VOL. 8, NO. 4, APRIL 2013 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science

www.arpnjournals.com

PREPARATION AND QUALITY EVALUATION OF SWEET POTATO READY TO DRINK BEVERAGE

Muhammad Sohail[1], Rehman Ullah Khan[1], Shamsur Rehman Afridi[1], Muhammad Imad[2] and Bibi Mehrin[3]
[1]Food Technology Centre, PCSIR Labs Complex, Peshawar, Pakistan
[2]University of Engineering and Technology, Peshawar, Pakistan
[3]Department of Chemistry, University of Peshawar, Pakistan
E-Mail: msohail294@gmail.com

ABSTRACT

Sweet potato ready to drink beverage was prepared using different formulations. The prepared beverage was formulated either with lemon juice (F_1), maize malt (F_2) or both lemon juice and maize malt (F_3). While one sample (F_o) was neither treated with lemon juice nor maize malt as control. Physico chemical analysis such as titratable acidity, vitamin C content, PH, total soluble solids, reducing sugar, non reducing sugar, total sugar, beta carotene content and sensory evaluation (colour, flavor and overall acceptability) was carried out in all the prepared beverage samples. Results revealed that titratable acidity (0.196%), vitamin C content (23.22 mg/kg), total soluble solids (13.92^{o}brix), reducing sugar (7.87%), non reducing sugar (5.99%), total sugar (13.47%), beta carotene (39.24 mg/kg), colour (8.4) and overall acceptability (8.7) values were highest for F_3 while the pH value was high for F_2 (4.29) and flavour for F_1 (8.7) as compared to the other formulations. On the basis of results obtained it is concluded that sweet potato ready to drink beverage prepared with maize malt and lemon juice (F3) is more acceptable and showed good quality attributes followed by F1 (Sweet potato ready to drink beverage + lemon juice) as compared to the other formulations used.

Keywords: sweet potato, beverage, beta carotene, maize malt, ready to drink.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) represents the sixth most important food crop in the world. World-wide production of sweet potato is 1076 million tonnes in 2009 and the major producers include China, Uganda, Indonesia, India and Japan (FAO, 2010). More than two billion people in Asia, Africa and Latin America will depend on sweet potato for food, feed and income by 2020 (Scott *et al*., 2000). The sweet potato is used widely as ready-to-eat foods such as noodles, Chinese style French fries, canned foods, etc. (Antonio *et al*., 2008). Sweet potato is excellent source of vitamin A and C, and the starch content of the fresh roots varies from 6.9 to 30.7%. Besides, they are high in energy and dietary fibre, low in fat, and are important sources of beta-carotene (Aina *et al*., 2010). It is reported that one medium sized sweet potato can provide about twice the β-carotene needed for the recommended daily requirement of vitamin A. The roots are usually consumed after processing like boiling, baking or making fried chips (Vimala *et al*., 2011).

Utilization of sweet potato is limited to their traditional uses. Development of low and intermediate technologies that will process sweet potato into value added products at the household and village factory levels would promote its production and consumption and increase its economic value. Sweet potato can be used for the juice preparation alone or its juice can also be consumed with other juices to form a variety of juice blends (Coggins *et al*., 2003). Fresh sweet potatoes having relatively high moisture contents are very sensitive to microbial spoilage, even at refrigerated conditions (Xiao *et al*., 2009). Hence, they must be consumed within a few weeks after harvest or be processed into various products (Akissoe *et al*., 2003). The use of sweet potato for drink preparation is a viable option for processing sweet potato into a valuable product. The objective of this work was thus to prepare a ready to drink beverage from sweet potato and hence minimize its post harvest losses.

MATERIALS AND METHODS

Sample preparation

Yellow fleshed fresh sweet potatoes (*Ipomoea batatas* L.) were purchased from a local fruit market in Peshawar, Pakistan. The research work was conducted in Food Technology Centre, PCSIR Labs Complex Peshawar.

The sweet potato ready to drink beverage was prepared with four different formulations according to the given plan.

F_o = Sweet potato ready to drink beverage
F_1 = Sweet potato ready to drink beverage + lemon juice
F_2 = Sweet potato ready to drink beverage + maize malt
F_3 = Sweet potato ready to drink beverage + maize malt + lemon juice

Preparation of maize malt

Maize grains were sprouted according to Khalil *et al*. (2007). The grains were first cleaned, washed and steeped for 24 hours and sprouted for 3-4 days on a jute sac. Sprouted grains were then oven dried at 50^{o}C for 2 days and milled to get maize malt. The maize malt acted as a source of external β- and α-amylase enzymes (in addition to indigenous enzyme of the sweet potato root) to convert the starch of the sweet potato to sugar and extract more soluble solids. Maize malt was added to homogenized sweet potatoes before heating at 60°C.

ARPN Journal of Agricultural and Biological Science

www.arpnjournals.com

Preparation of sweet potato ready to drink beverage

Sweet potatoes were washed, weighed, knife peeled and cut into smaller pieces and immersed into 1% potassium metabisulfite solution. They were rinsed with water and homogenized with the help of blender. Additional water (3 litre/ Kg) and 5% maize malt (as source of external β- and α-amylase enzymes), were added and heated to a temperature of 60°C and maintained at that temperature for 2 hours. The mixture was then strained with cheesecloth. The extract was formulated with 12% (w/v) sugar, 0.7% (v/v) lemon juice (only F_1 and F_3) to enhance the flavor, 0.1% sodium benzoate (as preservative) and 232 mg/litre ascorbic acid (as vitamin C fortification). It was then pasteurized at 90°C for 10 min and bottled hot. The bottled drinks were cooled under running cold water and stored at room temperature for analysis (Figure-1).

Physico chemical analysis

Evaluation for physico-chemical analysis was carried out in Food Technology Centre, PCSIR Labs Complex Peshawar Pakistan. The prepared drink was assessed for titratable acidity (%), vitamin C content (mg/100g), total soluble solids (TSS), pH, total sugar (%), reducing sugar (%) and % non reducing sugar according to the recommended methods of AOAC (2000). The % non reducing sugar was determined using the following formula:

Non reducing sugar (%) = total sugar - reducing sugar x 0.95

While the beta carotene (mg/kg) content in the prepared drink samples was determined at 446 nm using UV spectrophotometer model UNICO 2100 series Japan according to a method described by Ahmad *et al.*, (2011).

Organoleptic evaluation

The prepared drink samples were also organoleptically evaluated for colour, flavour and overall acceptability by a panel of 15 experienced judges using 9 Point Hedonic Scale of Larmond (1977).

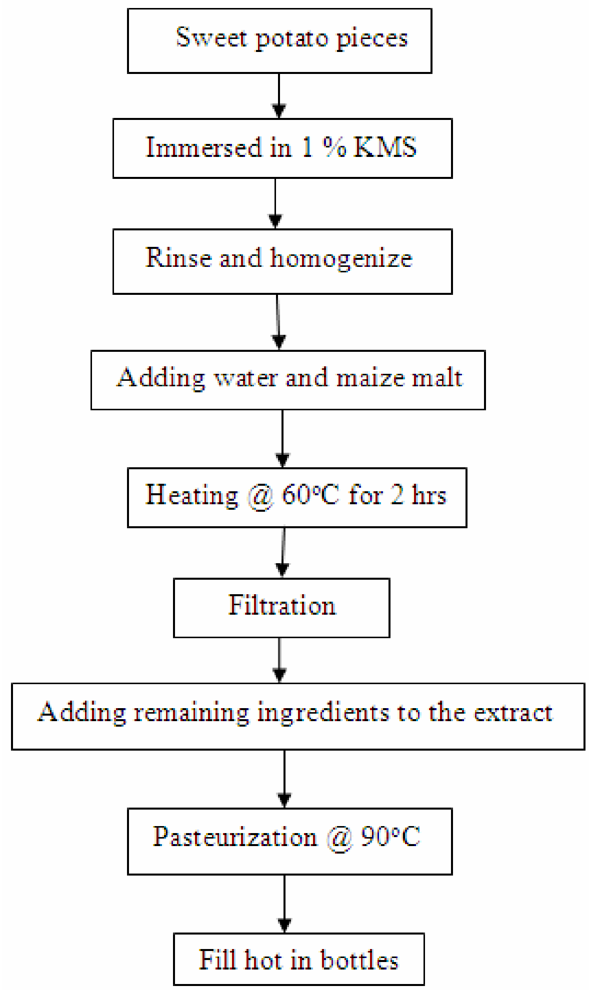

Figure-1. Steps in the preparation of sweet potato ready to drink beverage.

RESULTS AND DISCUSSIONS

The data pertaining to physicochemical analysis of sweet potato ready to drink beverage is shown in Table-1. Titratable acidity ranged between 0.183 - 0.196%, with highest acidity (0.196%) in sample F_3. The difference may be due to the presence of lemon juice which makes the beverage more acidic as compared to non flavoured treatments. The same results were obtained by Wireko-Manu *et al.,* (2010), who reported the same difference in the prepared non alcoholic sweet potato beverage. The maximum ascorbic acid content was recorded in treatment F_3 (23.22 mg/100g) followed by F_1 (21.35 mg/100g). The maximum content of ascorbic acid in F_3 and F_1 may be due to the addition of lemon juice. Sweet potato provides a considerable amount of vitamin C and it has been reported to provide more than one third of the daily requirements of vitamin C (Hou *et al*., 2001). Apart from increasing the nutritional content of the beverage, the ascorbic acid also acts as an antioxidant to help prevent molecular changes (Wardlaw, 1999).

PH of the beverage varied significantly ranging from 4.08-4.29 with treatment F_2 and F_3 having the highest and lowest values respectively. This difference is due to the presence of lemon juice which increased acidity of the beverage and caused low level of pH as compared to the other treatments. The results are also in agreement with the findings of Cecilia and Maia (2002) who observed a decrease in pH of high pulp content apple juice during storage. Total soluble solids of the beverage were in the range of 12.20 to 13.92 ^{o}brix. The lowest TSS (12.20 ^{o}brix) was noted in sample F_o while highest TSS was recorded in sample F_3 (13.92 ^{o}brix). The highest TSS values in sample F_3 may be due to the presence of maize malt and lemon juice as reported by Islam and Jalaluddin (2004).

The reducing and non reducing sugar values are also shown in Table-1. The reducing sugar values for treatment F_o, F_1, F_2 and F_3 are 6.32, 6.93, 6.56 and 7.87 % respectively. The highest value of reducing sugar for treatment F_3 and F_1 may be due to the inversion of sucrose to reducing sugars (glucose, fructose etc.) primarily due to the presence of acids (lemon juice) similar to those reported by khan *et al.,* 2012 who also reported inversion of sucrose to glucose and fructose in the blended drink of mango and sea buckthorn. Similarly the maximum non reducing sugar value (5.99 %) was observed in sample F_3 and minimum value (4.75 %) of non reducing sugar was found in sweet potato drink made with only lemon juice (F_1).

β-Carotene can make a major contribution in alleviating vitamin A malnutrition. The maximum content (39.24 mg/kg) of beta carotene was found in F_3 while the minimum value (35.46 mg/kg) for beta carotene was observed in sample F_o. The highest content of beta carotene in sample F_3 may be due to the addition of maize malt and lemon juice, which enhanced the beta carotene content of the drink by adding β-carotene present in lemon juice and maize malt. Since wu *et al*., (2008) reported one third loss in beta carotene content of sweet potato fruits during boiling for 50 minutes. That's why the prepared drink was formulated with maize malt and lemon juice which resulted in the recovery of beta carotene content.

The result pertaining to sensory evaluation is presented in Figure-2. The maximum score (8.4) for colour was achieved by sample F_3 having maize malt and lemon juice. The addition of maize malt and lemon juice increased the brightness of the beverage and attracted eyes of the panel hence more points were given to this treatment as compared to the other treatments. The observed natural color of the sweet potato ready to drink beverage, light yellow to orange is similar to that of fruit drinks and juices and this may be a promotional advantage to the enhanced artificial color in most commercial drinks (Philpott *et al*., 2003). The maximum score for flavour was attained by the sample F_1 (8.8) having lemon juice but with out maize malt. The presence of lemon juice enhanced the flavour of the product and was given preference over the other treatments as reported by Coggins *et al*., (2003) who prepared the sweet potato drink flavoured with lime and ginger extract. For the overall acceptability of the drink treatment F_3 has maximum score (8.7) followed by sample F_1 (7.7) formulated with out maize malt but with lemon juice. Thus, sweet potato ready to drink beverage will be more welcomed by consumers who are now more conscious about the nutritional content of what they consume.

CONCLUSIONS

On the basis of the results obtained it is concluded that sweet potato ready to drink beverage prepared with maize malt and lemon juice (F_3) is more acceptable followed by F_1 (Sweet potato ready to drink beverage + lemon juice) as compared to the other formulations used.

Table-1. Physicochemical evaluation of sweet potato ready to drink beverage.

Parameters	**F_o**	**F_1**	**F_2**	**F_3**
Titratable acidity (%)	0.185 ± 0.07	0.192 ± 0.63	0.183 ± 0.08	0.196 ± 0.05
Vitamin C (mg/100g)	17. 91 ± 0.78	21.35 ± 0.23	20.62 ± 0.05	23.22 ± 0.05
PH	4.23 ± 0.10	4.14 ± 0.09	4.29 ± 0.17	4.08 ± 0.07
Total soluble solids (^{o}brix)	12.20 ± 0.35	12.91 ± 0.28	13.38 ± 0.72	13.92 ± 0.10
Reducing sugar (%)	6.32 ± 0.06	6.93 ± 0.53	6.56 ± 0.38	7.87 ± 0.01
Non reducing sugar (%)	5.86 ± 0.06	4.75 ± 0.19	5.76 ± 0.08	5.99 ± 0.04
Total sugar (%)	11.86 ± 0.21	11.33 ± 0.34	12.18 ± 0.09	13.47 ± 0.44
Beta carotene (mg/kg)	35.46 ± 0.67	37.21 ± 0.33	38.75 ± 0.38	39.24 ± 0.28

Means ± SD of triplicate determinations.

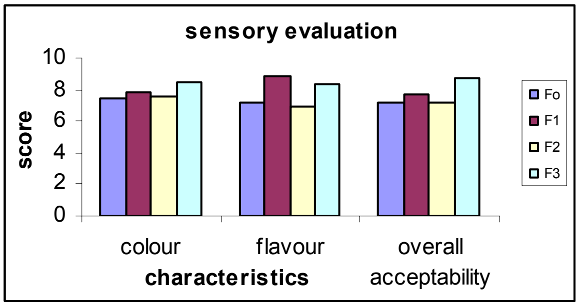

Figure-2. Sensory evaluation of sweet potato ready to drink beverage.

REFERENCES

Ahmed T., Atta S., Sohail M., Khan A. R. and Akhtar S. 2011. Effect of fluorescent light on quality and stability of edible fats and oils. Journal Chem. Soc. Pak. 33(2): 233-237.

Aina A.J., Falade K.O., Akingbala J.O. and Titus P. 2010. Physicochemical properties of Caribbean sweet potato (*Ipomoea batatas* (L) Lam) starches. Food Bioprocess Tech. 9-16.

Akissoe N., Hounhouigan J., Mestres C. and Nago M. 2003. How blanching and drying affect the colour and functional characteristics of yam (Dioscorea cayenensis-rotundata) flour. Journal of Food Chem. 82: 257-264.

Antonio G.C., Alves D.G., Azoubel O.M., Murr F. E. X. and Park K.J. 2008. Influence of osmotic dehydration and high temperature short time processes on dried sweet potato (*Ipomoea batatas* Lam.). Journal of Food Eng. 84: 375-382.

AOAC, Association of official and analytical chemists. 2000. 15th Ed (Helrich, K.). Arlington, Virgina, USA.

Cecilia E. and Maia G.A. 2002. Storage stability of cashew apple juice preserved by hot fill and aseptic process. Dept. of Food Tech. Univ. of Ceara, Brazil CEP.

Coggins P.C., Kelly R.A. and Wilbourn J.A. 2003. Juice yield of sweet potato culls. Session 104 C, Fruit and Vegetable Products: Vegetables (Processed). IFT Annual Meeting - Chicago, USA.

FAO. Food and Agriculture Organization. 2010. Agriculture Data. http://faostat.fao.org/site/567/ Desktop. Default. aspx? Page ID=567#ancor (September 02, 2010).

Hou W. C., Chen Y.C. and Chen H. J. 2001. Antioxidant activities of trypsin inhibitor, a 33 KDa root storage protein of sweet potato (*Ipomoea batatas* (L.) Lam cv. Tainong 57). Journal Agric. Food Chem. 49(6): 2978-2981.

Islam M.S. and Jalaluddin M. 2004. Sweet potato: A potential nutritionally rich multifunctional food crop for Arkansas. Journal Arkansas Agric. Rural Dev. 4: 3-7.

Khalil A.W., Zeb A., Mahmood F., Tariq S., Khattak A.B. and Shah H.2007. Comparison of sprout quality characteristics of desi and kabuli type chickpea cultivars (*Cicer arietinum* L.). LWT - Food Sci. Tech. 40: 937-945.

Khan R.U., Afridi S. R., Ilyas M., Abid H., Sohail M. and Khan S. A. 2012. Effect of different chemical preservatives on the storage stability of mango-sea buckthorn blended juice. Pak. J. Biochem. Mol. Biol. 45(1): 6-10.

Larmond E. 1977. Laboratory method of sensory evaluation of food. Canada Deptt. Agri. Ottawa.

Philpott M., Gould K. S., Markham K. R., Lewthwaite S. L. and Ferguson L. R. 2003. Enhanced coloration reveals high antioxidant potential in new sweet potato cultivars. Journal Sci. Food and Agri. 83: 1076-1082.

Scott G. J., Best R., Rosegrant M. and Bokanga M. 2000. Root and tuber crops in the global food system. International Potato Centre. Lima, Peru. 111.

Vimala B., Nambisan B. and Hariprakash B. 2011. Retention of carotenoids in orange-fleshed sweet potato during processing. Journal Food Sci. Tech. 48(4): 520-524.

Wardlaw G.M. 1999. Perspectives in Nutrition, McGraw-Hill, USA. 443.

Wu X., Sun C., Yang L., Zeng G., Liu Z. and Li Y. 2008. β-carotene content in sweet potato varieties from China and the effect of preparation on β-carotene retention in the Yanshu No. 5. Journal Innovative Food Sci. Emerging Tech. 9: 581-586.

Wireko-Manu F. D., Ellis W. O. and Oduro I. 2010. Production of a non-alcoholic beverage from sweet potato (*Ipomoea batatas* L.). African Journal Food Sci. 4(4): 180-183.

Xiao H. W., Lin H., Yao X.D., Du Z.L., Lou Z. and Gao Z.C. 2009. Effects of different pretreatments on drying kinetics and quality of sweet potato bars undergoing air impingement drying. Int. Journal Food Eng. 5(5).