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Acceptability and shelf-life studies on ivy gourd jelly

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Abstract
Ivy gourd is a perennial underexploited cucurbitaceous vegetable grown in India. The study was conducted to develop value added product (jelly) from ivy gourd. Three variations of ivy gourd jelly containing different levels of ivy gourd powder (10g, 20 g and 30g) were prepared. Among the variation 10 per cent level incorporation scored higher for over acceptability (8.40).The best accepted variation and control jellies were filled in glass jars and were stored at refrigerated temperature up to 21 days. Evaluation of fresh as well as stored samples for changes in chemical, sensory, microbial and moisture attributes was done at an interval of 7, 15 and 21 days. Sensory scores were decreased with increased storage period for both the control and best accepted variation. During storage study of jelly titratable acidity, total sugars and TSS were increased. However, pH and moisture were observed to be decreased with increase in storage period. Microbial population was also found to be increased with increase in storage period. The microbial growth in jelly under the study was within permitted limit till the end of shelf-life.

Keywords: Ivy gourd, jelly, variations, shelf-life, microbial growth

1. Introduction
Ivy gourd (*Coccinia indica* L.**)** is a tropical plant in the family of *Cucurbitaceae*, commonly known as little gourd. The other common names for Ivy gourd are scarlet fruited gourd, Tindori, and locally known as Thondekai (Wasantwisut and Viriyapanich, 2003; Chun 2001) [1]. The origin of ivy gourd lies in the tropical zone of Asia, North and Central Africa. It is commonly found in countries like India, Indonesia, Malaysia, Philippines and Thailand (Wasantwisut and Viriyapanich, 2003) [1]. The fruit of ivy gourd belongs to the berry type: ovoid to elliptical and hairless with thick and sticky skin. The raw fruit is green in color and turns bright red when it is ripe. The mature fruit is usually from 25 to 60 mm long by 15–35 mm in diameter and contains several pale, flattened seeds (Wasantwisut and Viriyapanich, 2003:Pekamwar *et al*., 2013) [1, 2]. The harvesting maturity of ivy gourd is determined by the fruit colour which changes from green to light green. The normal storage life of fruit is 3 to 4 days at room temperature and 7 to 10 days at refrigerated conditions (Sushmarani *et al.,* 2013) [3]. The tender green fruits are nutritious and are good source of protein, calcium, fibre and ß-carotene (vitamin A as precursor). Consuming 100 grams of ivy gourd supplies, 1.4 mg of Iron 1.6g of total dietary fiber, 40 mg of calcium and 30 mg of phosphrous (Behl *et al.,* 1993) [4]. In addition to nutrient composition, it is valued for its major biochemical constituents such as alkaloids, glycosides, flavonoids, tannins, saponins have been identified (Shaheen *et al.,* 2009) Apart from its nutritional significance, ivy gourd is valuable in medicine and various preparations which have been mentioned in indigenous system of medicine (Behl *et al.,* 1993) [4]. The claimed properties range from using the leaves, roots, stems and whole plant in the treatment of illness symptoms like skin eruptions, burns, insect bites, fever, indigestion, nausea and constipation in Unani systems of medicine (Wasantwisut and Viriyapanich, 2003) [1].
Despite, its good nutritional and medicinal value. There is not much demand for ivy gourd fruit either in fresh market or in processed form which may be due to poor awareness of consumers about its nutritive and medicinal importance. Thus, ivy gourd being under-utilized indigenous crops may be useful in food industries in the formulation of value added products thus cater for the daily needs of the citizens nutritionally. As fresh ivy gourds are perishable and easily subjected to microbial spoilage. Thus, it indicates that processing potential of ivy gourd needs to be explored for commercialization of ivy gourd. This study was planned keeping in view on its nutritional and medicinal importance of ivy gourd, to utilize them by processing product such as jelly including other value added product would provide opportunity for commercial exploitation of this crop.

2. Materials and Methods

The present experiment was conducted during the year 2016-2018 at post graduate food processing laboratory of Department of Food Science and Nutrition, College of Agriculture, UAS, GKVK, Bengaluru. Freshly harvested ivy gourds were purchased from a local vegetable market near GKVK and used for further studies.

2.1 Processing of the ivy gourd

Ivy gourd with uniform size, free from spoilage were sorted and washed with running tap water to remove adhering dirt and soil. Further they were slit into uniform slices of 1.55-2 mm thickness manually and dried in tray drier at 60°C for 6 hrs. Then the dried slices were ground into powder and sieved in 5 mm mesh and then powder is stored in air tight container, for further work.

2.2 Preparation of ivy gourd jelly

Three variations of ivy gourd jelly containing different levels of dehydrated ivy gourd powder (10g, 20 g and 30g) were prepared and compared with control pineapple jelly. Method used for preparation is given in Fig.1.Details of ingredients used is given in Table 1.Control sample was the market product.

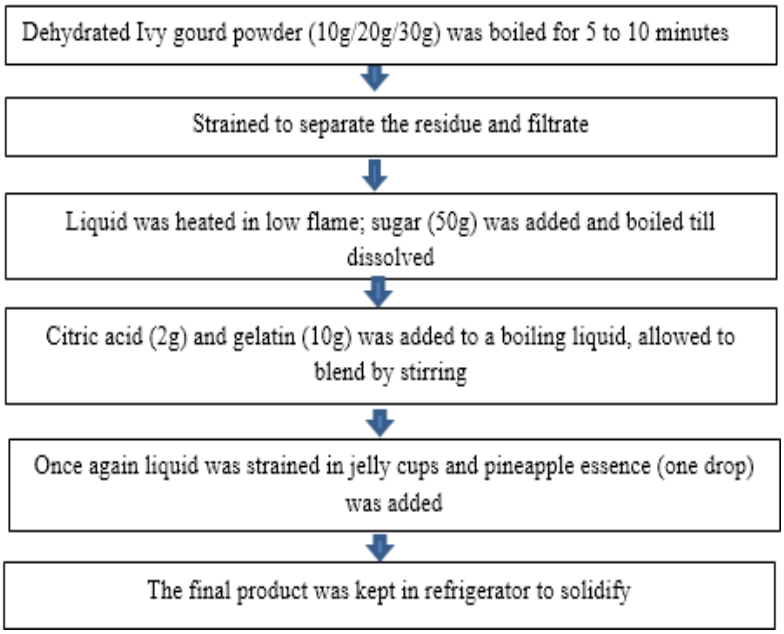

Fig 1: Flow chart for the preparation of ivy gourd jelly

Table 1: Ivy gourd jelly

S. No.	Ingredients	IGJ-1	IGJ-2	IGJ-3
1	Ivy gourd powder (g)	10	20	30
2	Sugar (g)	50	50	50
3	Gelatin(g)	10	10	10
4	Citric acid (g)	2	2	2
5	Pineapple essence-	One drop	One drop	One drop
6	Water (ml)	220	220	220

IGJ-1- Ivy gourd jelly-1, IGJ-2- Ivy gourd jelly-2, IGJ-3- Ivy gourd jelly-3

2.3 Organoleptic evaluation of the products.

Control jelly and with variations (10, 20 and 30%) were analysed for sensory characteristics. Sensory quality characteristics were evaluated by a panel of 21 semi-trained members using a 9–point hedonic scale. The products were evaluated for their appearance, colour, texture, aroma/ flavor, taste and overall acceptability.

2.4 Nutrient composition of the developed products

Nutrient composition of the best accepted jelly were analysed for macro (moisture, protein, fat, crude fibre, carbohydrate and energy) and micronutrients (calcium, iron, zinc, phosphorus and ß-carotene) using AOAC 1980 [6], procedure.

2.5 Shelf life study of the ivy gourd jelly

The best accepted jelly and control jellies were selected for shelf life studies. Jelly was stored in the glass jar and evaluated on 7th, 15th and 21st days for sensory attributes, microbial load and moisture content.

2.5.1 Microbial analysis for shelf life study (Tate, 1995) [7]

The microbial analysis of the jellies (control and best accepted variation) were carried out as per the standard method by using the Eosin Methylene Blue Agar (EMBA) for coliforms, for bacteria Nutrient Agar (NA) and Martin's Rose Bengal Agar (MRBA) for fungi.

2.6 Effect of storage on changes in chemical characteristics of jelly.

Effect of storage on changes in chemical properties such as pH, total soluble solids (TSS) and titratable acidity (TA) of ivy gourd jelly was analysed at initial and final day of storage.

2.6.1 pH

pH of the ivy gourd jelly was measured using digital pH meter of analog model micrpro grademate pH meter. Standard buffer solutions of pH 4.0, 7.0 and 10.0 were used to calibrate the instrument.

2.6.2 Total soluble solids (°Brix)

Total soluble solids of jelly were determined with the help of (Pocket Refractometer Pal-1, made in Japan 100%, (0-53) ATAG0).

2.6.3 Titratable acidity (Ranganna, 1986) [8]

To a diluted jelly (5 ml of jelly was diluted with 20 ml of water) three to four drops of 0.5 per cent phenolphthalein indicator (1% in 5% V/W alcohol) was added and mixture was then titrated against 0.1 N NaOH until a stable brownish

pink color was developed. The titre value obtained was used in the following formula to find out Titrable acidity in terms of citric acid (Ranganna, 1986) [8].

2.7 Statistical analysis

Data on sensory analysis (at initial and upon storage), microbial population and changes in chemical parameters were subjected to statistical analysis using Completely Randomized Design (CRD) using three replications.

3. Results and Discussion

3.1 Sensory evaluation of ivy gourd jelly

The mean sensory scores of appearance, colour, texture, taste and overall acceptability are presented in Table 2 and figure 2. Jelly was prepared by incorporating dehydrated ivy gourd powder at three different levels *viz.*10, 20 and 30 per cent. The scores for appearance ranged from 7.78 to 8.71, for colour 7.57 to 8.50, for texture 7.43 to 8.21, for aroma 7.55 to 8.17, for taste 7.43 to 8.15 and for overall acceptability it was found that, 7.33 to 8.40. The control had highest scores for appearance (8.71), colour (8.50) and aroma (8.17). Whereas 10 per cent dehydrated powder incorporated sample had highest scores for texture (8.21), taste (8.15) and over all acceptability (8.40). Among the variation 10 per cent incorporation level had higher scores followed by 20 per cent incorporation and least scores were observed in 30 per cent incorporation level. The difference was found to be significant among the variations for all the mean sensory scores, except for the texture and aroma. Utomo *et al.,* 2014 [9] showed that control sample of jelly had lowest mean sensory score which implies it was least accepted by the panel members. It can also be implied from Table 2 that, adding 10 per cent of ivy gourd powder was accepted by the panel members for preparation of jelly since it scored better in all the sensory characteristics. The jelly produced from 30 per cent ivy gourd powder was found to be harder due to increase in the amount of fibre from ivy gourd powder with gelatin. A drop of essence added to the jelly during preparation masked the raw flavour of ivy gourd powder. The sensory scores of the present study was found to be in conformity with study conducted by Charish (2016) who reported that, cluster bean jelly prepared out of 10 per cent incorporation was best acceptable (7.95) than the other variation.

Table 2: Mean sensory scores of ivy gourd jelly

Variations	Mean sensory scores					
	Appearance	Colour	Texture	Aroma	Taste	Overall acceptability
Control	8.71	8.50	8.14	8.17	8.12	8.26
IGJ1 (10%)	8.52	8.24	8.21	8.09	8.15	8.40
IGJ2 (20%)	7.95	7.71	7.98	7.98	7.74	7.81
IGJ3 (30%)	7.78	7.57	7.43	7.55	7.43	7.33
GM	8.23	8.01	7.94	7.95	7.86	7.95
F Value	*	*	NS	NS	*	*
SEm ± (0.05)	0.15	0.16	0.23	0.17	0.14	0.19
CD (P≤0.05)	0.43	0.44	0.65	0.48	0.38	0.54

* Significant at 5% NS- Non significant, IGJ1- Ivy gourd jelly-1, IGJ2- Ivy gourd jelly-2, IGJ3- Ivy gourd jelly-3

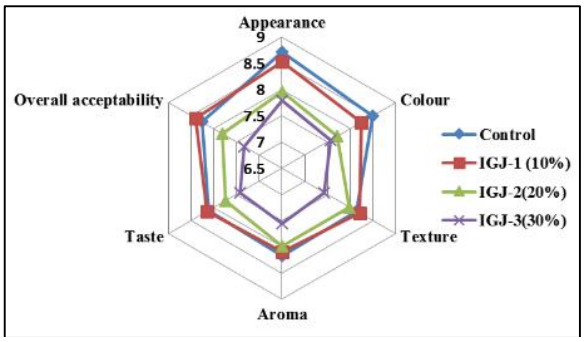

Fig 2: Mean sensory scores of ivy gourd jelly

3.2 Nutrient composition of the ivy gourd jelly

Table 3a depicts the macronutrient composition jelly. The best accepted variation IGJ1 had relatively higher moisture (43.81%), crude fibre (0.30 g) and ash (2.42 g) contents than the control jelly. However control sample had higher protein (0.54g), carbohydrate (50.11g) and energy (252.60 Kcal).The fat content in both samples was nil because preparation didn't had any fat based ingredients. Similarly results for micronutrients (Table 3b) such as, calcium (17.48mg), iron (3.81 mg), zinc (1.75 mg) phosphorus (11.81 mg) and ß carotene (211.88 µg) contents were also found higher IGJ1 variation than the control (Table 3). Results for proximates under the present study were found on par with that of Charish (2016) who reported the values for jelly developed from cluster bean powder. The cluster bean jelly had 11.27 g of protein,0.27 of fat, 1.94 g of ash, 0.19 g of fibre which was found relatively lower than the our study.

Table 3a: Macronutrient composition of ivy gourd jelly

Products		Moisture (%)	Protein (g)	Fat (g)	Crude fibre (g)	Ash (g)	Carbohydrate (g)	Energy (Kcal)
Jelly	Control	43.25	0.54	0.00	0.19	1.94	50.11	252.60
	IGJ1	43.81	0.53	0.00	0.30	2.42	49.70	245.00

IGJ-1: Jelly incorporated with 10% ivy gourd powder

Table 3b: Micro nutrients and ß-carotene composition of best accepted products

Products		Calcium (mg)	Iron (mg)	Zinc (mg)	Phosphorus (mg)	ß-carotene (µg)
Jelly	Control	16.00	1.08	0.11	9.00	18.00
	IGJ1	17.48	3.81	1.75	11.81	211.88

IGJ-1: Jelly incorporated with 10% ivy gourd powder

3.3 Mean sensory scores of ivy gourd jelly during storage studies

IGJ1 and control were kept in refrigerator for evaluation to know the changes that take place during storage period of 21 days. The results for the mean sensory score evaluation of jelly from initial day to 21 days of storage period are presented in Table 4. The mean sensory scores during storage period found to be in the declining trend. The control sample showed 8.36, 8.20, 7.98, 7.26, 7.86 and 7.33 for appearance, colour, texture, aroma, taste and overall acceptability, respectively on the 21st day of evaluation. Similarly sample IGJ1 had scores of 8.22(appearance), 8.04(colour), 7.97(texture), 7.17(aroma), 7.90(taste) and 8.19(overall acceptability) at 21st day of storage period. IGJ1 found to be more acceptable. It was evident from the study that, even after 21 days of storage both the products remained acceptable (>7).

Table 4: Mean sensory scores of ivy gourd jelly during storage studies

Duration	Mean sensory scores											
	Appearance		Colour		Texture		Aroma		Taste		Overall acceptability	
	C	S	C	S	C	S	C	S	C	S	C	S
0th day	8.71	8.52	8.50	8.24	8.14	8.21	8.17	8.09	8.12	8.15	8.26	8.40
7th day	8.57	8.45	8.37	8.12	8.09	8.19	7.81	7.79	8.09	8.14	8.21	8.31
15th day	8.45	8.33	8.24	8.05	8.07	8.08	7.45	7.40	7.90	8.02	7.81	8.21
21th day	8.36	8.22	8.20	8.04	7.98	7.97	7.26	7.17	7.86	7.90	7.33	8.19
GM	8.52	8.38	8.32	8.11	8.07	8.11	7.67	7.61	7.97	8.05	7.90	8.28
F Value	NS	NS	NS	NS	NS	NS	*	*	NS	NS	*	NS
SEm ± (0.05)	0.13	0.14	0.12	0.13	0.19	0.19	0.21	0.23	0.14	0.10	0.20	0.17
CD (P≤0.05)	-	-	-	-	-	-	0.58	0.65	-	-	0.56	-

* Significant at 5%, NS- Non significant, C-Control jelly, S- Jelly incorporated with 10% ivy gourd powder

Statistically significant difference was observed only for aroma at 5 per cent level. However, the scores over the storage period *viz.,* for appearance, colour, texture, taste and overall acceptability were found to be non-significant in both samples. Due to deterioration of flavor there was gradual decrease in the sensory scores in the both jelly samples. It was evident from the study that, fresh samples had the maximum overall acceptability, and thereafter the overall acceptability declined significantly in control sample though IGJ1 scored less but it exhibited the non-significant difference. The declining trend for sensory scores may be attributed to the decline in the moisture content. Similar observation were recorded in the study reported by Singh and Chandra (2012) [23] for guava-carrot jelly where, decrease in most of physico-chemical and sensory qualities were observed during the storage. Present study was also found in conformity with Masoodi *et al*. (2005) [12] and Selvamuthukumaran *et al*. (2007) [17]

3.4 Effect of storage on chemical properties of jelly

Table 5 depicts the effect of storage on chemical properties such as pH, titrable acidity, total sugars and total soluble solids (TSS) of ivy gourd jelly. Decreases in pH of jellies were observed from 4.00 to 3.83 for control and IGJ1 had 3.53 to 3.41 at refrigerated condition for a period of 21 days. Titratable acidity under the study tend to increase from initial to 21st days of storage period in both the samples. It was observed that in control sample the increase was from 0.87 to 0.90, whereas, IGJ1 showed 0.64 to 0.70 from initial to the end of the storage period. Total sugars and total soluble solids under the study tend to increase in both control and IGJ1 samples. In Control the per cent increase was observed from 51.75 to 52.00 for total sugars, similarly IGJ1 had 50.73 to 50.80 per cent of total sugars during storage period. Total soluble solids for control and IGJ1 were observed from 12.81 to 12.84 °brix and 13.06 to 13.08° brix, respectively during storage period.

Table 5: Effect of storage on chemical properties of jelly

Duration (days)	pH		Titratable acidity (%)		Total sugars (%)		Total soluble solids (°Brix)	
	C	S	C	S	C	S	C	S
Initial	4.00^{b}	3.53^{b}	0.87^{a}	0.64^{a}	51.75^{a}	50.73^{a}	12.81^{a}	13.06^{a}
Final	3.83^{a}	3.41^{a}	0.90^{b}	0.70^{b}	52.00^{b}	50.80^{b}	12.84^{a}	13.08^{a}
F Value	*	*	*	*	*	*	NS	NS
SEm ± (0.05)	0.05	0.05	0.03	0.02	0.02	0.01	10.77	1.10
CD (P≤0.05)	0.15	0.011	0.01	0.04	0.06	0.04	-	-

* Significant at 5% NS- Non significant, C- Control jelly, S- Jelly incorporated with ivy gourd (10%)

Statistically significant difference was observed at five per cent level for pH, titratable acidity and total sugars. Non-significant difference was observed for total soluble solids during storage.

Results for titratable acidity was found in agreement with findings of Priya and Prakash (2017) [14] who reported that, the per cent titrable acidity for three different concentrations increased on 30th day of storage interval. Similarly, Hossen *et al.,* (2009) [15] stated that the increase in acidity of guava jelly was due to fermentation and hydrolysis of sugar. Increase in acid content of jelly makes it firmer due to toughening of fibrils. The increase in titratable acidity may be due to formation of organic acids by the degradation of the ascorbic acid as it decreased with storage period of the jelly as reported by (Kumar and Deen, 2017) [17]. The increase in titratable acidity under the present study attributed to decline in pH of the jelly during storage period, which was found in line with the earlier study reported by Anitha (2015) [17] who reported the increase in the pH of the wood apple products at the end of storage period kept under refrigerated condition.

Panchal *et al*. (2018) [18] reported that, during storage study (90 days) of dragon fruit jelly TSS, titratable acidity, reducing

sugars and total sugars were increased. TSS increased from 67.26 to 68.16 ° brix at ambient temperature while, at the refrigerated temperature it increased from 67.26 to 68.17 ° brix. Similar observations were also recorded in the present study. The increase in TSS content of jelly may be due to the conversion of polysaccharides into sugars in the presence of organic acids (Kumar and Deen, 2017) [16]. Similar observations were also observed by Deen and Singh, (2013) [19] in karonda jelly and Kuchi *et al.* (2014) [20] in guava jelly bar.

The increase in the total sugars might be due to loss of moisture during storage. The result of the present study is in consonance with the findings of Panchal *et al*. (2018) [18]. Results from their study indicated that the, total sugars increased from 65.10 to 66.57 per cent at ambient temperature while, at refrigerated temperature it increased from 65.10 to 66.70 per cent. The total sugars content was also found to be increased in wood apple jelly from 62.90 to 65.10 per cent during storage (Kumar and Deen, 2017) [16] and from 64.63 to 67.29 per cent in pomegranate and sapota mixed jelly (Raut, 2015) [21].

3.5 Microbial load of ivy gourd jelly

Microbial count was estimated for the total bacteria, moulds and coliforms by standard plate count method and results are depicted in Table 35.The control and best accepted variation *i.e*. IGJ1 (10% ivy gourd powder) were packed in glass jars and kept for storage under refrigerated conditions up to 21 days. Microbial load was analysed at initial, 7th 15th and 21st days. The increase in total bacteria was found from nil to 1.32×10^2 cfu/g and 1.26×10^2 cfu/g in control and IGJ1 sample, respectively on 21st day. The mould population increased from nil to 1.23×10^2 cfu/g in control and nil to 1.00×10^2 cfu/g in IGJ1 on 21st day. Coliforms increased from nil to 0.31×10^2 cfu/g for control and nil to 0.29×10^2 cfu/g for IGJ1. The increase in microbial population was found to be statistically significant at five per cent level.

Storage period significantly increased the microbial growth of the jelly enriched with ivy gourd powder and increase in microbial growth may be due to the abundance of nutrients especially sugar used in the product. However, the microbial growth in jelly was under the limit up to the end of storage period. Hence, the prepared jelly was found safe and suitable for consumption up to 21 days.

The results of the present finding is in complete agreement with the Panchal *et al.* (2018) [18] who reported that the microbial count was increased slightly from 2×10^3 cfu/g to 3×10^3 cfu/g at ambient temperature and from 1×10^3 cfu/g to 2×10^3 cfu/g at refrigerated temperature. The less microbial growth was observed in the jelly stored at refrigerated temperature than at ambient temperature. Similar, results were also found in case of sapota and beetroot blended jelly where the microbial count was 2×10^3 cfu/g (Gaikwad, 2016) [22].

3.6 Moisture content in ivy gourd jelly

The jelly as packed in glass jars and stored at refrigerated condition for 21 days. There was gradual decrease in the moisture content of both control and IGJ1 was observed (Fig. 3) with the increase in the duration of storage days. The moisture content of control jelly decreased from 43.25 on day 1 to 43.18 on 7th day, 43.07 on 15th day and finally 43.00 per cent on 21st day of storage. For IGJ1 the moisture content was 43.81 initially, 43.73% on 7th day, 43.62% on 15th day and 43.55 per cent on 21st day of storage. This decrease in moisture may be due to higher moisture content in the product compared to storage environment creating moisture gradient. The increase in moisture may also be influenced by reopening of the same jars during storage for analysis.

Results of the present finding is in consonance with the findings of the Panchal *et al.* (2018) [18] who reported the changes in moisture content of the jelly prepared from dragon fruit. Results from the study revealed that the, moisture content decreased from 28.90 per cent to 27.15 per cent within storage period of 90 days at ambient temperature. However, slight decrease in moisture of jelly stored at the refrigerated temperature i.e. 28.90 per cent to 27.56 per cent was observed. The decrease in moisture content from 24.02 to 21.58 was observed in guava-carrot jelly during storage (Singh and Chandra, 2012 [23] and in karonda jelly from 35.44 to 30.87 per cent (Singh, 2010) [24].

Table 6: Population of bacteria and moulds in jelly on storage (per g)

Duration (days)	Group of microorganisms($\times10^2$cfu/g)					
	Total Bacterial Count		Moulds		Coliforms	
	C	S	C	S	C	S
Initial	Nil	Nil	Nil	Nil	Nil	Nil
7th day	0.56^a	0.52^a	0.61^a	0.53^a	Nil	Nil
15th day	0.70^b	0.58^a	0.86^b	0.73^b	0.10^a	0.08^a
21th day	1.32^c	1.26^b	1.23^c	1.00^c	0.31^b	0.29^b
F Value	*	*	*	*	*	*
SEm ± (0.05)	0.01	0.05	0.06	0.03	0.005	0.008
CD (P≤0.05)	0.03	0.16	0.19	0.10	0.02	0.03

* Significant at 5%, C-Control jelly, S- Jelly incorporated with 10% ivy gourd powder

Note: Superscript in capital letters (a, b & c) indicates the significant difference between the periods within the sample.

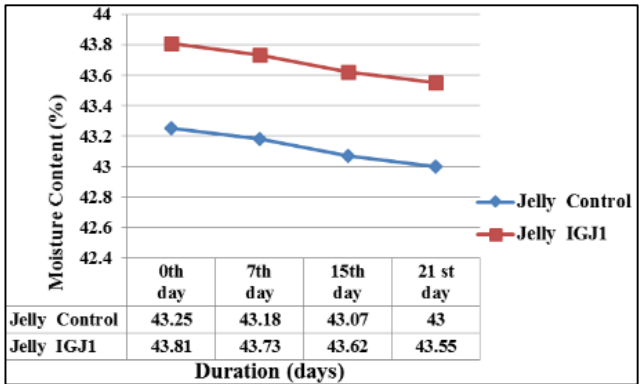

Fig 3: Moisture content in control and ivy gourd jelly during storage

4. Conclusion

It can be concluded from the present findings that we can use the dehydrated ivy gourd for the development of jelly. Among the three variations jelly with 10 per cent ivy gourd powder incorporation was found to be best accepted. However, ivy gourd jelly was observed to be acceptable over the study period of 21 days. The developed jelly was safe and suitable for consumption over the storage period.

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