Development, analysis and sensory evaluation of carrot squash as a natural health drink

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Abstract **- The present study has been undertaken to innovate a new health drink which might be nutritious and relished by all age group. As such, carrot squash has been prepared as a natural health drink because it was a rich source of vitamin A and antioxidants. It is an annual and biennial herbaceous plant. For the preparation of carrot squash, three different ingredient variations in the form of honey, sugar and jaggery has been taken. Sensory evaluation of all the varieties of carrot squash were carried out by 101 members who used the "Composite Scoring Test Card" as the tool to choose the better one amongst all the samples. Statistically the Code-II squash based on sugar syrup was found to be the highly acceptable among the three squashes. Nutritional analysis of Code-II squash was analyzed. Nutritional analysis of Energy and Vitamin A was found to be 220.68 Kcal/100 gm and 6679.5 µgm/gms using IS method and Spectrophotometric method respectively. Similarly, other physico-chemical parameters of the highest accepted squash were also analyzed. Moisture of the squash was found to be 45.6%, Fat -0.76%, Ash - 0.18%, Protein- 0.34%, Titrable acidity-1%, ascorbic acid- 0.95mg, total sugar- 40.1%, TSS - 60° Brix and pH was 6. It would be viable to bring it into market which would prove to be a nutritious and healthy squash available in all seasons throughout the year replacing other synthetic soft drinks.**

Index Terms **- carrot, Physico-chemical analysis, sensory evaluation, squash, vitamin A.**

1.INTRODUCTION

The major focus of fruit and vegetable processing in the food industry is to develop nutritious, wholesome, palatable, safe food to the people which can become available throughout the year. Fruit juices are important trade commodities in most countries (Vasavada, P.C. et al. 2003). Juices are available in their natural concentrations or in processed forms. Fruit juices are calorie free, fat-free, highly nutritious packed with the bundle of vitamins, minerals and naturally occurring bioactive compounds essential for good health (Franke, A.A., et al. 2005). Fruit squashes have been liked more in comparison to synthetic beverages due to their better taste, flavor, nutritional value and their storage stability.

Squash is a diluted fruit juice. It consists essentially of strained juice containing moderate quantities of fruit pulp to which sugar is added for sweetening. Microbial growth in the fruit squash can be lowered with the addition of acid which can reduce the pH of the product thus preventing food spoilage. Acid in combination with sugar also improve the taste of sugar. (Kayshar.M.K.et.al.2014)

Carrots (Daucus carota) are an excellent source of beta carotene, which is converted in the body to vitamin A. The deeper the orange color of a carrot, the higher the beta carotene content (Demir, N. et al. 2004) Carrot contain good amount of dietary fiber which has laxative effect and aids in digestion and absorption of nutrients and prevents constipation. Consumers like carrot squash because of its high nutritive value, fiber, carbohydrates, vitamin A derived from its high α carotene (β carotene), β-carotene content, colour, aromatic compounds and refreshing characteristics (Desobry, Set.al. 1998). The carrot has its bright orangish color due to the presence of β-carotene, lesser amounts of α-carotene, γ-carotene, lutein and zeaxanthin. Carrots contain 88% moisture, 2.8% dietary fiber, 4.7% sugar, 1% ash and 0.2% fat. Dietary fiber in carrot contains mostly cellulose, hemicellulose, lignin and starch.Free sugars present in carrot contains sucrose, glucose and fructose. (Gopalan.C.et.al. 1991).

The lutein and zeaxanthin carotenoids characteristic of carrots are studied for their potential roles in vision and eye health (Manay et al.,2003) .

Carrot juice also helps relieve congestion or inflammation and flushes the kidneys. It is also considered as a natural cure against cancer, bad

cholesterol and other serious disorders. A cup of carrot juice to our daily regimen can help us improve eyesight, skin, blood sugar levels, the health of your blood as well as help boost your brain function and your immune system. It is a precursor of vitamin A and as such is essential for the health and proper functioning of our immune system, for eye and skin protection, as well as for fighting the damage from free radicals in our body which can cause serious chronic diseases such as heart disease and cancer (Srilakshmi, B.2004). Smokers—and those who commonly receive second hand smoke—can benefit from the rich vitamin A in carrot juice as well. As the juice works to reduce oxidative stress in the brain, the nerve-signaling capacity that's typically weakened is lowered as well. At the same time, beta carotenes boost cognitive function and reduce the risk of dementia or other age-related memory issues.it easily detoxify our liver and improve its function. During and after pregnancy, a glass of carrot juice now and then can help develop strong cartilage and bones in the foetus, and prevent birth defects. The juice is full of nutrition and antioxidants vital for a healthier pregnancy, including: Calcium, Potassium, Folate, Magnesium, Vitamin A and Vitamin C.

Lactating mothers are recommended to have carrot juice in their diet to enrich the content of the breast milk. The minerals present in carrots are highly effective against the problems of tooth decay and cavities. Also, it helps in preventing cell damage by strengthening body's collagen protein production and the coumarin in carrots helps in decreasing the blood pressure. The carotenoids in carrot juice help reduce insulin resistance and thus help regulate the blood sugar (Hashem, H.A., et al. 2014). Drinking carrot juice is an easy way to consume them, and we may actually reap more vitamins and minerals through transforming the carrot into a delicious drink. Carrot juice is absorbed much quicker by your body than whole carrots, so it ensures a faster boost of nutrients absorbed and used by your body.

2. MATERIALS AND METHODS

The study was conducted in the laboratory of the Regional Food Research Analysis centre, LUCKNOW. The process of the development of carrot squash has been prepared in three phases.

Phase I -Development of the new food product.

Phase II - Sensory evaluation to assess the highest acceptability.

Phase III -Nutritional analysis of the highly acceptable sample.

2.1. Materials

Fresh, juicy, thick, fleshy and bright orange colored carrots of good variety were selected. Sugar, Citric acid (Class-I preservative) and Sodium benzoate (Class-II preservative) were used for preparation of syrup. Chemicals and materials were purchased from regular suppliers and were of analytical grade. Ammonium sulphate, conc. H_2SO_4, 30%NaOH, ammonia, 2% boric acid solution, standard hydrochloric acid, anhydrous ether, Fehling's solution, phenolphthalein, Sodium bicarbonate, distilled water, Sulphur dioxide, 40 % formaldehyde, 50% trichloro-acetic acid and di-chloromethane.

2.2. Phase I -Development of carrot squash (Fig.1):

Fresh, thick, firm, smooth as well as juicy carrot were selected. Carrot were cleaned and washed thoroughly, a certain weight of the dry carrots were weighed and then it was crushed or grated.

After cutting and cleaning carrot were put into a processor and their juices were extracted out of it in a big container. Fresh juices of carrot was then mixed with honey, sugar and jaggery to prepare carrot squash using three different ingredient variations.

2.2.1. Preparation of sugar syrup: After three samples were made ready, now the sugar syrup was prepared to mix with the three samples. For that 500 gm of sugar was mixed with 250 ml water and the mixture was put into a kettle and kept on the gas stove to heat. After about 15 minutes the mixture came to boiling and turned into a thick syrup. 2 mg of citric acid was then added to it and stirred for 2-3 minutes. The syrup was brought down from the stove to let it cool down. Then the syrup was filtered through a muslin cloth into a separate container. (Porter, N. 1987). Now the extracted juice of carrot was mixed with the sugar syrup and 2 gm of Sodium benzoate was added to it and stirred for 2 minutes. Squash of carrot with sugar has been prepared and labelled as Code-II. The extracted juice of carrot was mixed with honey to prepare squash and labelled as Code-I. Similarly, the extracted juice of carrot was mixed with the jaggery to prepare another variation of squash labelled as Code-

III. Prepared squash were filled in three sterilized HDPE (High Density Polyethylene) bottles of 750 mL capacity separately by leaving 2cm head space and capped finally. Bottled squash was stored at ambient temperature for further study and biochemical constituents were analyzed.

Phase-I Flow chart for preparation of Pomegranate – Watermelon mixed squash

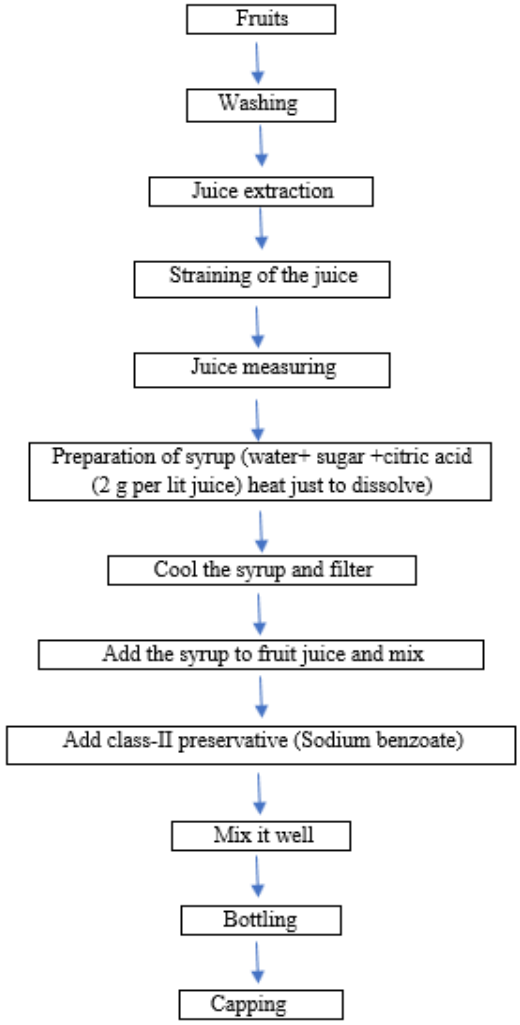

Fig.1 Flow chart of development of the new food product

2.3 Phase II - Sensory evaluation of the squash (Fig.2): Sensory evaluation offers the opportunity to obtain a complete analysis of the various properties of squash as perceived by human sense. The organoleptic evaluation for assessing the sensory attributes like-colour, taste, flavour, consistency and overall, of squash was conducted by a panel of 101 members using Composite scoring test proforma. Samples were selected on random basis. The three bottles of squashes were coded in Roman Nos.-I, II and III. The members in the panel examined all the three samples of squash and gave their analytical comments individually in the score card of composite test proforma.

Phase II - Sensory evaluation of the squash:

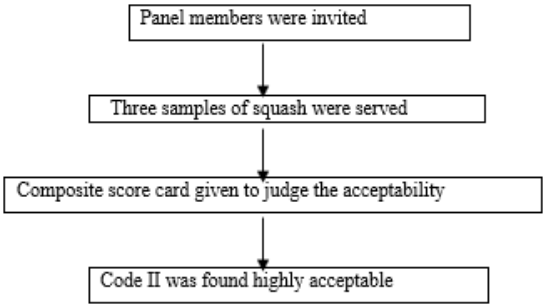

Fig.2 Flow chart of sensory evaluation to judge the best acceptability

2.4. Statistical analysis-

Statistical analysis of difference in mean values between the three samples was done using analysis of variance. Data were analyzed by two-way ANOVA method. After tabulation, collected data was analyzed in terms of percentage to determine the grades given to the characteristics of coded sample. The calculated value of F-ratio were compared with the tabulated value.

2.5. Phase III –Analysis of the highly accepted squash (Fig.3)-

After sensory evaluation of all the three samples of squashes, the highly acceptable among them was assessed by statistical analysis using F-test on the basis of two-way ANOVA method to prove the hypothesis. The physico-chemical parameters of the highly acceptable squash were analyzed. Total soluble solids (T.S.S.) was determined by hand refractometer and reading was rectified at 20°C (Ranganna, 2010). Vitamin A & energy was analyzed with the help of Spectrophotometric method and IS test method respectively. Similarly, other parameters of the squash were also analyzed, acidity in citric acid, total sugar were also analyzed. Total sugar was analyzed with the help of Lane – Eynon method. Fat and Protein were analyzed with the help of AOAC method.

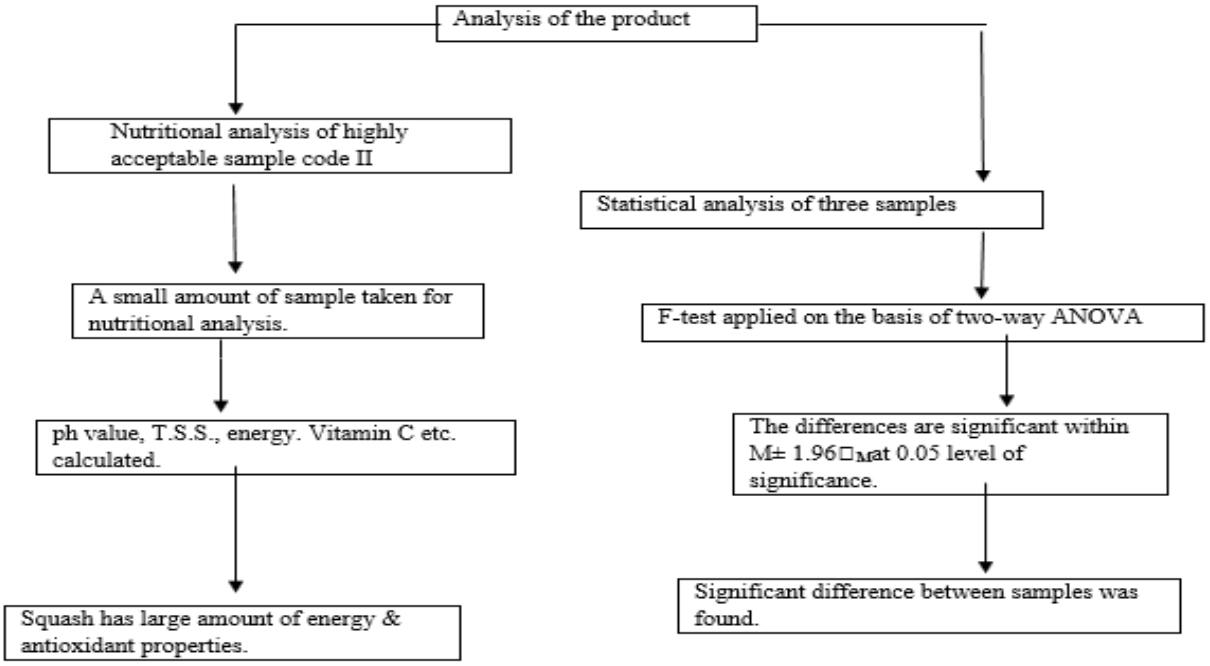

Fig.3 Flow chart of the analysis of the squash

3.RESULTS AND DISCUSSION

3.1. Sensory evaluation response of the product – Sensory evaluation of the three samples of squash by a panel of 101 members were done using the Composite test score card. The subject's response of all the three samples, coded as code I, II and III on different characteristics, i.e., Colour, Taste and Flavour were assessed (Table 1). All attributes like consistency and Overall likings were presented in the Table 1. Table no.1 Mean Sensory evaluation score* of the different attributes of all three squashes:

Code	N = 101	Colour	Taste	Flavour	Consistency	Overall
I		26.98	27.04	26.90	26.98	27.12
II		35.04	35.32	34.54	34.98	34.90
III		22.18	22.46	22.02	22.06	22.30

*All scores are average of 101

Sensory scores for different attributes of 'Carrot squash' was depicted in table no.1. Code I sample had the colour scores between moderately acceptable to highly acceptable range (26.98). Colour score was highest in code – II as the colour of Carrot dominated in it, while colour of Code-I was fade and Code-III was dark. They were in moderately acceptable range but code – II was best. With highly acceptable scores for colour (35.04) code – II (sugar based squash) differed significantly (P>0.05) from that of code – III which had low score of 22.18. The low taste scores of code – III differed significantly from that of code – I (P>0.05) and code – II (P>0.05). As such the code – III had jaggery as the base of syrup, the taste of jaggery highly dominated the taste of carrot in the squash. Average taste scores of the carrot squash ranged from moderately acceptable to highly acceptable. Flavour scores of code I, II and III squash vary from moderately to highly acceptable range which differed significantly at 5%. The overall acceptability scores for all squash were in acceptable range with code–II being highly acceptable due to bright colour and sweet taste.

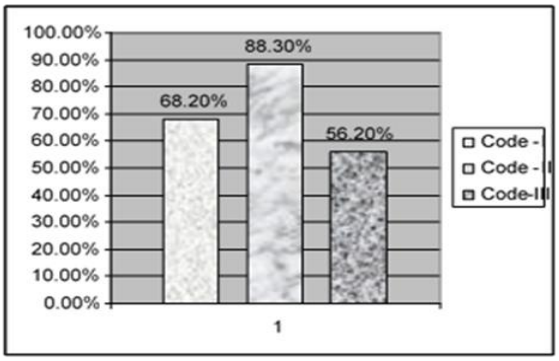

Fig.3(a) Acceptability of squash Colour wise in %

The acceptability of all the three varieties of squashes in terms of colour were shown in the Fig.3(a). Code II having Carrot squash based on sugar syrup was rated highly acceptable with 88.3% in terms of colour. Code I Carrot squash based on honey was rated slightly least acceptable in comparison to code II with 68.2%. Code III having Carrot squash based on jaggery was lowest with 56.2%. This clearly indicates that the colour of the squash of code II was predominant.

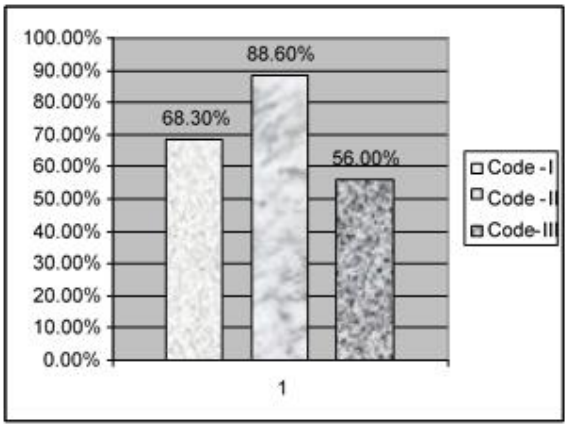

Fig.3(b) Acceptability of squash taste wise in %

Fig.3(b) describes the acceptability of three different variety of squashes in terms of taste. Carrot squash of Code II made from sugar syrup was rated highly acceptable with 88.6% in terms of taste. Code I Carrot squash based on honey was rated slightly less acceptable in comparison to code II with 68.3%. Code III Carrot squash based on jaggery syrup was rated lowest with 56.0%. This shows that the taste of the code II carrot squash was highly acceptable among people.

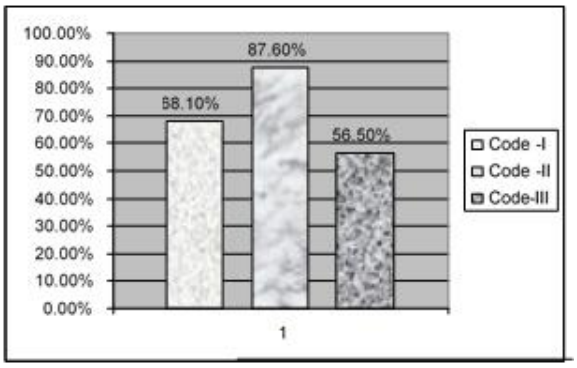

Fig.3(c) Acceptability of squash flavour wise in %

The acceptability of all squashes in terms of flavour were presented in the Fig.3(c). Code II Carrot squash was rated highly acceptable with 87.6% in terms flavour. Code I Carrot squash based on honey was rated slightly less acceptable in comparison to code II with 68.1%. Code III Carrot squash was lowest with the rating of 56.5%.

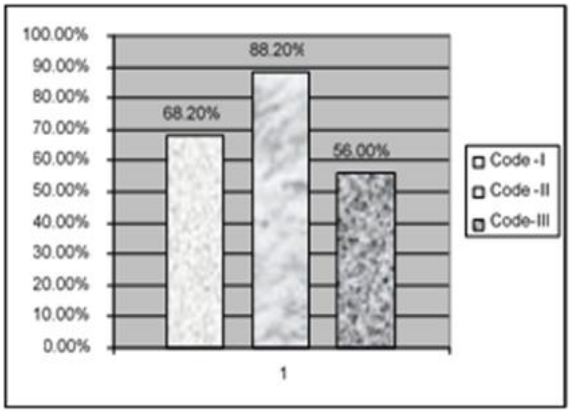

Fig.3(d) Acceptability of squash in consistency wise %

Fig.3(d) illustrates the acceptability of all the three variety of squashes in terms of consistency. Code II Carrot squash was rated highly acceptable with 88.2% in terms of consistency as it was based on sugar syrup which led to a thick consistency. Code I Carrot squash based on honey was rated slightly less acceptable in comparison to code II with 68.2%. Code III Carrot squash was lowest in the rating with 56.0%.

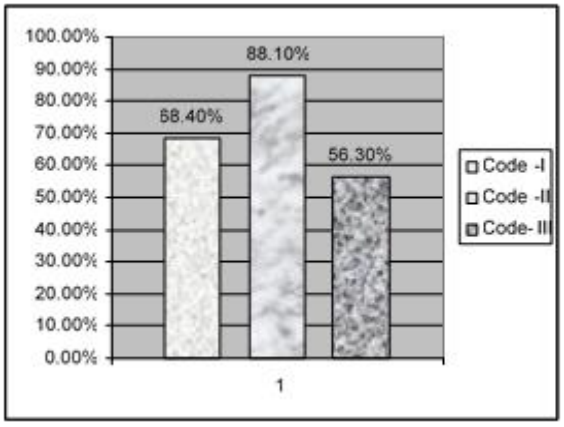

Fig.3(e) Acceptability of squash in overall %

The acceptability of three different variety of squashes in relative terms of overall of were depicted in the Fig.3(e). Code II Carrot squash based on sugar syrup was rated highly acceptable with 88.1% in terms of colour. Code I Carrot squash based on honey was rated slightly less acceptable in comparison to code II with 68.4%. Code III Carrot squash based on jaggery syrup was rated lowest in context of overall acceptability with 56.3%. This clearly shows that the overall acceptability of code II squash was highest among the three varieties of squash.

3.2. Statistical analysis-

The F-ratio, degree of freedom and standard error of mean were calculated. Significant differences were tested using F-test and calculated critical differences (CD) values were obtained from two-way ANOVA. Weighed scores were worked out for rating the mixed squash given by subjects (Gupta, S.P, 2003).

Table no. -2 Analysis of variance table for two - way ANOVA

Source of variation	SS	d.f.	MS	F- ratio	5% F-limit	(SE_M)	Significance
Between columns (i.e, between varieties of attributes)	215.3	5-1=4	215.3/4 =53.8	53.8/11.98 =4.49	F(4,8)=3.83	±0.95	**
Between rows	405.14	3-1=2	405.14/2 =202.57	202.57/11.86=17.08	F(2,8)=4.45	±0.95	**
Residual or error	94.9	4×2=8	94.9/8 =11.86				

3.3. NUTRITIONAL ANALYSIS OF HIGHLY ACCEPTED PRODUCT:

Table no. 3- Nutrient composition of carrot squash:

S. No	Parameters	Results
1.	Vitamin A(Carotene)mg/100g	6679.5µg/100g
2.	Total Sugar%	40.1%
3.	Moisture	45.6%
4.	Fat	0.76%
5.	Ash	0.18%
6.	Protein	0.34%
7.	Energy	220.68kcal/ 100gm
8.	pH	6
9.	TSS%	60◦
10.	Titratable Acidity%	1.00 %

On the basis of the results revealed in the study it was concluded that Code-II was highly acceptable among all the squashes. After sensory evaluation, nutritional analysis of the highly acceptable squash (code – II) was done. Nutritional analysis was done in the Regional Food Research Analysis centre, LUCKNOW. The analysis of Energy and Vitamin A were on top priority as the squash was rich in energy and antioxidant properties. The results of the analysis of Carrot squash are shown in the Table 3. Vitamin A & energy was analyzed with the help of Spectrophotometric method and IS test method respectively. Energy and Vitamin A was found to be 220.68 Kcal/100 gm and 6679.5 µgm/gms. Similarly, other parameters of the squash were also analyzed, Titrable acidity in citric acid was 1%, total sugar – 40.1 %. Total sugar was analyzed with the help of Lane – Eynon method. Fat and Protein was found to be 0.76% and 0.34% (AOAC method). The pH value of the squash was determined with the help of a pH meter. The pH of the squash was found to be 6. Since the value of pH was less than 7, it was acidic in nature. Significant difference has been observed in Vitamin A(Carotenoid), Moisture content and very little difference was observed in the Fat, and protein content as compared to (Bommy, D. et al2016). The results of the present study are in close conformity to the findings of (Kumar A et al., (2018) in context of Titratable Acidity and Total Sugar.

4.CONCLUSION

In this study, a new innovative form of a squash of Carrot was prepared. In the preparation of the squash, three ingredient variations have been used as the base of syrup in the form of honey, sugar and jaggery. Both class I and class II preservatives i.e. citric acid and Sodium benzoate were added to the squash to preserve it throughout the year and to enhance its shelf life. Sodium benzoate was used in this squash (as carrot contains anthocyanin pigment) which prevented it from de-colorization providing a good, attractive and appealing color to the squash. The findings on different parameters like color, taste, flavor, consistency and overall acceptability were recorded by Composite test score ratings and after sensory evaluation, statistical analysis was carried out to find out the hypotheses. In statistical analysis, two-way ANOVA method was used. According to two-way ANOVA calculations, there was a significant difference among the samples. Statistical analysis showed that sample code no. II (sugar syrup-based squash) was highly acceptable among the three

samples of squashes on all parameters. Nutritional analysis of Code II was determined. Nutritional analysis of the squash such as Vitamin A, energy, T.S.S., pH, value, total sugar, acidity in %age in citric acid, etc. of the product were analyzed. Therefore, the carrot squash prepared with sugar syrup was found to be the highly acceptable based on the sensory and nutritional evaluations.

ACKNOWLEDGMENTS

The author acknowledges the Analytical Laboratory, R-FRAC, Lucknow for providing the characterization instruments used in this work. My heartiest thanks to almighty god, my parents Shri Rishishwar Prasad and Mrs. Maya Prasad. Also, I would like to thank my sisters for their support.

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