05 level

The data in Table 14 indicates the correlation coefficient between the sensory parameters of RTS beverage and storage period. It is evidenced that a strong negative correlation exists between all the sensory parameters of the RTS beverage and storage period, which was found to be not significant at 5 per cent level.

#### 4.7.2 Effect of storage period on chemical composition of ash gourd RTS beverage stored at refrigerated temperature

The Data on chemical changes of ash gourd RTS beverage stored at refrigerated conditions at different intervals are presented in Table 15. Slight increase in total soluble solids from 2.5 to 3<sup>0</sup> B was observed which was found to be not significant ( $P \leq 0.01$ ). The titrable acidity significantly increased ( $P \leq 0.01$ ) from 0.3 per cent to 1.92 per cent with the advancement of the storage period. The pH of the extract reduced from 5.06 to 5.14, though it was statistically not significant ( $P \leq 0.01$ ). The Change in the acidity and pH of the RTS beverage resulted in the development of sour taste during storage.

Ascorbic acid content of the RTS beverage was significantly reduced ( $P \leq 0.01$ ) from 10.8mg to 4.8 mg, rapid loss of ascorbic acid was found during first 30 days of storage. The total sugars decreased from 0.5mg to 0.25mg where as reducing sugars increased from 0.75mg to 1.25 mg, however the decrease was statistically not found to be significant ( $P \leq 0.01$ ).

The data in Table 16 indicates the correlation between the chemical constituents of the ash gourd RTS beverage and storage period. It is revealed that, pH, total sugars and ascorbic content of RTS beverage stored at refrigerated temperature was negatively correlated with storage period which was found to be statistically non significant ( $P < 0.01$ ), while total soluble solids, titrable acidity and reducing sugars of the RTS beverage are positively correlated with the storage period. Correlation among titrable acidity and total sugars was found to be significant ( $P \leq 0.01$ ). Apparently there was no visible off flavor, fermentative gas production in Ash gourd RTS beverage during storage.

**Table 15: Effect of storage period on chemical composition of ash gourd RTS beverage**

Storage days(≠)	Parameters					
	Total Soluble Solids (°B)	Titrable acidity (%)	Ascorbic acid (mg/100g)	Total sugars (mg/100g)	Reducing sugars (mg/100g)	pH
0	2.5	1.28	10.80	2.93	0.75	5.14
30	3.0	1.35	4.80	0.50	0.95	5.10
60	3.0	1.92	4.80	0.25	1.25	5.06
SEm	0.14	0.40	2.13	0.06	0.19	0.05
'F' value	6.5	894**	111**	9.2	2.84	4.84
CD (0.05)	NS	0.014	1.97	NS	NS	NS

Note: 1. \*\*Significant at 0.01 level  
 2. NS- Not Significant  
 3. ≠ Refrigerated temperature

**Table 16: Correlation co-efficient between chemical composition and storage period of ash gourd RTS beverage**

Parameter	'r'
Total soluble solids (°B)	0.86 <sup>NS</sup>
Titration acidity (%)	0.99 *
Ascorbic acid (mg/100g)	-0.87 <sup>NS</sup>
Total sugars (mg/100g)	-0.96 *
Reducing sugars (mg/100g)	0.86 <sup>NS</sup>
pH	-0.67 <sup>NS</sup>

\* - Significant at 0.01 level  
<sup>NS</sup>- Not Significant

**Table 17: Effect of storage period on microbial counts of ash gourd RTS beverage during storage at refrigerated temperature**

(Population=NoX10<sup>-2</sup> CFU/ml)

Micro organisms	Initial (0 day)	Final (60 days)	S.Em.	'F' Cal	CD (0.05)
Yeast	1.60	8.00	1.06	1.20	NS
Bacteria	1.00	6.30	2.22	25.6*	3.58
Mould	ND	2.00	0.89	12.0	NS

Note: 1.ND -Not detected  
 2.\*Significant at 0.05 level  
 3. NS- Not Significant

#### 4.7.3 Microbial evaluation of ash gourd RTS beverage stored at refrigerated temperature

The data pertaining to the microbial evaluation of RTS beverage during storage are given in the Table 17. It is evident that yeast counts increased non significantly ( $P \leq 0.05$ ) from  $1.6 \times 10^{-2}$  cfu/ml to  $6.3 \times 10^{-2}$  Cfu/ml, where as non significant in the bacterial counts from  $1 \times 10^{-2}$  cfu/ml to  $6 \times 10^{-2}$  cfu/ml was observed. The fresh RTS beverage was free from the moulds, after 60 days of refrigerated storage  $1 \times 10^{-2}$  cfu/ml moulds were detected (Plate 5, Plate 6 and Plate 7).

The data in Table 18 elicits the data on correlation coefficient between microbial load and storage period of the ash gourd RTS beverage. Yeast and the bacteria are positively correlated ( $r=0.50$  and  $0.32$  respectively) with the storage period. Correlation among chemical composition and microbial counts of Ash gourd RTS beverage during the refrigerated storage is presented in the Table 19. Yeast and bacteria are negatively correlated with the titrable acidity ( $r=-0.15$  and  $-0.68$  respectively), total sugars ( $r=-0.62$  and  $-0.95$  respectively) and pH ( $r=-0.77$  and  $-0.29$  respectively) while strong negative correlation exist between moulds and total soluble solids ( $r=-1$ ), ascorbic acid ( $r=-0.99$ ) and pH ( $r=-0.50$ ).

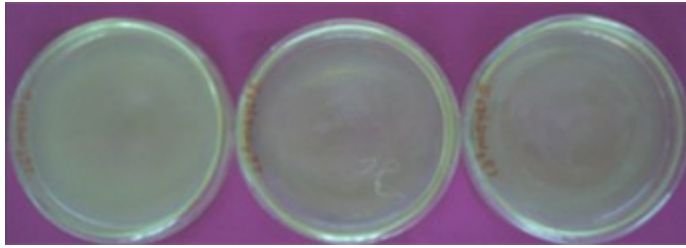
**Table 18: Correlation between microbial counts of ash gourd RTS beverage and storage period**

Micro organisms	Initial	Final	'r'
Yeast	$1.60 \pm 1.10$	$8.00 \pm 1.70$	0.50
Bacteria	$1.00 \pm 1.00$	$6.30 \pm 1.50$	0.32
Mould	ND	$2.00 \pm 1$	0

ND- Not detected

**Table 19: Correlation between chemical composition and microbial load of ash gourd RTS beverage**

Chemical parameters	(Population= $\text{No} \times 10^{-2}$ CFU/ml)		
	Yeast	Bacteria	Mould
Total soluble solids ( $^{\circ}\text{B}$ )	0.15	0.68	-1
Titrable acidity (%)	-0.15	-0.68	1
Ascorbic acid (mg/100g)	0.26	0.76	-0.99
Total sugars (mg/100g)	-0.62	-0.95	0.86
pH	-0.77	-0.29	-0.5

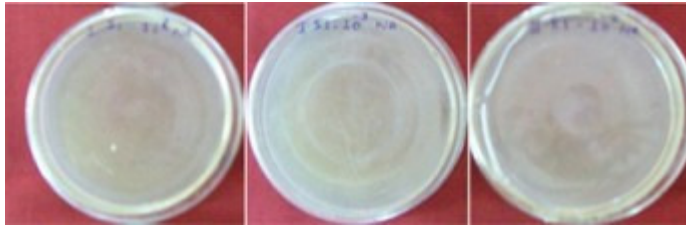


**Initial**

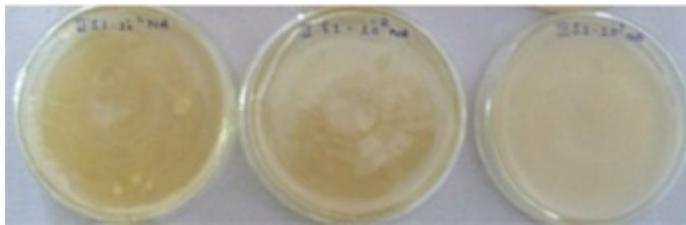


**Final**

**Plate 5. Yeast colonies (10-2cfu/ml) of the developed ash gourd RTS beverage during storage**



**Initial**



**Final**

**Plate 6. Total bacterial colonies (10-2cfu/ml) of the developed ash gourd RTS beverage during storage**



**Initial**



**Final**

**Plate 7. Mould colonies (10-2cfu/ml) of the developed ash gourd RTS beverage during storage**

## 5. DISCUSSION

Ash gourd (*Benincasa hispida*) is considered as one of the underutilized horticultural crops, as the crop is neither grown commercially on large scale nor traded widely. Ash gourd is cultivated, traded and consumed locally. The importance of ash gourd as a vegetable crop has been long recognized due to its high nutritional value, medicinal properties and innumerable use. *Petha*, the very popular sweet with a delicious and absorbing taste is translucent, clear candy prepared from matured fruits. The famous Ayurvedic preparation '*Kusumanda rasayanam*' used as a nerve tonic and health rejuvenator which is prepared using a well matured fruit. High costs, lack of awareness and ideological aspects keep the fruit away from regular consumption and adversely affects vegetable business. Utility of ash gourd can be enhanced by developing the nutritionally and therapeutically acceptable products and made available commercially. Effective use of such neglected species can help in increase awareness of their value and promote efforts to conserve them. Hence, the present investigation was carried in the direction of studying the availability of Ash gourd and its products, physico-chemical constituents and to develop the technology for preserving the Ash gourd RTS beverage. The findings of the present study are discussed with relevant justification.

### 5.1 Availability and utility of ash gourd and its products

Many of the Cucurbitaceous vegetables being resilient and adaptive can be grown on the land, which is not suitable for other vegetables. They do not require a high input technology and can be raised with comparatively lower management costs. Several of them are very nutritious, remunerative and have come to rescue of the farmers in times of crisis. Apart from the nutritional value, many regional cucurbitaceous crops are used for medicinal purposes, income generating and poverty alleviation programmes (Yadav *et al.*, 2003). Ash gourd also referred as Winter melon belongs to cucurbitaceae family, which is extensively used for therapeutic purposes in the Ayurvedic medicine. Ash gourd is commonly found to grow on sandy loamy soil in warm sunny light and stable temperature. Although fruit requires hot weather to grow, fruit can be stored through the winter. The surface of the fruit is covered with the waxy, hairy layer which helps in extending the shelf life. In spite of the favorable conditions in India, fruits are underutilized. Vegetable vendors of the Dharwad city procured the fruit from the nearby villages. Maximum sale of the fruit was noticed during summer, as fruit is commonly used in *Sandige* which is dehydrated using natural sunlight. Occasionally fruits are also used for culinary purposes in the Brahmin families. However the usage of the fruit is very limited, as the cut opened fruits are highly perishable and being bigger in size (>1 Kg), it is difficult to utilize the whole fruit for a short period of time. This might be the reason for underutilization of the ash gourd fruit at house hold level. In general only 5-10 fruits were sold in a week, as people were unaware about medicinal values. Fruits are also purchased during some special occasions like marriage rituals, house warming ceremony etc since it was believed in some Hindu religion that, the fruit draws the negative vibrations from the surrounding atmosphere. Because of the limited sale and higher cost (20-30Rs/Kg), fruits were not commonly available among all vegetable vendors as compared to other fruits and vegetables.

Amongst the retail outlets of Dharwad market, *Sandige* was the only ash gourd product available, which were supplied from local Self Help Groups and small scale cottage industries. Movement of the product was found to be low, which shows the consumer preference is restricted towards such traditional product. The residue of the fruit was used as animal feed in the villages (Table 1, 2 and 3).

The ash gourds have also being used in several other countries. In China, chunks of the matured fruit are prepared as a soup, often with pork. In Nepal, the fruit are picked or sliced dried and mixed together with Mango fruit and formed into a ball to fry later (Mark *et al.*, 2007). Various other uses of Ash gourd in India has been reported by Satyanarayana *et al.* (2010). The inner soft portion (pith) is used in preparation of tomato ketchup, where as tender leaves are used as spinach in the preparation of *Bhaji*.

In the Ayurvedic Health Care Centers, about 50-100ml of juice from the matured ash gourd fruits have been found to prescribe during obesity, acidity, nausea and epilepsy (Table 5). According to Ayurvedic experts, ash gourd is useful in preventing sugars from being

converted into fat. Antacid action of the fruit maintains the pH of the body and counteracts the acidity created in the stomach as a result of the intake of acidic foods like soft drinks, fried foods etc. Due to its diuretic action, it increases the output of urine and washes out waste products from the body. Not only the extract of the ash gourd possess the curative properties, but a delicious sweet prepared from pulp of the fruit by boiling in the sugar syrup is used as a medicine to increase weight during tuberculosis, weakness and anemia. Literature survey revealed that there is no published information on the components of the ash gourd extracts which are beneficial in curing the various diseases or disorders and its mechanism of action. Nevertheless, there is hardly any documentation of the cases being benefited by ash gourd extract. Hence, there is an urgent need for designing the further studies with ash gourd in these aspects. However Satyanarayana, *et al.* (2010) reported that, ash gourd juice when given empty stomach to hyper lipidemic subjects for 45 days recorded slight increase in HDL and decrease in VLDL cholesterol.

Matured ash gourds have known to contain significant amount of ascorbic acid and crude fibre. Fruits are found to be fair sources of carbohydrates, protein, fat and micronutrients (Table 7). The present findings are on par with the composition reported by Gopalan *et al.* (1997) except for crude fibre and ascorbic acid which were reported as 0.8g and 1mg respectively. Variations observed in the present study may be due to differences in the agronomical factors. In spite of the acidic pH and higher titrable acidity, the matured fruit was found to be bland in taste.

## 5.2 Development and quality evaluation of ash gourd RTS beverage

In developing countries like India large population of all income and age groups consume freshly squeezed fruit and vegetable juice because of the health and nutritional benefits. With change in life style, people always are on lookout for health drinks to boost the immune system as well as to feel energetic. These health drinks are also reported to have various therapeutic properties in some physiological ailments for faster recovery. Health drinks provide a foundation for the body's curative process by cleaning and restoring the vitality. Considering the therapeutic values of the ash gourd fruit, if the RTS beverage was developed and made available commercially as any other fruit beverages it could benefit the health conscious people, as the juicing is the easiest and most effective method for extracting the active principles which are stored within the individual cells of the fruit.

Before developing the RTS beverage, the stability of the juice extracted from the matured ash gourd without the application of any of the processing was studied in terms of changes in sensory profile during storage at ambient temperature ( $28\pm 1^\circ\text{C}$ ). The unprocessed ash gourd extract was found to be stable only for two hours and thereafter showed declining trend in the sensory quality (Table 9), which shows that there is a need for processing the fruit and RTS beverage to extend the shelf life.

Keeping this in view, the protocol for the development of the RTS beverage was designed (Fig.1). Initially fruit pieces were subjected to blanching, which inhibits the enzymatic activity that brings undesirable changes (Karla, 1990). Since the extracted juice was bland in taste, various taste enhancers viz., common salt, rock salt, sugar, cumin seed powder and pepper were tested at the different concentrations. Juice was found to be better accepted with salt and pepper, as pepper is one of the commonly used spices in the food. Product had appealing spicy flavour, taste and acceptable salt and pepper blend for Indian market. Pepper contributed to the mild flavour without affecting the colour of the RTS beverage (Table 10 and 11). The developed ash gourd RTS beverage was filled in sterilized glass bottles and pasteurized ( $80^\circ\text{C}$ , 20 mins) to extend the shelf life by reducing the microbial load.

The developed ash gourd RTS beverage stored at ambient temperature ( $28\pm 2^\circ\text{C}$ ) during preliminary study, was not found to be stable with respect to sensory quality for not more than two days. Processing of the RTS beverage was not found to be beneficial at ambient temperature. Hence the rest of the study was designed to store at refrigerated temperature ( $5\pm 2^\circ\text{C}$ ).

When compared with the matured ash gourd fruit, RTS beverage contained considerably higher amount of total sugars (2.93mg) and reducing sugars (0.75mg). Ascorbic acid content of the developed ash gourd RTS beverage was estimated to be low (10.8mg/100ml) when it was compared with ascorbic acid content of the fruit (11.04mg/100g) which was due to the heat treatment applied during pasteurization, which might have degraded the vitamin (Table 12).

The residue obtained after the extraction of the juice from the ash gourd was found to contain higher amount of micronutrients than that of the fruit, which needs further value addition (Table 8). Similarly the byproduct of potato i.e, peels was reported to contain higher amount of crude fibre, mineral matter and insoluble minerals than potato tubers (Sood *et al.*, 2008).

Microbial load in the food products indicates the sanitary quality. Negligible counts of yeast were observed in the RTS beverage on the day of preparation (Table 16). Contamination of RTS beverage with the bacteria on the day of preparation may resulted from their wide spread presence in air as well as contamination from the extracting machine.

Changes in sensory scores of the ash gourd RTS beverage during refrigerated storage were apparent (Fig.2). In spite of the change in colour of the ash gourd RTS beverage being darkened after 30 days storage, it was found to be acceptable by the panelists. Dark colour of the RTS beverage might be due to non enzymatic browning reactions of organic acids with the sugars or oxidation of phenols which lead to the formation of brown pigments. Packing the RTS beverage in the containers like tetra pack or other suitable packaging materials might help in preventing browning. A slight decrease in the mean scores consistency (7.90 to 7.80) was observed. The average scores for aroma of the RTS beverage exhibited declining trend (7.0 to 6.3) during 30 days of storage onwards. Significant decrease in aroma of the RTS beverage might be due to loss of aromatic substances during storage (Krishnaveni *et al.*, 2001).

Scores for the taste of the RTS beverage decreased gradually (7.54 to 6.30) because of the development of sour taste during 30 days of the storage onwards, which has also affected the overall acceptability significantly. Development of the sour taste in the RTS beverage during storage might be due to the microbial activity resulted in the fermentation.

Madhukar (2008) observed the significant decrease in the mean sensory scores of the bottle gourd RTS beverage bottled and stored at refrigerated temperature for a period of three months.

Marginal increase in total soluble solids (2.5 to 3.0°B) of RTS beverage may be due to partial hydrolysis of complex carbohydrates during storage. Increase in titrable acidity (1.28% to 1.92%) and decrease in pH (5.14 to 5.06) might probably due to growth of micro organisms or conversion of lactose to lactic acid due to mild fermentation and formation of other organic acid by ascorbic acid inherently present in the fruit during the storage (Table 15). Total sugars of the ash gourd RTS beverage ranged between 2.93 mg to 0.25 mg, where as reducing sugars varied between 0.75 mg to 1.25 mg during 60 days of storage at refrigerated temperature. The increase in reducing sugars is due to hydrolysis of non reducing sugars, where as decrease in total sugar content of RTS beverage might be due to Maillard reactions or other chemical reactions of the sugars in presence of acid (Aruna *et al.*, 1997 and Srivastava *et al.*, 1998).

About 44.44 per cent of ascorbic acid of the RTS beverage had lost during storage of 30 days. Loss of ascorbic acid concentration could be due to thermal degradation during processing and subsequent oxidation during storage period as it is highly sensitive to heat, oxidation and light (Brock *et al.*, 1998). About 86.76 per cent of ascorbic acid was reported to be lost in bitter melon RTS beverage stored at ambient temperature for six months (Barwal *et al.*, 2005b). Sawate *et al.* (2008) reported the declining trend in the total solids (15-14.9°B), acidity (0.32-0.31per cent) and ascorbic acid (1.59-1.20mg) content of bottle gourd RTS beverage during storage of one month at ambient temperature, where as such changes were not recorded at refrigerated conditions.

The number of micro organism in a food product depends on the substrate (product), its nutrient content storage period and temperature. The microbial counts observed in the RTS beverage during the storage period were considered as low (<30CFU/ml) and hence the

product was found microbiologically safe (Table 17). Good Manufacturing Practices followed during development of RTS beverage restricted the microbial growth. The standard plate count of pasteurized bottle gourd RTS beverage without any preservatives was also found to be microbiologically safe during refrigerated storage conditions for three months (Madhukar, 2008).

Microbial levels accepted in an industry range from 500 to 100,000 cfu/ml of concentrated RTS beverage. Some commercial specification for pasteurized RTS beverage allow less than 1000 to 5000 cfu bacteria, while yeast and mould levels to less than 10 cfu per ml of RTS beverage (Ladaniya *et al.*, 2004). Blocher and Busta (1983) observed that the low pH of the fruit products prevents spore germination and outgrowth. Higher acidity of RTS beverage from fruit helps to protect the product from the microbial spoilage (Sri and Bobby 2005).

Based on the above results and discussion it can be concluded that, without addition of any preservatives ash gourd RTS beverage remained stable for period of 60 days. Addition of preservatives definitely helps in extending the shelf life. Thus processing of Ash gourd fruit into RTS beverage aid in safe guarding the interests of growers during glut period and also fruit can be commercially exploited.

Future line of work:

- Attempt can be made to study the effect of different packaging materials on shelf life of ash gourd RTS beverage.
- Efficacy testing of ash gourd RTS beverage.
- Development and quality evaluation of the diversified products from the ash gourd residue.

## 6. SUMMARY AND CONCLUSIONS

Ash gourd (*Benincasa hispida*) is an annual climbing herb producing large fruits which are fleshy, succulent and densely hairy when young but thickly covered with white waxy coating on maturity. Lack of processing technology made the fruit underutilized. In view of the therapeutic and medicinal value of Ash gourd and to overcome post harvest losses it is necessary to exploit the fruit into various value added products which will give more remunerable returns to the growers and benefits the consumers with respect to nutritional and therapeutic importance. Hence the present study was undertaken to document the availability, utility of the Ash gourd and value addition to Ash gourd RTS beverage.

Survey was carried out to elicit the information on the availability of Ash gourd fruit among the vendors and ash gourd products among the retail outlets of Dharwad. Five different localities situated in different directions of Dharwad city and two villages of Dharwad where Ash gourd is commonly grown were surveyed to know the utility of Ash gourd at household level and in Ayurvedic health Care Centres of Hubli-Dharwad city was also documented.

Ash gourd RTS beverage was developed with taste enhancers like salt (0.5%) and pepper (0.2%) and pasteurization. Changes in sensory profile and chemical constituents of developed Ash gourd RTS beverage during the storage at refrigerated temperature were studied. Total bacterial counts, fungi and yeast were detected before and after storage employing serial dilution technique followed by pour plate method.

ANOVA was employed using completely randomised design to determine the changes that occurred in sensory chemical as well as microbial load of the RTS beverage during storage. Association of sensory parameters, chemical composition and microbial load with the storage period was tested with the help of correlation.

Salient features of the present investigation are summarized below:

- The vegetable vendors procured the ash gourd fruit from the nearby villages of Dharwad city. The fruit are available throughout the year, but highest sale was recorded during summer (70%) and during special occasions (30%). Usually 5-10 fruits were sold in a week. On an average fruit costs between 20-30 Rs per Kg. An average shelf life of the fruit varied from 6-8 months, if kept unopened. Generally fruits were kept on wooden rack or hung to extend the shelf life.
- *Sandige* was the dehydrated product available in 40 per cent of retail shops. Which were supplied by the local self help groups (50%) and small scale cottage industry (50%). *Sandige* was packed in a High Density Polyethylene packs, without any labels. Cost of per 100g of unit pack varied from 16-17 Rs. Movement of the product in the market was found to be very low.
- About 50.00 per cent of urban population and 53.3 per cent of rural folk utilized the ash gourd fruit for the preparation of *Sandige*. The method of preparation and ingredients varied with religion. The residue was used as animal feed in the villages, whereas, it was discarded in the urban sector. People were unaware about the nutritional significance of Ash gourd.
- About 50-100 ml of ash gourd juice was prescribed twice in a day during the obesity, acidity, nausea and epilepsy in 60 per cent of Ayurvedic Health Care Centres.
- The ash gourd fruits were available in different shapes and sizes. The outer portion of the fruit was medium green in colour which darkens with the maturity. The average weight of the fruit varied from 0.5-3kg, length 18-35cm, breadth 15-33cm and circumference 30 - 37cm.
- The edible portion of the matured ash gourd constituted 96 per cent moisture, protein 0.58g, fat 0.28g, carbohydrates 1.68g, crude fibre 1.0g, ash 0.6 per cent and iron 0.73mg copper 0.036 mg and zinc 0.14mg per 100g.

- The fresh ash gourd fruit was composed of total soluble solids 2.5° B, titrable acidity 1.28 per cent, total sugars 0.98mg, reducing sugars 0.69 mg and 11.04mg of ascorbic acid per 100g of the matured fruit.
- The ash gourd residue recorded moisture of 95 per cent, ash 1.0 mg, crude fibre 4.0g, iron 1mg, copper 0.048 mg and zinc 0.16 mg per 100g.
- The stability of the unprocessed ash gourd extract at ambient temperature ( $28\pm 1^{\circ}\text{C}$ ) was found to be very short, as there was rapid decline in the sensory quality thereafter.
- The fresh ash gourd RTS beverage with 0.5 per cent plain salt and 0.2 per cent pepper scored more than 7.0 for all the sensory parameters. The fresh ash gourd RTS beverage recorded total soluble solids of 2.5°B, titrable acidity 1.28 per cent, total sugars 2.93 mg, reducing sugars 0.75 mg and ascorbic acid 10 mg per 100ml of juice. pH of the fresh RTS beverage was 5.14.
- Ash gourd RTS beverage had extended the shelf life of 60 days at refrigerated conditions ( $5\pm 2^{\circ}\text{C}$ ), while the sensory parameters declined thereafter.
- An increase in the titrable acidity (1.28 to 1.92%), reducing sugars (0.75 mg to 1.25mg) and total soluble solids (2.5°B to 3°B) were evidenced. whereas pH (5.10 to 5.06), total sugars (2.93 mg to 0.25 mg) and ascorbic acid (10.8 mg to 4.8 mg) of the RTS beverage decreased continuously with the progress of storage at refrigerated temperature.
- The microbial growth observed in the RTS beverage during storage was within the safer limits, as the detected colonies were less than 30 cfu/ml.

Based on the present investigation, it can be concluded that availability and utility of the ash gourd fruit can be enhanced by developing acceptable RTS beverage and effectively stored in sterilized crown corked glass bottles at refrigerated conditions.

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\*Originals not seen

# APPENDIX I

## Questionnaire to elicit the information on availability of ash gourd

### I General information

Name of the vendor :

### II Specific information

- 1) Do you sale ash gourd? Yes/No
- 2) If yes,
  - a) Place of procurement :
  - b) Season of availability :
  - c) Quantity sold (per week) :
  - d) Season of highest sale :
  - e) Selling cost (Rs/Kg) :
  - f) Method of storage :
  - g) Utilization of damaged fruit : Reused/discarded totally
- 3) Physical properties of ash gourd

Sl no	Size	Colour	Shape	Circumference (cms)	Weight (Kg)	Length (cms)	Breadth (cms)
1							
2							
3							
4							
5							

## APPENDIX II

### Availability of ash gourd products in retail outlets

#### I General information

Name of shop :

Address :

#### II Specific information

1) Are there any ash gourd products available in your shop? Yes/No

2) If Yes,

a) Name of product :

b) Place of procurement : Prepared at home/SHG/Cottage industries/Others

c) Details of the products : Branded

Unbranded

Labeled

Unlabelled

d) Packaging material used : .....

e) Cost (per unit pack) : .....

f) Frequency of sale (per week/month) : .....

### APPENDIX III

#### Questionnaire to elicit information on utility of ash gourd among urban house holds

##### I General information

Name of the respondent: \_\_\_\_\_  
 Address : \_\_\_\_\_  
 Age : \_\_\_\_\_  
 Caste : \_\_\_\_\_  
 Occupation : Housewife/Agriculturist/Labor/Business/Government employee  
 Type of family : Nuclear/Joint/Extended  
 Size of family : M: \_\_\_\_\_ F: \_\_\_\_\_ Children: \_\_\_\_\_ Total: \_\_\_\_\_

##### II Specific information

- 1 Do you use ash gourd? Yes/No
- 2 If yes,
  - a. Matured/Immature \_\_\_\_\_
  - b. From where do you procure? : Vendor/Retail shop/Kitchen garden
  - c. Frequency of consumption : Daily/Weekly/Fortnightly/Monthly/Occasionally
  - d. Consumption pattern of ash gourd and its products

Products	Method of preparation

- 3 Do you utilize byproducts? Yes/No
- If yes,

Byproducts	Food	Feed	Others
Seed			
Pith			
Peel			

- 4 Is it used as medicine for any ailment? Yes/No
- If yes, list.

## APPENDIX IV

### Questionnaire to elicit information on utility of ash gourd among rural house holds

#### I General information

Name of the respondent:

Address :

Age :

Caste :

Occupation :

Housewife/Agriculturist/Labor/Business/Government  
employee

Type of family : Nuclear/Joint/Extended

Size of family : M: F: Children: Total:

#### II Specific information

- 1 Do you use ash gourd? Yes/No
- 2 If yes,
  - a. Matured/Immature :
  - b. From where do you procure? : Vendor/Retail shop/Kitchen garden
  - c. Frequency of consumption : Daily/Weekly/Fortnightly/ Monthly/  
Occasionally
  - d. Consumption pattern of ash gourd and its products

Products	Method of preparation

- 3 Do you utilize byproducts? Yes/No  
If yes,

Byproducts	Food	Feed	Others
Seed			
Pith			
Peel			

- 4 Is it used as medicine for any ailment? Yes/No  
If yes, list.

## APPENDIX V

### Utility of ash gourd in health care centers

#### I General information

Name of the health care centre :

Address :

Head/In charge :

#### II Specific information

1) Do you use ash gourd to treat any diseases? Yes/No

2) If yes,

Diseases	Form in which it is prescribed	Frequency	Quantity	Method of preparation	Storage	
					Method	Packaging material

## APPENDIX VI

### Proforma for sensory evaluation of ash gourd RTS with taste enhancers

Name of the judge:

Sl No.	Sensory scores	Samples							
		A	B	C	D	E	F	G	H
1	Colour and appearance								
2	Consistency								
3	Aroma								
4	Taste								
5	Overall acceptability								

Date:

#### Sensory Score ratings

9 Like extremely

4 Dislike slightly

8 Like very much

3 Dislike moderately

7 Like moderately

2 Dislike very much

6 Like slightly

5 Neither like/dislike

1 Dislike extremely

**Remarks:**

**Signature**

## APPENDIX VII

### Proforma for sensory evaluation of Ash gourd RTS beverage during storage

Name of the judge:

Sl No.	Sensory scores	Number of days						
		0	15	30	45	60	75	90
1	Colour and appearance							
2	Consistency							
3	Aroma							
4	Taste							
5	Overall acceptability							

Date:

#### Sensory Score ratings

9 Like extremely

8 Like very much

7 Like moderately

6 Like slightly

5 Neither like/dislike

4 Dislike slightly

3 Dislike moderately

2 Dislike very much

1 Dislike extremely

Remarks:

Signature

## APPENDIX VIII

### Composition of agar medium

#### Nutrient Agar Medium (Pramer and Schmiedt, 1965)

Ingredients	Grams
Peptone	5.0
Yeast extract	3.0
Sodium Chloride	5.0
Agar	15.0
Distilled water	1000 ml
pH	7.0

All ingredients were dissolved in 1000ml distilled water. pH was adjusted to 7, and medium was sterilized at 121°C for 15mins in an autoclave.

#### Martins Rose Bengal Agar (Martin 1950)

Ingredients	Grams
Dextrose	10.0
Peptone	5.0

All ingredients were dissolved in 1000ml distilled water. pH was adjusted to 6, medium was sterilized at 121 °C for 15 mins in an autoclave.

#### MGYEP Agar Medium

Ingredients	Grams
Yeast Extract	3
Malt Extract	3
Peptone	5
Glucose	10
Agar	16
Distilled water	1000ml
pH	6.4-6.8

All the ingredients were dissolved in 1000ml distilled water. pH was adjusted to 6.4-6.8, and medium was sterilized at 121°C for 15min in an autoclave.

## APPENDIX IX

### Effect of storage period on sensory scores of Ash gourd RTS beverage

Storage hours (≠)	Parameters				
	Colour	Consistency	Aroma	Taste	Overall acceptability
0	7.40	7.90	7.00	7.54	7.20
15	7.40	7.90	7.00	7.54	7.10
30	7.40	7.80	6.70	6.80	6.80
45	7.30	7.80	6.70	6.60	6.70
60	7.00	7.80	6.30	6.30	6.70
<b>SEm</b>	0.47	0.39	0.41	0.47	0.47
<b>'F' value</b>	0.36	1.57	5.27*	12.1*	14.8*
<b>CD (0.05)</b>	NS	NS	1.01	1.16	1.31

Note: 1.\* Significant at 0.05 level  
 2. <sup>NS</sup> Not Significant  
 3. ≠ Refrigerated temperature

# STANDARDIZATION AND CHARACTERIZATION OF VALUE ADDED ASH GOURD (*Benincasa hispida*) READY-TO-SERVE BEVERAGE

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2010

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## ABSTRACT

Considering the therapeutic values of ash gourd (*Benincasa hispida*), the present investigation was carried out with the objectives to document the availability and utility of ash gourd and its products, as well as to develop the acceptable ash gourd Ready-to-Serve (RTS) beverage. Matured green fruits were available in varied size, length, breadth and circumference. *Sandige* was the only product available in the retail outlets of Dharwad city, which was packed and procured from the local cottage industries and self help groups. Ash gourd juice was provided in the Ayurvedic Health Care Centres for obesity, nausea, acidity and epilepsy. At household level, the fruit was utilized for the preparation of dehydrated product *Sandige*, both in urban and rural sectors of Dharwad. The fruit composed high moisture and low protein, fat, carbohydrates, total minerals and crude fibre. The ash gourd residue had high moisture, crude fibre and low mineral matter. The ash gourd juice was unstable beyond two hours at ambient temperature ( $28\pm 2^{\circ}\text{C}$ ). The developed RTS beverage with salt and pepper was bottled, refrigerated ( $5\pm 2^{\circ}\text{C}$ ), studied for changes in the quality during storage of three months. The stored RTS beverage was organoleptically acceptable and microbiologically safe up to 60 days. As storage period continued, RTS beverage turned sour with decline in sensory scores. The total soluble solids, acidity and reducing sugars increased, while ascorbic acid and total sugars decreased at the end of storage. Thus availability and utility of the ash gourd fruit can be enhanced by standardization and characterization of value added RTS beverage which can be effectively stored at refrigerated conditions.