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Development of Functional and Dietetic Beverage from Bitter Gourd

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Abstract

Functional and health endorsing benefits of various foods are investigated. A beverage made from bitter gourd for diabetic and health conscious individuals by incorporation of bitter gourd extract at different levels such as 5%, 10%, 15% and 20%. Properties were investigated of a refreshing low calorie beverage. During storage for 6 weeks titratable acidity increased from 0.57-0.77%, pH (4.23-3.97) and ascorbic acid contents (18.92-14.74 mg/100mL) decreased. Sensory properties of the dietetic ready-to-serve beverage were ranked above acceptable range by a panel of judges during storage. Results indicated that bitter gourd beverage with 15.0% extract had good flavor, palatability and storage stability and could benefit diabetic, obese and health conscious people.

Key words: bitter gourd, beverage, dietetic drink, storage, quality changes

Introduction

The growing interest in new functional foods with special characteristics and health benefits has led to development of new functional beverages. The global market of functional food has been estimated to be at least 33 billion US$ (Hilliam, 2000). The functional beverages can play an important role in health promotion and disease prevention. They provide means to reduce increasing burden on health care system by a continuous preventive mechanism (Shahidi, 2004).

The functional beverages not only provide taste and refreshment satisfaction, but can also provide necessary nutrients to prevent nutrition-related diseases (Menrad et al., 2000).Beverages are considered to be an excellent medium for the supplementation of nutraceutical components for enrichment (Kuhn, 1998) such as soluble fiber or herbal extract (Swientek, 1998). The new formulations of beverages are rapidly changing.

The market shelves are full of different beverages with not only soda pop, juices and dairy beverages. There is huge number of food products taken as beverages such as iced teas, coffees, sports drinks, herbal teas, frozen carbonated beverages, mint blends, vegetable juices and smoothies (Giese, 1992). However, in current years consumers have not been choice for traditional drinks but also have more exotic beverages such as the, teas iced coffees, isotonic or sports drinks and non-carbonated beverages and ready-to-drink iced herbal teas are also gaining popularity (Swientek, 1998).

Momordica charantia L. commonly known as bitter gourd is an economically important medicinal plant belong to the family Cucurbitaceae (Chakravarty, 1990) commonly known as karela or bitter melon. The immature fruit are eaten as vegetables and are a good source of Vitamin C, Vitamin A, phosphorus and iron (Sultana and Bari, 2003; Paul et al., 2009). The bitter flavor is due to the alkaloid momordicine produced in fruit and leaves.

Recently, several phytochemicals with the health benefits of bitter gourd have been isolated and studied (Murakami et al., 2001). Charantins, a mixture of steroidal saponins that are abundant in the fruit of bitter gourd, have been proposed to contribute to the hypoglycemic and antihyperglycemic activity of bitter gourd (Harinantenaina et al., 2006). Additionally, bitter gourd is a good source of phenolic compounds, including gallic acid, gentisic acid (2, 5-dihydroxyl benzoic acid), catechins, chlorogenic acid and epicatechin (Horax et al., 2005). Gentisic acid has been proven as an active metabolite of salicylic acid and may account for the anti-inflammatory property of salicylic acid by inhibiting cyclooxygenase-2 (COX-2) mRNA expression and activity as well as PGE2 production (Hinz et al., 2000).

Treatment of hyperlipidemia in diabetes involves improving glycemic control, exercise and the use of lipid lowering diets and drugs (Betteridge et al., 1997). The extracts of fruit pulp and seed have been reported to have various medicinal properties, including antitumour and antimutagenic activities (Jilka et al., 1983). However, in

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Chinese and Ayurvedic traditiona medicine, the plant is usually used as a hypoglycemic and antidiabetic agent (Karunanayake and Tennekoon, 1993) and many components have been identified from M. charantia which possess hypoglycemic properties (Platel and Srinivasan, 1997). Bitter gourd fruit juice has also been shown to stimulate, significantly, both glycogen storage by the liver (Welihinda et al., 1986) and insulin secretion by isolated -cells islets of Langerhans. The hypoglycemic activity of bitter gourd fruit has been shown in both spontaneous and chemically-induced diabetes mellitus in experimental animals as well as in human patient. The present study is an effort to develop a suitable formulation and processing procedure for a functional beverage with incorporation of bitter gourd extract for diabetic and health conscious people.

Material and Methods

Procurement of raw material. Commercially available bitter gourd (Momordica charantia L) was procured from local market and washed thoroughly to remove dirt, dust and the pesticide residues. Chemicals and the ingredients used in the formulation and chemical analysis were procured from Riedel-de Haen. Seeize, Germany and Danisco Company, Lahore, Pakistan.

De-bittering process and storage. The selected samples was cut into small pieces and de-bittering process was carried out followed by extraction process with water of ratio (1:2) and filtered through muslin cloth/filter paper. The de-bittering of bitter gourd was carried out by following the method of Kulkarmi et al. (2005) with some modification. In this process 5% NaCl was applied for 1 hour, washed with fresh water and then blanched for 5 minutes.

Preparation of dietetic beverages. The stored filtered extract was utilized in beverage formulation by following standard formulation method using artificial sweetener. The following treatment plan was used in the preparation of beverage

Table 1. Treatment plan

T_1	5.0% bitter gourd extract
T_2	10.0 % bitter gourd extract
T_3	15.0% bitter gourd extract
T_4	20.0% bitter gourd extract

Physico-chemical analysis. The prepared beverage was analyzed for following parameters:

pH. The pH of each sample was determined with the help of digital pH meter (InoLab 720, Germany). A sufficient quantity (50mL) of bitter gourd drink was taken in 100mL beaker and pH meter was used to record pH according to method explained in AOAC (2006).

Ascorbic acid. The ascorbic acid content was estimated by using detective dye, DCPIP (2, 6-dichlorophenolindo phenol) according to the standard method of AOAC (2006).

Titratable acidity. The acidity in each sample was determined according to standard procedure given in AOAC (2006). 10mL of bitter gourd drink along with 100mL water was taken and then titrated with 0.1 N NaOH using phenolphthalein as an indicator (1-2 drops) till light pink end point which persist for three sec.

Color. The color values of beverage samples were measured according to method of Yu et al. (2003) by using the L* a* b* color space (CIE-LAB Space) with Color Tech-PCM (USA). The L* value indicates lightness, a* and b* values are chromaticity coordinates (a*, from red to green; b*, from yellow to blue).

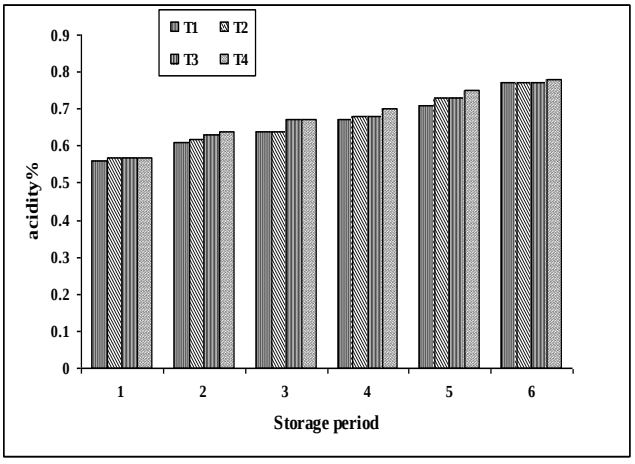
Sensory evaluation. Sensory evaluation, based on color, flavor, taste and overall acceptability attributes, was conducted after every week. A 9-point hedonic scale was used for evaluation as described by Lee et al. (2003). A panel of five judges from the Post Harvest Research Center, Ayub Agricultural Research Institute, Faisalabad, Pakistan, evaluated drink according to 9-point hedonic scale.

Statistical analysis. The data obtained was subjected to statistical analysis by using analysis of variance technique and comparison of means was done by LSD test (Steel et al., 1997).

Results

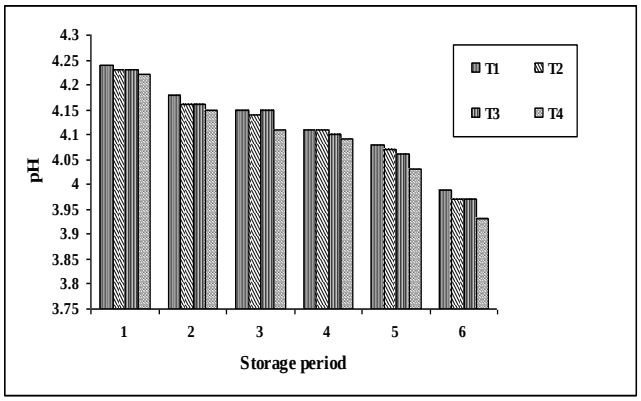
Physico-chemical analysis. The statistical results regarding acidity% are presented in Fig-1. It is depicted that slight difference of acidity (0.66-0.68%) among treatments and significant increase with respect to storage period was observed. At 1st week interval it ranged from 0.56-0.57%, all treatments showed analogous trend except T1. There was a significant increase 0.57-0.77% at the end of 6 weeks as compared to 2nd (0.64-0.67%) and 1st week (0.56-0.57%) interval. There was 39.28% increase in acidity with respect to storage.

Fig 1. Effect of treatments and storage intervals on acidity% of dietetic beverage



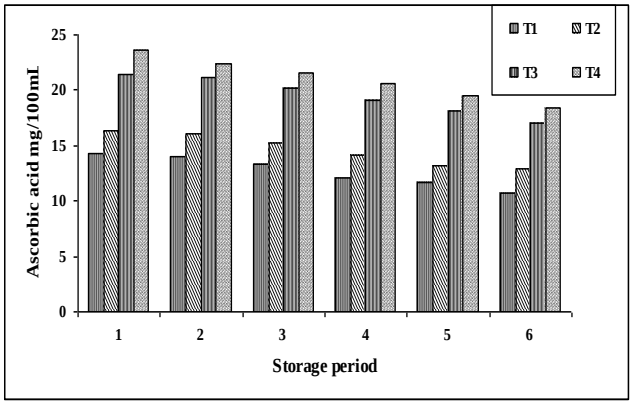
Means concerning pH are demonstrated from Fig-2. Comparatively there was significant decrease in pH among treatments and storage period was observed. It is evident from results that T1 showed highest value (4.13), while T4 showed lowest value (4.09) among all treatments. It is also depicted that there was a significant decrease in pH at the end of 6th weeks. T4 showed an immense decline during storage.

Fig 2. Effect of treatments and storage intervals on pH of dietetic beverage



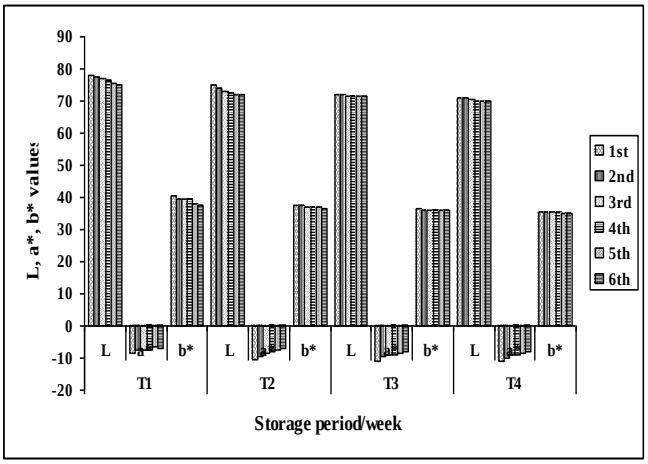
The ascorbic acid contents of functional drink are depicted from Fig-3. There was considerable decline (12.67-21.00) in ascorbic acid contents among treatments. Among treatments T4 had highest value (21.00 mg/100mL) while, T1 showed lowest value 12.67 mg/100mL after 1st week. At the end of 6th weeks significant decrease (18.92-14.74 mg/100mL) was interpreted

Fig 3. Effect of treatments and storage intervals on ascorbic acid mg/100mL of dietetic beverage



In terms of consumer perception color is calculated as LAB values. L*-value indicate the intensity of color towards lightness. The - a* shows the greenness while + a* shows trend towards redness. The positive b*-value indicating tendency toward yellowness of drink while negative value indicate blue color. It is reveled from Fig-4 that T1 showed the highest value (76.57) while T4 was with lowest (70.46). There was significant decrease in L-value with respect to storage period.

Fig 4. Effect of treatments and storage intervals on color (L, a*, b* values) of dietetic beverage

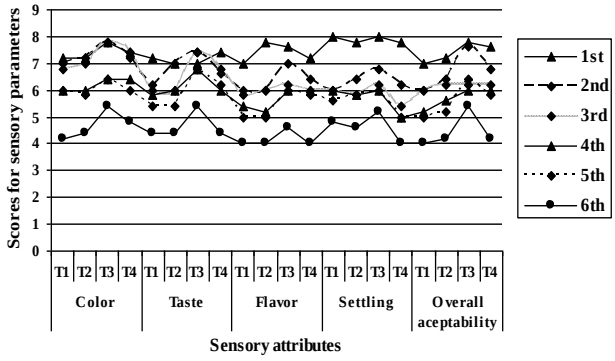


It is also evidenced from Fig-4 that T4 showed tendency for more greenness then all other treatments. There was a slight change in color of T1 from 2-4 weeks interval. From 4-6 weeks the T3 and T4 showed slight changes in color. Overall at the end of 6th weeks there was significant decline in a* value.

The obtained data pertaining b*-value are demonstrated from Fig-4. T1 showed a maximum (39.05) value comparatively to other treatments. The storage period results in a remarkable decrease (37.44-36.16) in b*-value.

Effect of storage on sensory characteristics. The dietetic bitter gourd drink is subjected to trained panel of judges for sensory attributes. Color of any food product is an important criterion for the acceptability of any food product. The data pertaining to sensory attributes of functional drink is presented in Fig-5. The T3 was ranked at highest score in color than other treatments. The 3rd week interval of storage showed stability in color wile at the end of 6th week there was a tremendous decrease in color was observed.

Fig 5. Effect of treatments and storage intervals on color of dietetic beverage



T3 was ranked highest score on the bases of good taste while T1 was put forth at lowest. The storage period results a remarkable decrease in taste 2-4 weeks storage period showed stability in taste to some extent, while at 6th week interval there was an incredible decrease in taste.

The results pertaining to flavor attribute of drink demonstrated that T4 was ranked highest score on the bases of flavor and T4 at lowest. At the end 6th week interval the decrease in flavor was observed.

The results relating to settling characteristic of drink are also depicted from Fig-5. Visual observation of judges ranked T4 at lowest settling than other treatments. The storage period results in decrease in settling of drink. It was observed that T3 containing 15.0% bitter gourd was superior in overall acceptability than other treatments and acceptability decreases with respect to storage period for other treatments.

Discussion

Physico-chemical analysis. Most fruit and vegetables contain water to the degree of 80%. The carbohydrates are the main constituents which are broken down to carbon dioxide and water during storage. This conversion results in increase in acidity of the beverages. Alessandra et al. (2004) also reported similar results which supports the present findings for increase in acidity during storage. This increase is attributed to production of CO2 that forms weak acid on dissolution. The decrease in pH and increase in acidity during storage might be due to degradation of artificial sweetener and carbohydrate present in the bitter gourd extract by the action of microorganisms which causes production of acids in beverage. The results of present project with respect to storage studies are in concordance with the findings of Miguel et al., 2004 who found a decreasing trend of pH in beverages during storage. High acid and low pH may be due to production of acetic acid and lactic acid during storage. Such types of changes in pH vales have been demonstrated by Souci et al. (1987).

The findings of present study are in line with the work reported by Maria et al. (2003) who observed a significant loss of ascorbic acid (25 to 26%) during storage. In the present study the ascorbic acid content decreased with the increase in storage periods, because ascorbic acid can inhibit browning reactions by reducing the quinones back to the original phenol compounds. This decrease might be due to the factors such as storage temperature, oxidative enzymes, processing techniques, metal contamination, and the presence of atmospheric oxygen in the head space.

However, decline in L*-value during storage may be attributed to the cloud loss in the beverage. The decrease in L*-value during storage was more persistent during first two weeks but a bit stabilized after third week of storage. A small amount of precipitate was visible at the bottom of the bitter gourd beverage which is due to insoluble fiber components present at low levels. A decrease in a*-value indicated that beverage became less greenish intensity with progress in storage periods. Sa´nchez-Moreno et al. (2005) have reported a decline in a*-value in pasteurize orange juice during storage which supports to our findings. The results of present study are in close agreement with the previous finding of Rodrigo et al. (2003) who showed a significant decrease of b*-value on pasteurized orange–carrot juices when processed at 77 0C and stored at 100C stable for a period of 32 days.

Effect of storage on sensory characteristics. The change in color parameter may be due to the maillard reaction between sugars and amino acids (Gonzalez and Leeson, 2000). The results are in close agreement with the findings of Granzer (1982) who also reported similar results for color of beverages at different storage periods. A decrease in the scores assigned to flavor of different beverages may be attributed to the increase in acidity of beverage. A gradual decrease in flavor, during storage may also be due to degradation of flavor due to storage of product at refrigerator temperature and due to heat treatment applied during processing and such reasons for decrease in flavor have been reported by Pruthi et al. (1984). The results of the present study are in line with the findings of Renuka et al. (2009) who prepared fruit juice beverages with fortified fructo-oligosaccharide and noted the quality characteristics with six months storage period.

Conclusion

Momordica charantia plant is usually used as a hypoglycemic and antidiabetic agent and many components have been identified which possess hypoglycemic properties. The present study was a step towards in this era to develop dietetic beverage. The functional drink with 15.0% bitter gourd extract was found best. Further research is needed to develop such products for dietetic and health conscious people with low calorific value from medicinal plants.

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