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Studies on Stability of Strawberry Drink Stored at Different Temperatures

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ABSTRACT

Strawberry drink was stored at room temperature (25^0C), refrigeration temperature (4-6^0C) and high temperature (40-45^0C). The treatments were analyzed for physico-chemical and sensory quality fortnightly for three months. Significant results were obtained for acidity, ^{0}Brix, Reducing sugars and ascorbic acid with regards to the treatments as well as storage. The pH was non significantly affected by treatments; however, storage had significant effect on it. The acidity, ^{0}Brix and reducing sugars increased while pH and ascorbic acid decreased during storage. The acidity and pH changed gradually in all treatments while ^{0}Brix, reducing sugars and ascorbic acid changed differently and maximum variations were observed in the treatment stored at 40-45^0C. The storage temperatures and period also significantly affected all the sensory characteristics. On organoleptic evaluation, the treatment stored at refrigeration temperature remained most acceptable and no significant change occurred in it during the storage period. It was found that strawberry drink can successfully be stored at refrigeration temperature on commercial scale manufacturing due to significant stability in colour, flavour and taste.

Key Words: Strawberry; Fruit drink; Storage Temperature; Stability

INTRODUCTION

The extreme hot summer weather of Pakistan is mainly responsible for the demand of fruit drinks. There has been a spectacular growth in the consumption of fruit drinks. Fruit juices are now a regular part of the diet of many people. The huge amount of beverages is imported on the expense of foreign exchange which can be saved through production of local drinks.

Strawberry belonging to family Rosaceae is the most widely grown berry of the world. It is a small, juicy, nutritious, flavourful and sweet in taste fruit. It is an excellent source of Vit. C. and thought to have tonic, depurative, diuretic, remineralizing and astringent properties (Johnson & Peterson, 1974). Strawberry production in world was 2438 million tons in 1989-91 and 2987 million tons in 1999 and also in Asia was 402 million tons in 1989 and 497 million tons in 1999 (Anonymous, 1999).

Edible portion of strawberry contains about 89.9 g water, 0.7 g protein, 0.5 g fat, 8.4 g carbohydrates, 1.3 g fiber, 0.5 g ash, 21 mg calcium, 21 mg phosphorus, 1.0 mg iron, 1.0 mg sodium, 164 mg potassium, 60 I.U. vitamin A, 0.03 mg thiamin, 0.07 mg riboflavin, 0.6 mg niacin, 59 mg ascorbic acid per 100 g (Considine, 1982).

Strawberry is widely used as fresh fruit and being a short season and highly perishable fruit can be preserved in the form of pulp. It is mainly used as preserved fruit in juices, dairy and bakery goods etc.

Fruit juices are preserved by several methods such as freezing, irradiation, heat processing and use of chemical preservatives. The last two methods, being most suitable and economical, are employed for preparation and preservation of ready to serve drink but no work has so far been done to follow the changes like colour and flavour losses during storage.

Keeping all these factors in view, the present study was conducted to use strawberry pulp for preparation of ready to serve drink with the objective to determine the quality and storage stability of the drink, under different temperatures.

MATERIALS AND METHODS

The strawberries were bought from local market and after thorough washing, treated in steam jacketed vessels at 80^0C for one minute. The pulp was extracted by means of a fine pulper and cooled at room temperature.

Drink was prepared with 20% pulp, filled in 250 mL bottles and pasteurized at 80^0C for one minute. The pasteurized bottles of drink were stored at room temperature (25^0C) (T_1), refrigeration temperature (4-6^0C) (T_2) and high temperature (40-45^0C) (T_3).

The physico-chemical and sensory evaluation of the samples were conducted fortnightly for three months. Acidity, pH, TSS, Reducing sugars and Ascorbic acid were determined according to the method given by AOAC (1990). Sensory evaluation was carried out on nine point hedonic scale (Larmond, 1977). The results obtained were statistically analyzed as described by Steel *et al.* (1996).

RESULTS AND DISCUSSION

Physico-chemical analysis of strawberry drink acidity. The results showed an increase in acidity of all samples with the increase in storage days (Table II). The data indicates that maximum percent acidity i.e. 0.3186 was recorded for samples stored at room as well as high temperatures (Table I). The gradual increase in acidity might be due to the formation of acidic compounds by degradation or oxidation of reducing sugars present in the drink by the breakdown of peptic bodies (El-Warraki *et al.*, 1976).

pH. The pH of the drink differed significantly with regard to the storage and non-significantly with regard to the treatments. The mean pH of drink samples ranged from 3.40 on 0 day which decreased to 2.56 after 90 days storage. The maximum decrease in pH was observed in sample stored at refrigeration temperature i.e. from 3.4 to 2.5. The pH of the samples decreased due to an increase in acidity during storage period.

^{0}Brix. The per cent soluble solids (^{0}Brix**)** differed significantly among the treatments and with regard to the storage period. The initial mean soluble solid content value was 13.00 on 0 day which rose to 13.87 after 90 days (Table II). The increase in soluble solid contents may be due to hydrolysis of sucrose to invert sugars as reported by Bhatti (1975) and Ullah (1990).

Ascorbic acid. The result of ascorbic acid contents showed highly significant effect of treatments and storage period. The initial mean ascorbic acid contents were 65.0 mg/100 mL on 0 day which decreased to 38.0 mg/100 mL after 90 days (Table II). The less loss was observed among the sample stored at refrigeration temperature i.e. 65 to 44 mg. The decrease in ascorbic acid was due to prolong storage at high temperature (Otta, 1984).

Reducing sugars. The increase in percent reducing sugar showed significant effects with regard to the treatments and storage. The mean percent reducing sugar was 1.50 on 0 day and increased to 12.90 after 90 days of storage. The minimum increase was observed in the treatment stored at refrigeration temperature i.e. 1.50 to 10.59%. The increase in reducing sugars can be attributed to the hydrolysis of non-reducing sugars due to processing and storage as Zaheer (1986) and Lodhi (1989) expressed similar findings.

Sensory evaluation of strawberry drink. Strawberry drink was organoleptically evaluated for colour, flavour and taste during three months of storage. Each observation was made fortnightly by a panel of five judges on the basis of nine point hedonic scale.

The statistical analysis revealed that all sensory characteristics differed significantly with regard to the treatments as well as storage.

The drink stored at refrigeration temperature (4-6^{0}C) was ranked the best for colour, flavour and taste as compared to the others stored at room temperature (25^{0}C), and high temperature (40-45^{0}C) (Table III). The difference in colour was due to the browning reaction between reducing sugars and amino acids accelerated by high temperature (Gonzalez & Leeson, 2000). The loss of flavour and taste may be due to the degradation of ascorbic acid and furfural production (Shimoda & Osajima, 1981; Perez & Sanz, 2001) and high storage temperature (Daepp, 1973). Under refrigeration, there was less loss of flavour and taste.

Table I. Effect of storage temperatures on physico-chemical characteristics

Treatments	Acidity %	pH	^{0}Brix	Ascorbic Acid (mg/100ml)	Reducing Sugars %
T_1	0.3186a	2.94a	13.33c	50.57b	6.86b
T_2	0.3100b	2.91b	13.42b	53.57a	5.37c
T_3	0.3186a	2.94a	13.63a	48.14c	8.39a

Table II. Effect of storage period on physico-chemical characteristics

Storage Period	Acidity %	pH	^{0}Brix	Ascorbic Acid (mg/100ml)	Reducing Sugars %
S1 (0 days)	0.2800g	3.40a	13.00f	65.00a	1.50f
S2(15days)	0.2967f	3.23b	13.23e	60.33b	2.39e
S3(30days)	0.3060e	3.06c	13.40d	54.67c	4.73d
S4(45days)	0.3167d	2.82d	13.43d	50.33d	6.89d
S5(60days)	0.3267c	2.76de	13.57c	45.67e	9.64c
S6(75days)	0.3367b	2.66ef	13.73b	41.33f	10.83b
S7(90days)	0.3467a	2.56f	13.87a	38.00g	12.90a

Table III. Effect of storage temperatures on sensory characteristics

Treatments	Colour	Flavour	Taste
T_1	3.80b	3.46b	3.57c
T_2	7.42a	7.06a	6.66a
T_3	3.28c	3.43b	3.76b

Table IV. Effect of storage period on sensory characteristics

Storage Period	Colour	Flavour	Taste
S1 (0 days)	7.86a	7.60a	7.33a
S2(15days)	5.46b	5.73b	6.40b
S3(30days)	5.20c	5.06c	5.26c
S4(45days)	4.66d	4.33d	4.40d
S5(60days)	4.33d	3.93d	3.33d
S6(75days)	3.66e	3.46e	3.20e
S7(90days)	2.66f	2.73f	2.73f

CONCLUSION

The fruit drinks can be stored best at refrigeration temperature with the minimum alteration in their physico-chemical and sensory quality.

REFERENCES

Anonymous, 1999. Food & Agric Organization of the United Nations, *FAO Year Book*, Vol. 53, Rome, Italy

AOAC, 1990. *Official Methods of Analysis.* The Association of Official Analytical Chemists, 15th ed. Arlington, USA

Bhatti, M.S., 1975. Studies on some ripening changes in mangoes during storage. *M.Sc. Thesis*, Deptt. Food Technol. Univ. Agri., Faisalabad, Pakistan

Considine, M., 1982. *Food and Food Products Encyclopedia*. Van Nostrad Inc. New York. USA

Daepp, H.U., 1973. State of technology of fruit juice concentrates. Report, *Int. Fed. of Fruit Juice Products, Scientific Tech. Commission* No. 13: 43–56. USA

Elwarraki, A.G., N.R. Abdel–Rehman, M.A. Abdallah and T.A. Abdel–Fattah, 1976. Physical and chemical properties of locally canned orange juice. *Annals of Agric. Sci.,* Moshtohor 6: 195–209 (*Food Sci. Technol. Abst.* 11: 606, 1979)

Gonzalez, E.R and S. Leeson, 2000 An investigation on the preservation of kunun–zaki, an African fermented cereal based food drink. *Acta Alimentaria.* 29: 385–92

Johnson, A.H. and M.S. Peterson, 1974. Encyclopedia of Food Technology. *The AVI. Co. Inc*. Westport. Connecticut, USA

Larmond, E., 1977. *Laboratory Methods for Sensory Evaluation of Foods.* Canada Department of Agriculture, Pub. No. 1637

Lodhi, A., 1989. Effect of different gelling agents in the preparation of watermelon jam. *M.Sc. Thesis*, Deptt. Food Technol. Univ. Agri., Faisalabad, Pakistan

Otta, K., 1984. Minimum shelf life of fruit juices. *Flussinges abst*., 51: 570, 574–590

Perez, A.G. and C. Sanz, 2001. Effect of high oxygen and high carbon–dioxide atmospheres on strawberry flavour and other quality traits. *J. Agric. Food Chem*., 49: 2921–30

Shimoda, M. and Y. Osajima, 1981 Studies on off–flavour formed during storage of Satsuma mandarin juice. *J. Agric. Chem. Soc. Of Japan* 55: 319–24 (*Food Sci. Technol. Abst*.,14: 1194, 1982)

Steel, R., J.H. Torrie and D. Dickey, 1996. *Principles and Procedures of Statistics: A Biometrical Approach*, 3rd ed. McGraw Hill Book Co. Inc., New York

Ullah, I., 1990. Development, characterization and evaluation of watermelon, mango, pear and lime–juice blend. *M.Sc. Thesis*, Deptt. Food Technol. Univ. Agri., Faisalabad, Pakistan

Zaheer, H., 1986. To study the acceptability of mixed fruit jam (Apple & Muskmelon) *M.Sc. Thesis*, Deptt. Food Technol., Univ. Agri. Faisalabad, Pakistan

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