

STANDARDIZATION AND QUALITY EVALUATION OF OPTIMIZED FOOD FORMULATIONS BASED ON ALOE VERA (*Aloe barbadensis* MILLER)

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ABSTRACT

Aloe vera gel, well known for its nutraceutical potential, is being explored as a functional ingredient in a wide array of health foods and drinks. Aloe vera's health benefits include anti-inflammatory, immune modulating and anti-tumour, antifungal properties and also used in food applications. Considering the above factors, the study was selected to formulate the optimized food beverages (squash) from Aloe vera. In the present study the freshly prepared Aloe vera juice was preferred as main ingredient for developing squashes, in combination with mango ginger juice, ginger juice, lemon juice and pink guava extract. The developed squashes were analysed based on the qualities such as physico-chemical parameters, phytochemical properties, antioxidant activity and sensory qualities. Various experimental trials were employed with different combinations of the Aloe vera with other ingredients to standardize the composition. Based on the overall acceptability of the squashes, Aloe vera ginger lemon squash scored highest (5.0) by the panellists in the sensory evaluation. The selected physico-chemical parameters were total soluble solids, titrable acidity, total sugar, pH and ascorbic acid. The phytochemicals assessed were phenols and flavonoid contents. The total phenol content was found to be highest (438 mg/100 ml) in the Aloe vera pink guava lemon squash. The analysis of the total flavonoid content of the developed products revealed that Aloe vera pink guava lemon squash contained the highest amount (80.32 mg/100 ml) of flavonoids. The antioxidant activity analysed through DPPH method in the samples showed that Aloe vera pink guava lemon squash has the increased radical scavenging activity when compared with other samples (IC₅₀ value - 0.71µg/ml). In summary the total phenolic, flavonoid and antioxidant activity were found to be highest in Aloe vera pink guava lemon squash. In the shelf life study results was better for samples kept under refrigeration in amber colour glass bottles than those stored in room temperature. The results of the present study indicated the consumer acceptability of Aloe vera products in consumable form. Here it was also revealed that the three combinations of developed products like Aloe vera mango ginger lemon, Aloe vera pink guava and Aloe vera ginger lemon can be recommended as a good source of phenol, flavonoid and antioxidant. Thus, future attempts can be made to further explore the utilization of Aloe vera in different food products. From the above study and the results revealed, it can be concluded that Aloe vera, the magic plant has great potential in medicinal and nutritional properties and hence can be recommended for enhancing the nutritional quality of beverages in food industry.

KEYWORDS: Aloe Vera Juice, Physico-Chemical, Phytochemical, Antioxidant, Squash.

Functional foods can be considered to be those whole, fortified, enriched or enhanced foods that provide health benefits beyond the provision of essential nutrients (e.g., vitamins and minerals), when they are consumed at efficacious levels as part of a varied diet on a regular basis. The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The Aloe vera leaves contain polysaccharides, amino acids, vitamins, minerals, plant steroids, anthraquinones, salicylic acid, and enzymes and these components can play a vital role in the maintenance of human health (Surjushe et al.,2008). The aloe vera gel is bitter in taste due presence of aloin component and it could be improved with the addition of fruits juices (Ahlawat and Khatka, 2011). Aloe Vera is most commonly used in making cosmetics and some medicines. But very few attempts have been made to process Aloe vera into food products. The most available product of the Aloe vera available in India is Aloe Vera Juice. Beverages are considered to be an excellent medium

for the supplementation of nutraceutical components for enrichment (Khan and Anderson,2003). Blended drinks are good alternative for development of new products to provide benefit of taste, nutrition as well as medicinal properties. It has been reported that utilization of Aloe vera gel or juice in the formulation of a beverage with other fruit juices. Hence, present work was carried to optimize level of Aloe vera, ginger, mango ginger, lemon juice and pink guava extract in development of blended therapeutic RTS with desirable characteristics. The present study was framed with the following objectives that are to formulate and standardize squashes with Aloe vera, to assess the sensory parameters and consumer acceptability of the developed product, to evaluate the physico-chemical parameters and phytochemical parameters of the developed products and evaluate the antioxidant activity of the developed products.

MATERIALS AND METHODS

The present study was designed to do formulation, sensory evaluation of products with Aloe vera. Three products were formulated using aloe vera. The formulated products were then assessed for their physico-chemical properties, phyto chemical properties, antioxidant activity, shelf life study and consumer acceptability.

Selection and Procurement of Ingredients

The materials chosen in the study for the preparation / development of value added products from Aloe vera fully matured fresh leaves were procured from Agricultural nursery (Mannuthy). The other ingredients namely ginger, mango ginger, pink guava, lemon, sugar were purchased from lockel market in Alappuzha.

Processing

The selected ingredients were processed and used for the preparation of three different squashes. The preliminary preparations of ingredients such as washing, peeling, cutting, removal of seeds (pink guava) were adopted to enhance the palatability and acceptability of the raw ingredients.

Formulation of the Products

The study involves the development of three different flavoured squashes from Aloe vera after several trials. The major ingredient as Aloe vera, along with ginger, mango ginger, pink guava and lemon were used in different quantities for the preparation of the products. The combinations are follows:-

Aloevera + Ginger+ Lemon

Aloe vera + Mango ginger+ Lemon

Aloe vera + Pink guava + Lemon

Sensory Evaluation

The developed squashes were presented to a panel of five judges consisted of teachers purposefully selected from the Home Science department of St. Josephs College. The evaluation was carried out in the nutritional lab of the home science department. The judges evaluated the product using numerical rating score. The attributed tested were appearance, taste, flavour, consistency and overall acceptability.

Consumer Acceptability

The developed products were assessed for their consumer acceptability by using untrained ten consumer panel members who do not have any knowledge about the products. The numerical scoring test was used as tool for this test. The panel members were asked to rate the products based on the sensory attributes according to the rating scale provided to them.

Evaluation of Shelf Life of the Product

In the present study the developed squashes with best blended combinations and their ratio (on the basis of sensory evaluation) were packed in glass bottles and pet bottles kept at refrigerated temperature and room temperature and changes were determined during storage at intervals up to 5 weeks and overall acceptability was measured on hedonic scale by 5 trained panel members.

Quality Analysis of the Products

Here, the quality of the developed products were evaluated in terms of physico-chemical characteristics, phytochemical properties and antioxidant activity.

Analytical Methods

Total soluble solids, titrable acidity, total sugars, pH and ascorbic acid content, total phenol and flavanoid content and total antioxidant activity determined in three samples of each treatment.

Total Soluble Solids (TSS)

Total soluble solids (TSS) were estimated by using hand refractometer which indicates a measure of sugars present in the sample. The instrument works on the principle of refractive index of the sample and gives the RI as '0' brix.

Titratable Acidity

Titrable acidity was determined according to the official method of (AOAC, 2005).

Total Sugar

Total sugars was determined as official method of (AOAC, 2005).

The pH Value

The pH value was measured using a pH_meter .

Ascorbic Acid

Vitamin C was determined by using titration method.

Phenolic Compounds

Phenolic compounds were determined by conventional chemical method as well as using spectrophotometer (Stalikas, 2007).

Flavonoid Compounds

Total flavonoid compounds was determined by aluminium chloride colorimetric method (Stalikas, 2007).

Antioxidant Activity

The antioxidant activity of three developed products of squashes were determined by DPPH (1,1 Diphenyl 1-2-picrylhydrazyl) free radical scavenging assay. In this study DPPH radical scavenging activity was determined by the Mensor method (Mensor, 2001).

RESULTS AND DISCUSSION

Formulation

The best suited proportion for the development of the drink was optimized by several step wise screening methods based on their organoleptic qualities. The three developed squashes were formulated are:

S1-Aloevera mango ginger lemon squash

S2-Aloe vera pink guava lemon squash

S3- Aloe vera ginger lemon squash.

Standardisation of the Products

A standardized recipes is one that has been tried, adapted and retried several times for use by a given food service operation and has been found to produce the same food to produce good results and yield every time when the exact procedures are used with the same quality and quantity of ingredients (Srilakshmi, 2003).

On analysing the sensorial aspects, in different combinations the above samples were proved to be the best suitable preliminary treatment among the repeated four treatments. Hence these samples were opted as the most suitable pre treatment to reduce the bitterness of Aloe vera gel and as an ideal proportion of raw ingredients for the development of the drink. These three treatments were optimized and diluted in equal proportion with water for obtaining the desired consistency of the final drink.

Sensory Evaluation

The table shows that the mean ± standard deviation scores of attributes of three squashes as evaluated by panel members.

Table 1: Sensory evaluation of the developed squashes

Products	Colour	Taste	Flavour	Consistency	Overall acceptability
Mean ± SD					
S1	3.8 ± 0.5	4.2 ± 0.8	4.2 ± 0.5	4.2 ± 0.8	3.8 ± 0.5
S2	4.8 ± 0.4	4.4 ± 0.5	4 ± 0.0	4.4 ± 0.8	4.4 ± 0.5
S3	4 ± 0.5	4.4 ± 0.5	4.8 ± 0.4	4.6 ± 0.5	5 ± 0.0

S1-Aloevera mango ginger lemon squash

S2-Aloe vera pink guava lemon squash

S3- Aloe vera ginger lemon squash.

Colour

Colour is commonly used as a basis for the initial judgment of foods. Consumer buying decisions can be influenced on the basis of colour. This can also affect the cooking and eating decisions of the consumers (Wadhvani et al., 2010).

Based on the colour attribute, Aloe vera pink guava lemon squash (S2) was highly accepted (4.8) by the panellist and Aloe vera mango ginger lemon squash (S1) obtain the least mean value (3.8). The highest mean score for colour was obtained for S2 sample as the combination ingredient added was pink guava .It was also observed

that there was no colour change noted even after it was processed with Aloe vera.

Taste

Taste sensation is an important contributor to the reward value and delicious sensation produced by food in the mouth. In addition to taste, other oral sensory processes including oral texture contribute to the reward value of food flavour, as do olfactory, visual, and cognitive effects (Mikiko, 2015).

Based on the taste attribute ,the Aloe vera pink guava lemon squash (S2) and Aloe vera ginger lemon squash(S3) obtained highest mean score (4.4)and Aloe vera mango ginger lemon squash (S1) with the least mean

value (4.2). Therefore, the flavour compound (chemical) profile of the culinary ingredients is a natural starting point for a systematic search for principles that might underlie the choice of acceptable ingredient combinations.

Flavour

Shankaer et al., (2010) said that although many factors such as colors, texture, temperature, and sound play an important role in food sensation, palatability is largely determined by flavor, representing a group of sensations including odors (due to molecules that can bind olfactory receptors), tastes (due to molecules that stimulate taste buds), and freshness or pungency (trigeminal senses).

The flavour may have the largest impact on acceptability and desire to consume it again, as far as flavour is concerned maximum score of 5 is recorded for sample 3. So it can be concluded that the sample S3 was preferred more when comparing it with other attributes.

Consistency

Consistency also another important criteria for judging the acceptability of the product. In this attribute the sample 3 was highest (4.6) mean scores showing that compared to other squashes were perceived best by the panel members.

Overall Acceptability

The dietary patterns and practices of individuals are affected by many variables that may be categorised as physiological factors, food accessibility, food characteristics, environmental

influences, and psychological influences. It is the combination of these factors that ultimately determines what, how, and why foods are consumed.

Among all the samples based on the overall acceptability of the squashes, Aloe vera ginger lemon squash (S3) was liked very much by the panellists.

Consumer Acceptability

The numerical scoring test was done among the consumer panellists for the assessing the consumer acceptability. All the products were accepted by the consumers at different level. They assess the acceptability based on the overall quality based on the attribute. The result reveals that Aloe vera pink guava squash got the highest mean score(4.8) and Aloe vera mango ginger lemon squash (4.8) are comparatively more acceptable products. The Aloe vera ginger lemon ranked (4.0) moderately accepted by the untrained panelist in the consumer acceptability test. So from the data it was clear that all the products developed from Aloe vera were accepted by the panelists considering all the attributes.

Evaluation of the Shelf Life of the Product

Shelf life study was better for samples kept under refrigeration in glass bottles than those stored in room temperature. On the basis of the organoleptic acceptability, it may be concluded that formulation of Aloe vera based squashes is possible to satisfy consumer taste and preferences up to 3weeks of storage at refrigerated temperature.

Physico Chemical Evaluation of the Products

Table 2: Physico -Chemical properties of three different squashes

Samples	Total soluble solids (%)	Titration acidity (%)	Total sugar (%)	pH	Ascorbic acid (mg/100 ml)
S1	23.9	0.8	12.6	2.5	1.9
S2	20.9	0.25	17.2	3.8	0.39
S3	25	0.49	16	3	0.26

S1-Aloevera mango ginger lemon squash

S2-Aloe vera pink guava lemon squash

S3- Aloe vera ginger lemon squash.

Total Soluble Solids

Maximum TSS was recorded in S3 (25%) followed by S1 (23.9%) against minimum in S2 (20.9%). The Treatment S3 sample contains the ginger juice had more total soluble solids compared to others.

It can be assumed that the TSS level of Aloe vera ginger lemon squash was higher as the ingredient was

taken for the analysis gained the maturity during processing. TSS of a given sample of fruit juice represents the various chemical substances by S3 having 16 % of total sugars. The lowest sugars was obtained by S1 having 12.6%.

pH

The pH for developed squashes studied was in range of 2.5 to 3.8. The highest pH was observed in S2 with 3.8 and followed by S3 with 3.0 and the lowest was 2.5 in S1. The pink guava based squash was higher in pH .

Ascorbic Acid

From the above table, it can be concluded that the S1 contains the highest amount of Ascorbic acid of 1.9 mg/100ml followed by 0.39 mg/100ml S2 and 0.26 mg/100ml in S3.

Phytochemicals Evaluation

The major phytochemicals analyzed in the present study were total phenols and flavonoids.

Total Phenol Content

Total phenol content of developed products presented in graph.

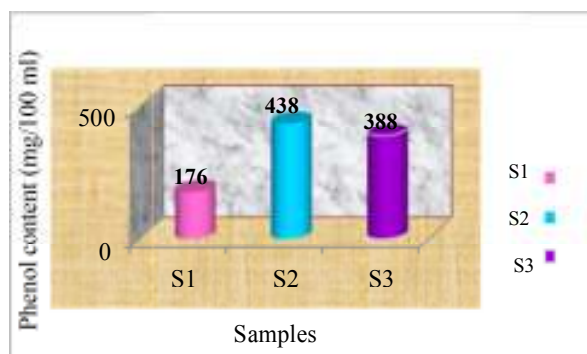


Figure 1: Total phenol content of developed products

- S1-Aloevera mango ginger lemon squash
- S2-Aloe vera pink guava lemon squash,
- S3- Aloe vera ginger lemon squash

The results indicates that the phenolic content of the S1 is 176mg, S2 is 438mg and that of S3 is 388 mg. S2 contains more phenolic content than others two treatments. A study conducted by Anil kumar (2014) revealed that the phenolic contribute directly to the antioxidant action; therefore, it is necessary to investigate total phenolic content. A study conducted by Mohammed (2011) revealed that the pink guava contains phenolic compounds that are present in high amounts include myricetin, apigenin and ellagic acid and anthocyanins.

Total Flavonoid Compounds

Total flavonoid content of developed products presented in the graph.

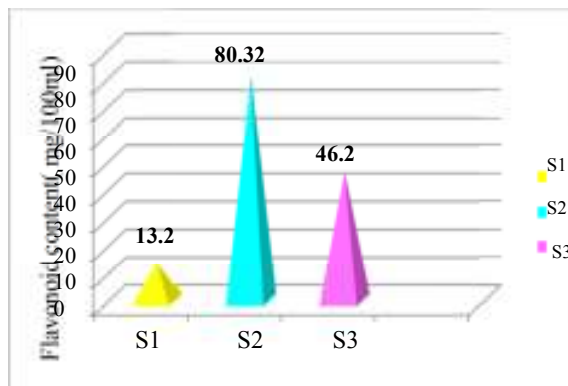


Figure 2: Total Flavonoid Contents

- S1-Aloevera mango ginger lemon squash
- S2-Aloe vera pink guava lemon squash
- S3- Aloe vera ginger lemon squash

From the above graph it can be concluded that the S2 showed a higher flavonoid content of 80.32 mg/100ml when compared to the S1 and S2 with 13.24 mg/100 ml and 46.2 mg/100ml equivalents of flavonoids respectively. Khalid et al.,(2015) reported that kaempferol as the main flavonoid compounds in pink guava.

Total Antioxidant Activity

In the present study, free radicals scavenging activities of developed products by the DPPH assay (1, 1-diphenyl -2- picrylhydrazyl) was determined by Mensor method (Mensor,2001).The scavenging effects of developed products on DPPH radicals are discussed as follows:

DPPH radical scavenging activity of Sample 1

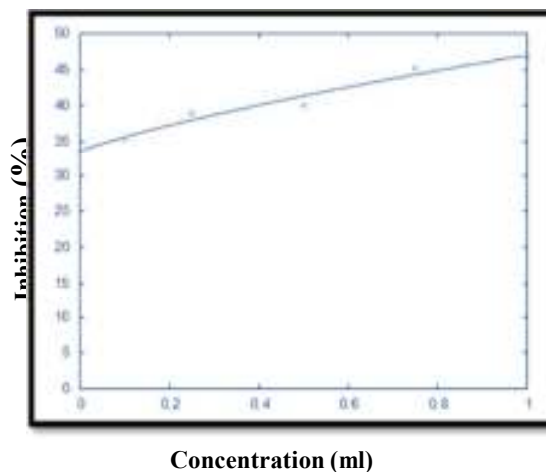


Figure 3: DPPH Scavenging activity of the Aloe vera mango ginger lemon squash (S1)

The figure shows that DPPH scavenging activity of the Aloe vera mango ginger lemon squash. The radical scavenging activity is increased as the concentration is increased. The IC₅₀ value (µg/ml) is the concentration of antioxidant at which 50% inhibition of free radical activity is observed (Scavenging Effect=Inhibitory Concentration or IC) (Issoufou and Amadou 2011). The IC₅₀ value of S1 is 11.44 µg/ml. The lower IC₅₀ indicated the stronger capability of samples to catch free radical of DPPH.

DPPH radical scavenging activity of Sample 2

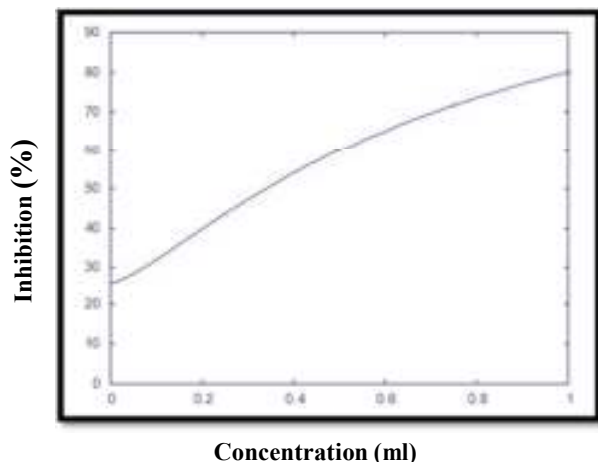


Figure 4: DPPH Scavenging activity of the Aloe vera pink guava lemon squash (S2)

The figure shows the DPPH scavenging activity of the Aloe vera pink guava lemon squash. The sample IC₅₀ value is 0.71 which indicates the stronger capability of samples to catch free radicals. As the concentration increased the percentage of inhibition was also increased.

DPPH radical scavenging activity of Sample 3

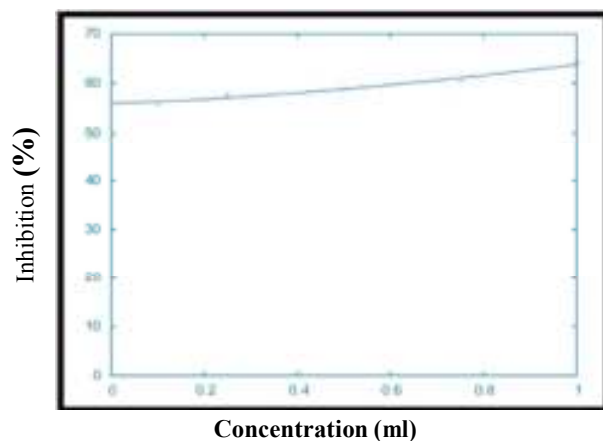


Figure 5: DPPH scavenging activity of the Aloe vera ginger lemon squash (S3)

The figure shows the scavenging activity of the Aloe vera ginger lemon squash. The effect of antioxidants on DPPH radical scavenging was thought to be due to their hydrogen-donating ability. The IC₅₀ value of S3 was 48.17 which indicates the radical scavenging activity was comparable indicating the capability to catch free radical.

CONCLUSION

The results of the present study indicated the consumer acceptability of Aloe vera products in consumable form. Here it was also revealed that the three combinations of developed products like Aloe vera mango ginger lemon, Aloe vera pink guava and Aloe vera ginger lemon can be recommended as a good source of phenol, flavonoid and antioxidant. So it is advised to develop food products like squash that are ready to consume. Thus, future attempts can be made to further explore the utilization of Aloe vera in different food products.

FUTURE SCOPE

- The developed products can be prepared commercially in large scale.
- As the products developed using Aloe vera is limited for consumption other varieties of recipes can be developed with Aloe vera.
- Formulation of customized drug and health supplements from Aloe vera
- Developed products showing potent antioxidant, phenol, and flavonoid activity can be incorporated in to anticancer, diabetics care formulations.

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