EFFECT OF VARIOUS STABILIZERS AND PRESERVATIVES ON THE QUALITY OF GRAPE JUICE DURING STORAGE

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Abstract

Studies were carried out with an objective to assess the effect of various post-harvest treatment with chemical preservatives and stabilizers stored at room temperature (20-25 ^{0}C) on stability and overall quality of whole grape juice. The treatments were comprised of G_0 (whole grape juice control), G_1 (whole grape juice + sodium benzoate 0.05% + potassium sorbate 0.05%), G_2 (whole grape juice + pectin+ potassium sorbate 0.05 % + sodium benzoate 0.05%), G_3 (whole grape juice + guar gum. + potassium sorbate 0.05 % + sodium benzoate 0.05%), G_4 (whole grape juice, Carboxyl methyl cellulose + potassium sorbate 0.05 % + sodium benzoate 0.05%), G_5 (whole grape juice Homogenization + pectin+ potassium sorbate 0.05 % + sodium benzoate 0.05%). Treatments were studied for acidity, ascorbic acid, pH, TSS, reducing sugar and non-reducing sugars and for sensory evaluation (color, flavor, and overall acceptability). Results indicated that an increase was observed in acidity (from 0.43 to 0.74%), total soluble solid (from 21.11 to 22.13 ^{0}brix), and reducing sugars (from 12.18 to 14.44%). While decrease was observed in ascorbic acid content (from 26.10 to 10.30 mg/100g), pH (from 3.78 to 3.54) and non-reducing sugar (from 3.09 to 1.96). Sensory evaluation explained that the sample G_5 (whole grape juice, Homogenization + pectin+ potassium sorbate 0.05 % + sodium benzoate 0.05%) and G_2 (whole grape juice, pectin+ potassium sorbate 0.05 % + sodium benzoate 0.05%) showed best result during

180 days of storage period. Hence it can be concluded that sample G_5 was found to be better for preserving sensory, overall quality and nutritive value of the whole grape juice.

Keywords. Storability. Chemical preservative. Quality. Stabilizers

Introduction

Grapes (*Vitis vinefera L.)* are the most important species of the family *vitacea*. Grapes are grown worldwide for edible purposes, and also for the production of wine, juice and resin (Malik, 1994). Grape juice, jam wine and raisins are economically important products of grape (Rao *et al*., 2009). About 80% of the total grapes in the world are used for wine making (Patil *et al.*, 2007). While 13% is used as table grapes and the remaining is used mainly for raisins, juice and other processed products (Kammerer *et al*., 2004).

Among fruit juices grape juice is most important it is taken as processed form or as untreated material i.e. winemaking (Cerdan *et al*., 2007). Grape juice contains greater amount of water (81–86%) and having glucose and fructose in greater concentration. Due to the presence of citric acid, malic acid, and tartaric acid it shows high acidity, which affected the pH value assurance balances between acidic and sweet tastes (Park *et al*., 2003). Mineral elements, present in grape are potassium and sodium at high level and sodium have low value. Among the bioactive compounds present in grape juice, phenolic components are of great importance because color and astringency effected by their characteristics and directly or indirectly related to the quality of the juice (Girard and Mazza, 1998). Due to the presence of rich constituents and have positive energetic, nutritional and bioactive affect which classify grape juice as a differential beverage (Mazarotto, 2005).

Food additives like preservatives are used to preserve the food increase the shelf life of food and to inhibit the growth of microorganism. Food additives are generally known as safe because the harmlessness of such compounds is tested (Parke and Lewis, 1992). Sodium benzoate, potassium metabisulphite, Sulphur dioxide, sodium sorbate, sodium propionate, sorbic acid are important chemical preservatives use for preservation of food. Several factors are involved for selecting a chemical preservative. These include the compound properties, safety, price, food properties, and have good quality result. Storage condition, post processing and type and level of microorganisms there also include, while choosing a chemical preservative the food laws must also be followed. A preservative used is sodium benzoate (confirmed on the label). Maximum permitted level which is observed as safe for sodium benzoate and benzoic acid is 0.1%. From 0.15 to 0.25% range is the maximum permissible amount for most countries. In different foods sorbates have wide applications as food preservatives, mainly as mold and yeast inhibitors. In the majority of foods from 0.05%-0.03% range of sorbates is efficient for antimicrobial concentration. (Sattar and Rehman, 1987).

Stabilizers are polysaccharides, water soluble, and have high molecular weight perform various functions, such as increase thickness, formation of gel, formation of layer, inhibit formation of crystal, inhibit syneresis, improving texture, improve physical stability and increase flavor etc. (Dickinson, 2003). In food technology stabilizers have been widely used as additives to: change the rheology and texture of aqueous suspensions (Dziezak, 1991) and improve texture of food (Armero and Collar, 1996). Some hydrocolloids are starch, xanthan, guar gum and carboxyl methyl cellulose etc. Stabilizers used in food industries pectin is one of the most usually used stabilizer and polysaccharides having gel ability. Pectin used in variety of applications such as mayonnaise flavor and emulsion for vegetable oils due to its gelling properties. In addition to pectin, cellulose derivatives have also increased acceptance for pharmaceutical, cosmetic, food, and packaging utilizes. They are obtained when hydroxyl-alkyl groups or alkyl group are replaced by hydroxyl group. Carboxy methyl cellulose (CMC) offers major viscosity, brilliant suspension capability and clarity. It creates a different pour and can have a sticky texture at extreme levels (Sahin and Feramuz, 2004). CMC is used as thickener, binder, stabilizer, water retaining and suspending agent in food, pharmaceuticals and other most important industries (Pilizota *et al*., 1996).

The main focus of this research work is to study the overall quality maintenance and preservation of whole grape juice by the addition of stabilizers and mixed chemical preservatives (sodium benzoate and potassium sorbate). Moreover, to stop the settling problem that occurring during storage in grape juices so that the consumer may get a new product in all seasons.

MATERIALS AND METHODS

Fresh, matured and healthy grapes (Yaquti variety) were purchased from the local market of Peshawar and brought to the processing hall of the Department of Food Science and Technology, Khyber Pakhtunkhwa Agricultural University, Peshawar. Grapes were washed with clean water to remove dust and other materials and diseased and bruised grapes were removed. After that grapes were separated from the cluster by hand and seeds were removed and juice was extracted with the help of electric blender. Each juice sample was placed in 250 mL beakers and stored for 180 days at ambient temperature. Following chemical preservative and different stabilizers, was added to the juice in following concentrations.

Table 1; Details of Treatments

G_0	Whole grape juice (control)
G_1	Whole grape juice + potassium sorbate (0.05 %) + sodium benzoate (0.05%)
G_2	Whole grape juice + pectin and potassium sorbate (0.05 %) + sodium benzoate (0.05%)
G_3	Whole grape juice + guar gum and potassium sorbate (0.05 %) + sodium benzoate (0.05%)
G_4	Whole grape juice + Carboxyl methyl cellulose (CMC) and potassium sorbate (0.05 %) + sodium benzoate (0.05%)
G_5	Whole grape juice + Homogenization + pectin and potassium sorbate (0.05 %) + sodium benzoate (0.05%)

Parameters

Parameters regarding pH, Total Soluble solids, Titratable acidity, Ascorbic acid, Total sugar and sensory evaluation was studied during the research period. pH of grape juice samples was determined by pH meter as described in the standard method of AOAC (2000). TSS of the selected juice samples was analyzed by Atago digital refractometer as described by method of AOAC (2000). Standard alkali solution was used for titration of juice and TA was measured by usin following formula (AOAC-2000)

$$\text{Acidity (\%)} = \frac{\text{C.F} \times \text{N} \times \text{T} \times \text{D}}{\text{V} \times \text{S}} \times 100$$

The titrimetric method as explained by AOAC (2000) was used to analyze the content of ascorbic acid in sample. Content of ascorbic acid of juice samples was calculated by following formula:

Ascorbic acid (mg/100g) = $L \times F \times 100/D \times P$

Sugars (reducing and non-reducing) was measured by Lane Eynon method as reported in AOAC (2000).

Larmond (1977) method was used to analyze the samples of the whole grape juice for color, flavor and overall acceptability. Panels of 10 judges were called to taste the samples (whole grape juice) for color, flavor and overall acceptability to compare them and allocate the score between 1-9, where digit 1 show extremely disliked and digit 9 represents extremely liked.

Different means were separated by applying least significant difference test (LSD) as illustrated by Steel and Torrie (1997).

Results and Discussion

Grape juice sample were analyzed for physicochemical tests such as ascorbic acid, acidity, pH, total soluble solids, reducing and non-reducing sugars and for sensory evaluation such as color, flavor and overall acceptability.

pH

It is evident from the fig.1 that the mean pH value reduced significantly ($P<0.05$) from 3.78 to 3.54 during 180 days of storage period. For treatments, in sample G_5 (3.79) highest mean value was observed followed by G_4 (3.72) while in G_1 (3.56) lowest mean value was observed followed by sample G_3 (3.57). Highest reduction occurred in sample G_2 (10.73%) followed by G_4 (6.99%), during storage, the reduction in pH may be due to the breakdown of pectin and formation of free acid (Imran *et al*., 2000). During storage of grape juice, there was a proportional increase in acidity as the pH decreased. The degradation of reducing sugar and pectin forms an acidic compound which might causes increase in acidity. Similar observation was studied during preservation of orange juice that is canned by (El Warraki *et al.,* 1976).

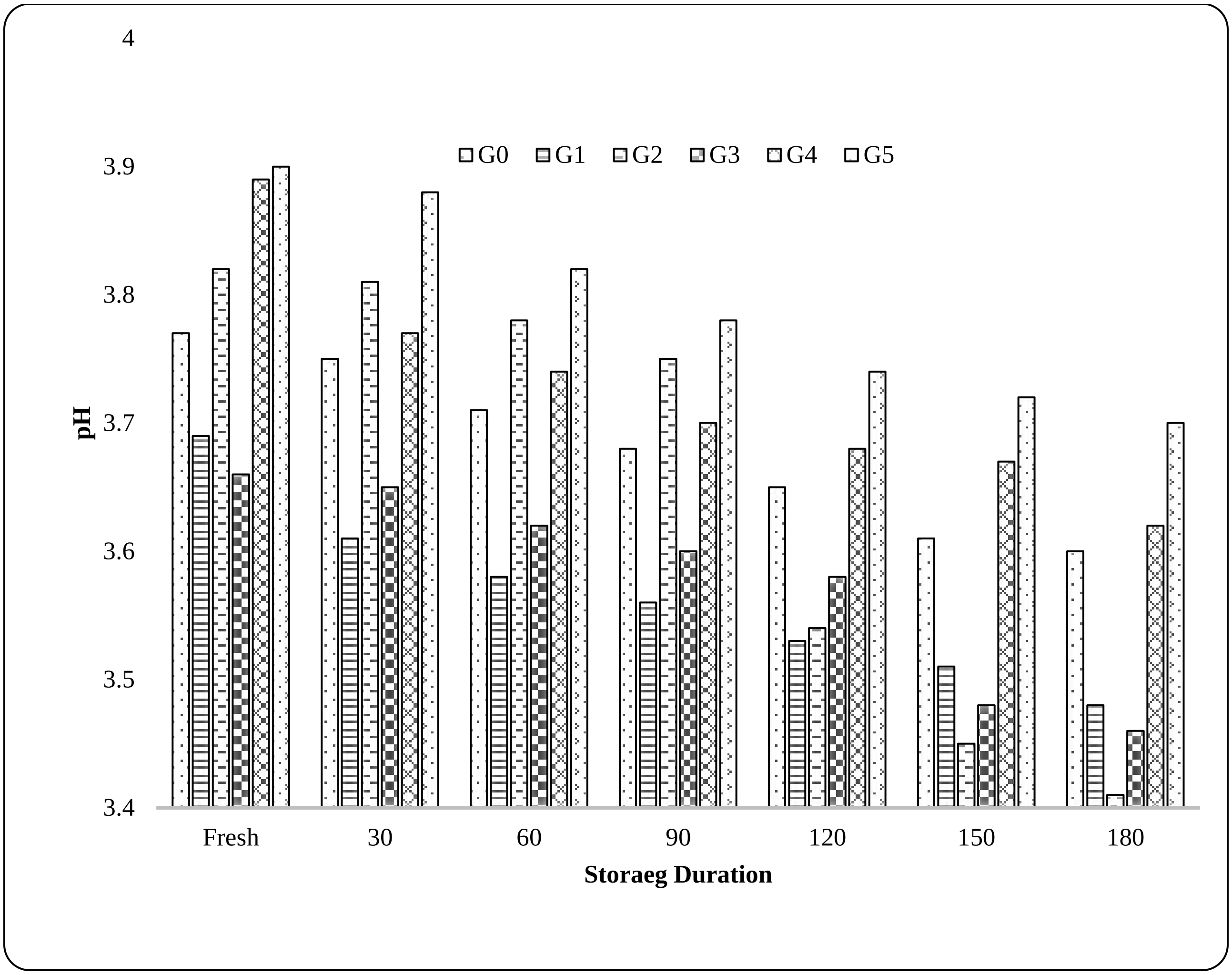

Fig.1 Effect of storage intervals and treatments on pH of whole grape juice

Total soluble solids

It is evident from the fig. 2 that the mean TSS values increase significantly ($p<0.05$) from 21.11°brix to 22.13°brix during 180 days of storage period. For treatments, in sample G_5 (22.59) highest mean value was observed followed by G_3 (22.40) °brix while in sample G_0 (19.85) lowest mean value were recorded follow by G_2 (21.55) during storage. These results were reported to be in favor with the work of Zeb *et al*. (2008). Muhammad (1986) reported that at room temperature the chemical, physical and sensory evaluation of citrus squash affected by the florescent. By storing squash for five months, a significant increase was observed in TSS.

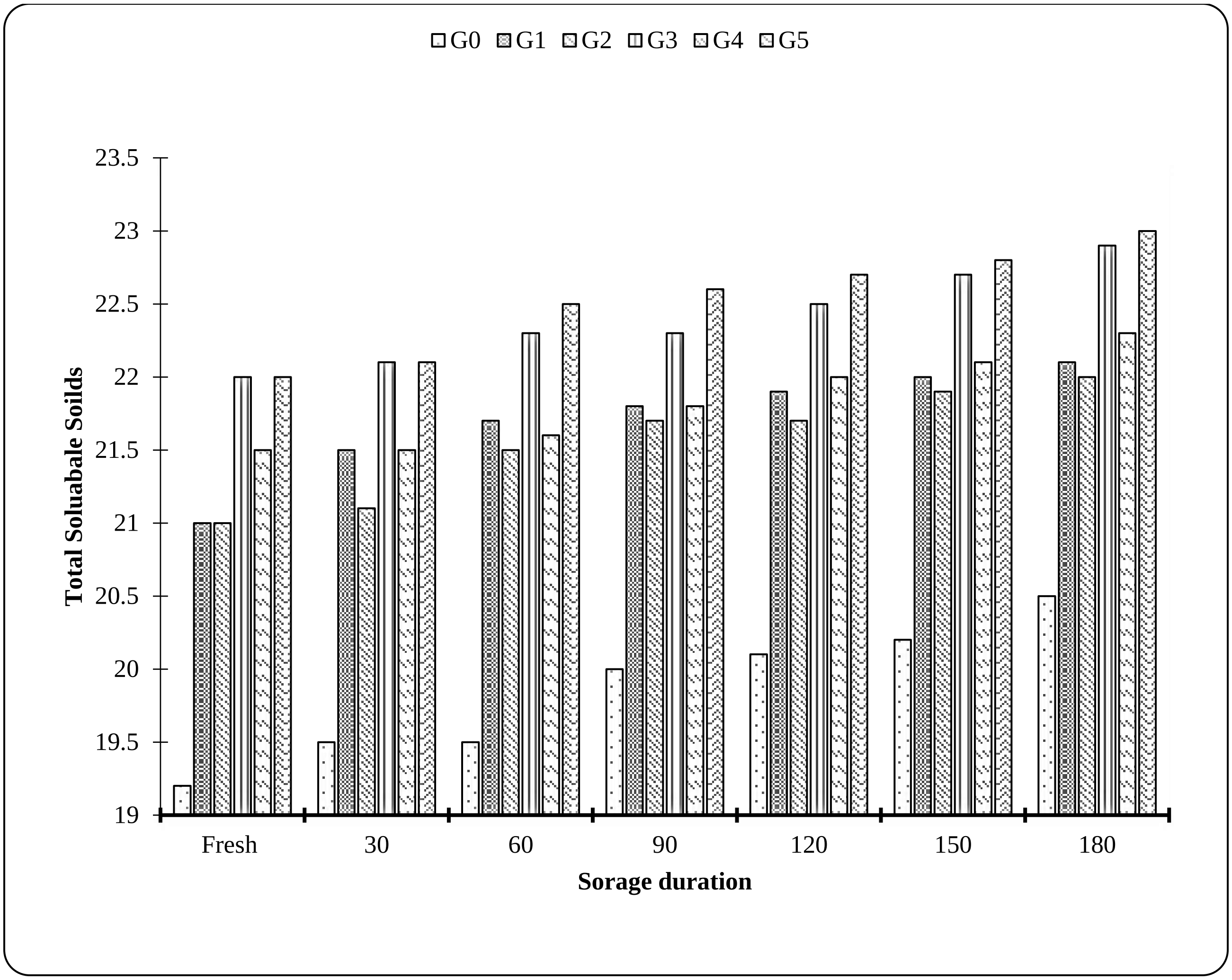

Fig.2 Effect of storage intervals and treatments on TSS of whole grape juice

Titratable acidity (%)

Fig.3 shows that during storage significant ($P<0.05$) increased was observed in the mean value of titrable acidity from 0.43 to 0.78. In sample G_3 (0.67) highest mean value was observed followed by G_4 (0.65) while G_5 (0.47) lowest mean values were observed followed by G_0 (0.53). During storage maximum increase was observed in sample G_2 (52.56%) followed by G_3 (43.75%) while minimum increase was observed in G_0 (30.76%) followed by G_5 (40.32). Similar result obtained from study of Mehmood *et al*. (2008) stated that during storage and processing of fruit juices pH was decreased and acidity was increased. During the study of Cecilia and Maia (2002) who determined that titrable acidity was increased in high pulp apple juice. High storage temperature is responsible for increasing in acidity, Oxidation or degradation of reducing sugar or pectic bodies break down into pectinic acid causes the formation of acidic compounds.

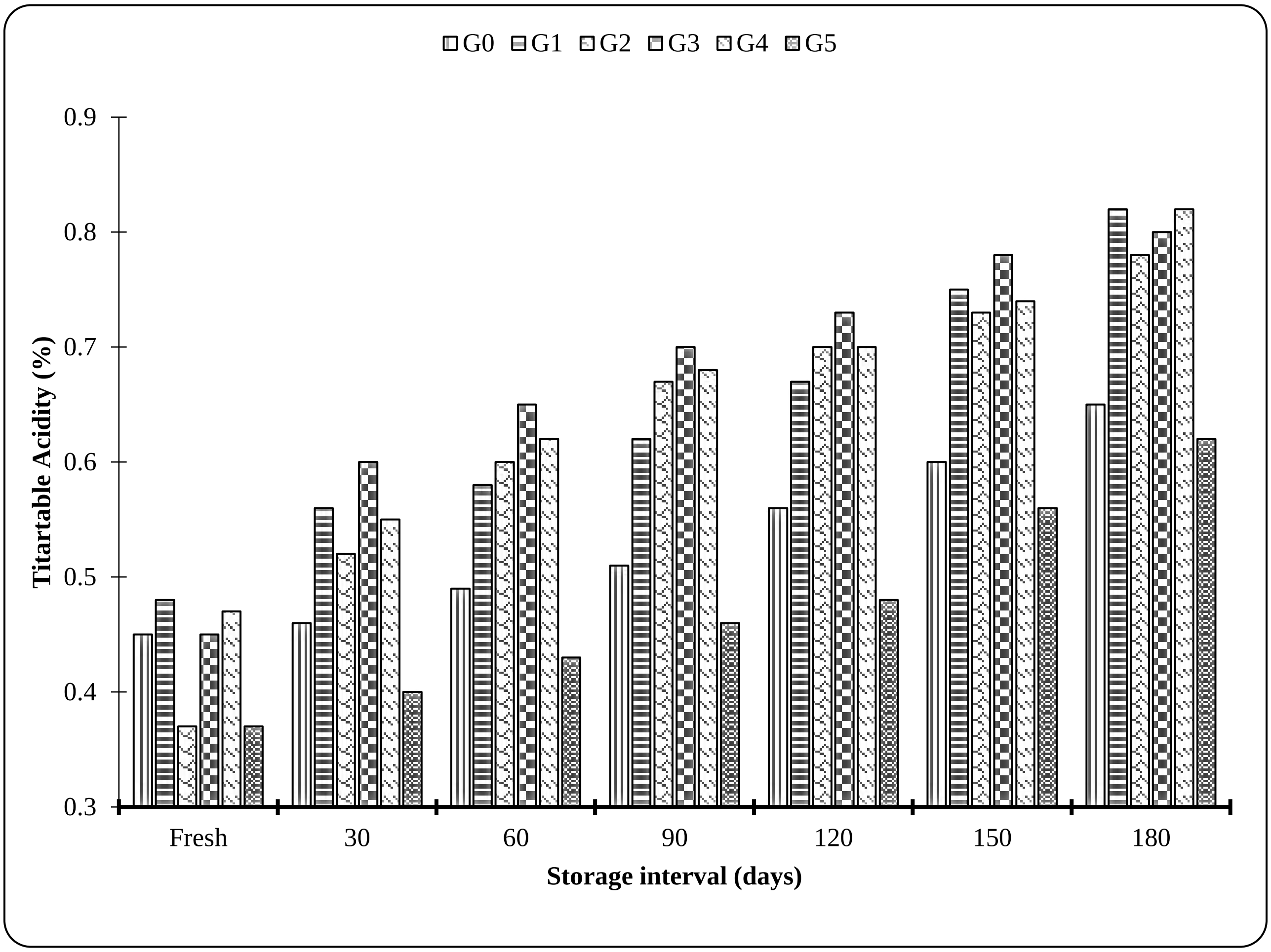

Fig.3 Effect of storage intervals and treatments on Titratable acidity of whole grape juice

Ascorbic acid (mg/100g)

Fig. 4 shows that content of ascorbic acid decreased significantly from 26.1 to 10.30 mg/100 g during 180 days of storage. Maximum mean values for treatment were recorded in sample G_3 (20.0) followed by G_2 (19.6 mg/100g), while in G_0 sample lowest mean values were observed (15.95) followed by G_5 (18.27 mg/100g). In G_0 sample highest decrease was recorded (72.00%) followed by G_4 (66.66%), Findings of Kinh *et al*. (2001) matched with this result, who recorded a decrease in ascorbic acid content in apple pulp. High temperature and light during storage causes loss in ascorbic acid. Same result was recorded by Mehmood *et al*. (2008) observed that during storage ascorbic acid content was decreased.

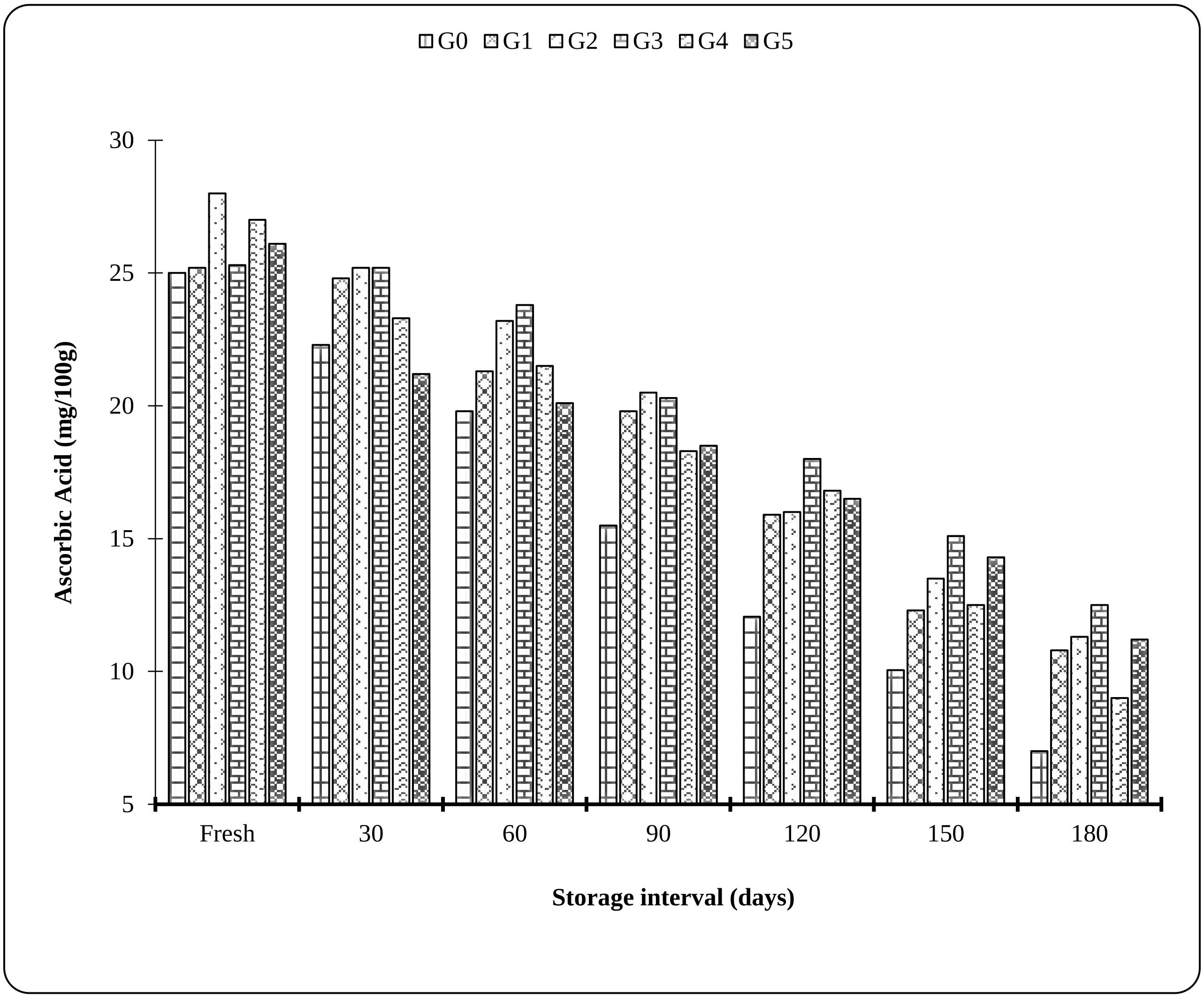

Fig.4 Effect of storage intervals and treatments on Ascorbic acid of whole grape juice

Reducing sugar (%)

It is clear from the fig. 5 that during storage period mean values for reducing sugar increased significantly (*$p<0.05$*) from 12.183 to 14.440. Highest mean values for treatment was noted in sample G_5 (14.01) followed by G_3 (13.94), while lowest mean values were noted in sample G_2 (12.90). Highest increase was noted in sample G_0 (25.61%) followed by G_1 (22.16%), while lowest increase was recorded in sample G_5 (7.74%) followed by G_2 (13.57%). These results match with the study of Mehmood *et al.* (2008) stated that in packed orange apple reducing was increased which may be due to the conversion of non-reducing sugars to reducing sugars. The raise in reducing sugar may be due to the inversion of sucrose to reducing sugar because of acids and high temperature during preservation at high temperature and acid the sucrose invert to reducing sugar cause to increase the value of reducing sugar (glucose + fructose) Hashmi *et al.* (2007).

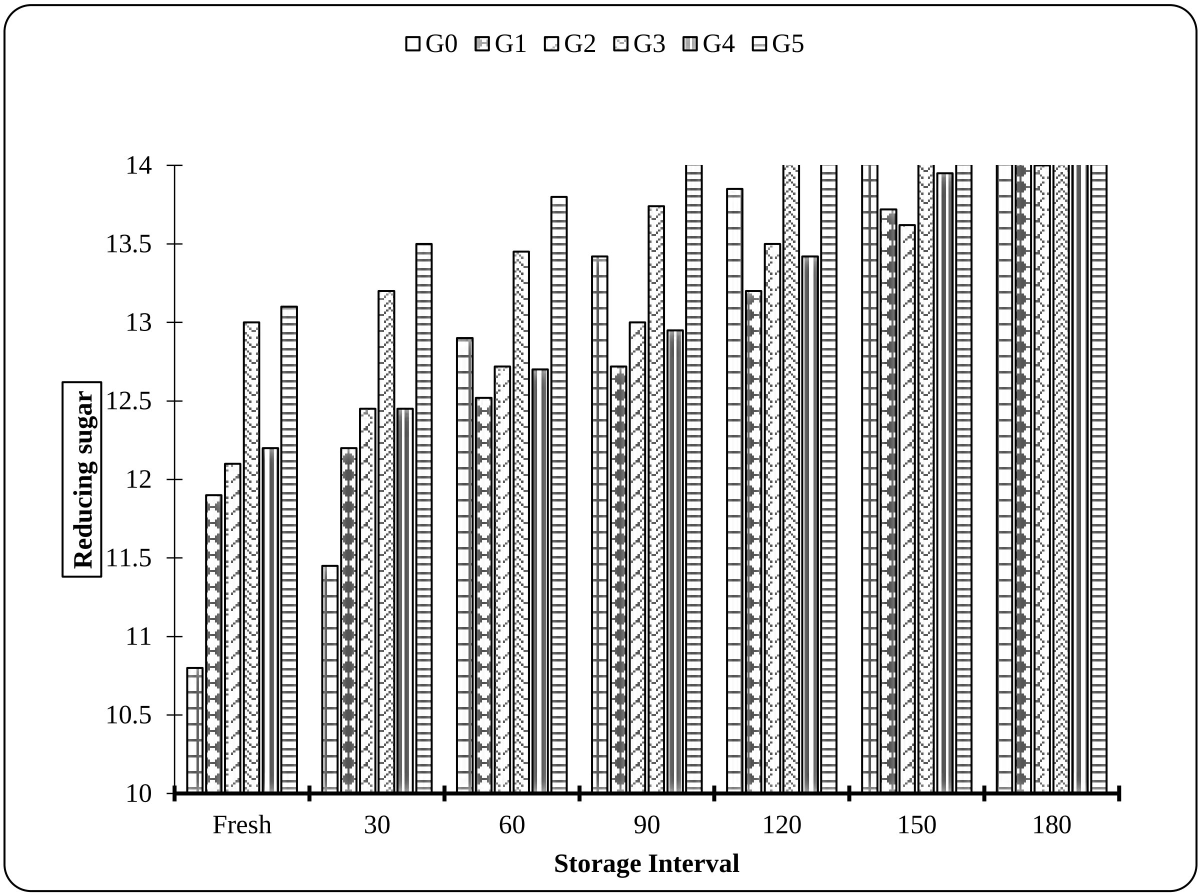

Fig.5 Effect of storage intervals and treatments on Reducing sugar of whole grape juice

Non reducing sugar (%)

Fig.6 shows that a significant ($P<0.05$) reduction occurred in mean value of non-reducing sugar which was from 3.095 to 1.968. Highest mean values for treatments was observed in G_1 (3.23) followed by G_5 (3.20), while lowest mean values were noted in sample G_3 (1.50) followed by G_0 (1.55). In sample G_3 (54.54%) maximum reduction occurred followed by G_0 (51.72%), while minimum reduction occurred in sample G_5 (28.60%) followed by G_1 (29.84%) The finding of Kinh *et al*. (2001) agreement with this result who observed that during storage reducing sugar increased of apple pulp. Hashmi *et al*. (2007) observed that reduction in non-reducing may be inverted to reducing sugar

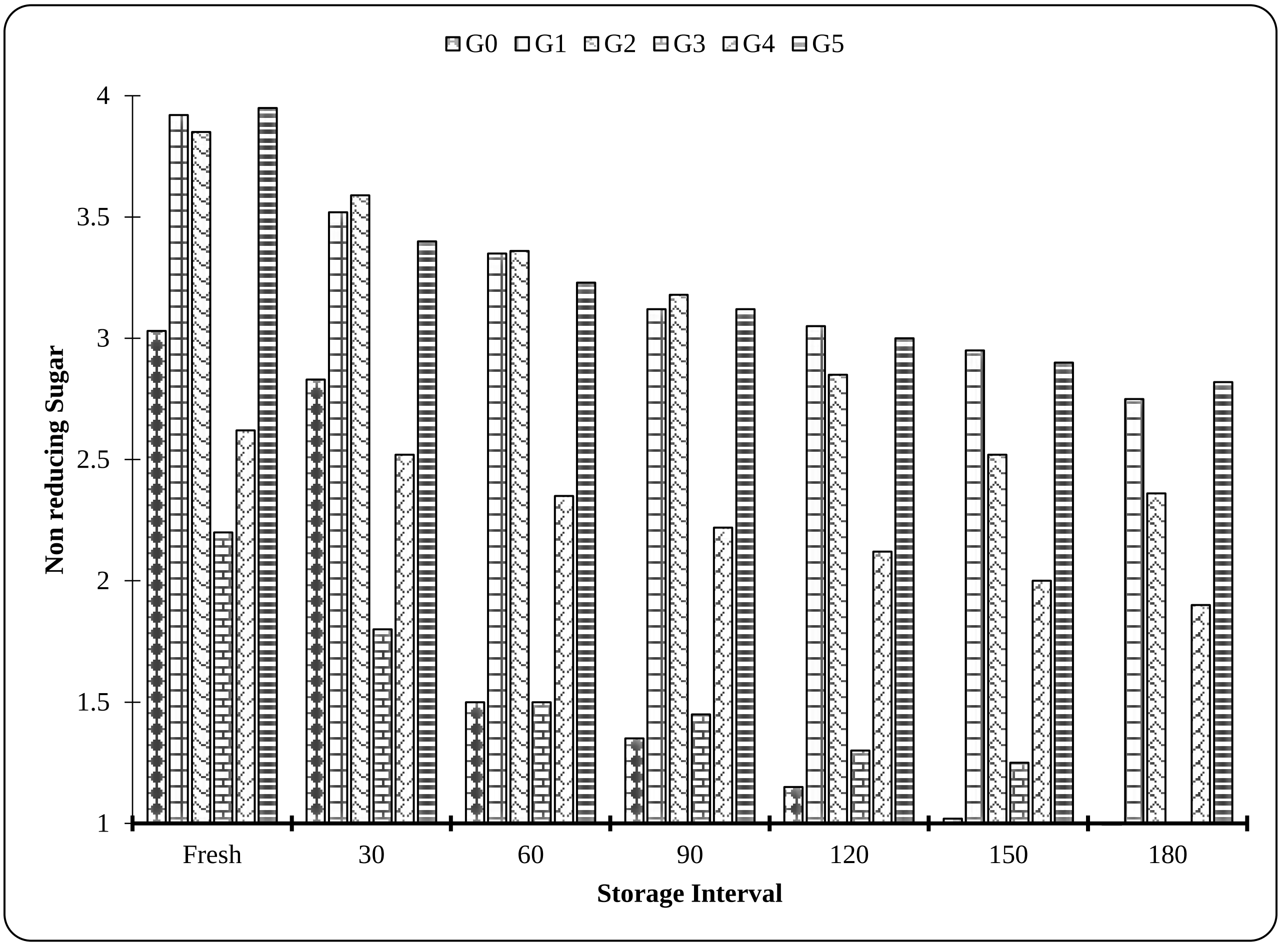

Fig.6 Effect of storage intervals and treatments on Non reducing sugar of whole grape juice

Sensory evaluation

Color, flavor, taste and overall acceptability of the samples were analyzed by a panel of 10 skilled judges at 30 days' storage interval for a total period of 6 months. 9-point hedonic scale was used to analyze the sensory evaluation as described by Larmond, (1977).

Color

It is evident from the fig.7 that during storage significant ($P<0.05$) decrease was observed in mean score for color that is from 7.54 to 5.45. For treatments in sample G_5 highest mean values was recorded that is (7.56) followed by G_2 (6.81), while in sample G_0 lowest mean values was noted that is (5.29) followed by G_4 (6.51). Highest reduction occurred in sample G_0 (75.00%) followed by G_3 (34.11%), while minimum reduction occurred in sample G_5 (15.66%) followed by G_2 (26.82%). The finding of Brenndor *et al*. (1985) agreement with this result who reported that browning of fruits and vegetables reduces by the use of SO_2. The reduction in color scores might be due to Millard reaction accelerated during storage. In fruit juices and syrup precipitation occur due to high temperature. Off- taste, off-odor, increased acidity and color reduction due to the bacterial fermentation in fruit juices and beverages. Zeb *et al*. (2009) analyzed the reduction in color stored at room temperature. The change in color during storage was due to browning reaction between amino acid and reducing sugars, speed up by high temperature.

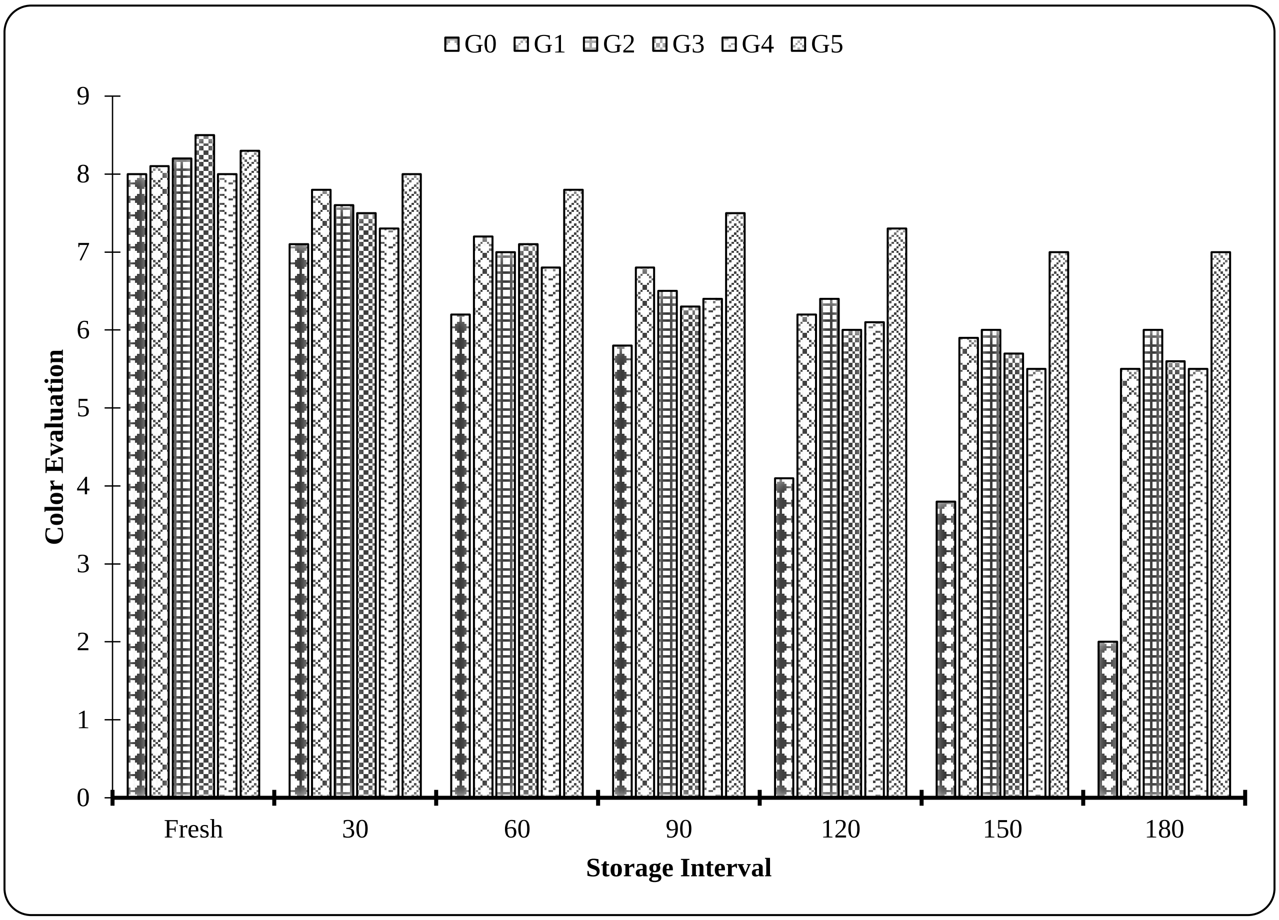

Fig.7 Mean score of judges for color of whole grape juice

Flavor

Fig.8 shows that a significant (P<0.05) reduction was observed in mean score for flavor suggested by different judges that is from 8.25 to 5.45. For treatments in sample G_5 highest mean value was noted that is (7.42) followed by G_2 (7.14), while in G_0 sample lowest mean score was recorded that is 4.56 followed by G_4 (6.54). This result was agreement with finding of Ayub and Bilal (2001), who reported that the flavor of pomegranate syrup had affected by the light. Kinh *et al*. (2001) stated that during storage apple pulp maintained better flavor when preserved with chemical preservatives. The flavor loss is due to the furfural production and losses of ascorbic acid content which causes loss of flavor as explained by Shimoda and Osajima (1981).

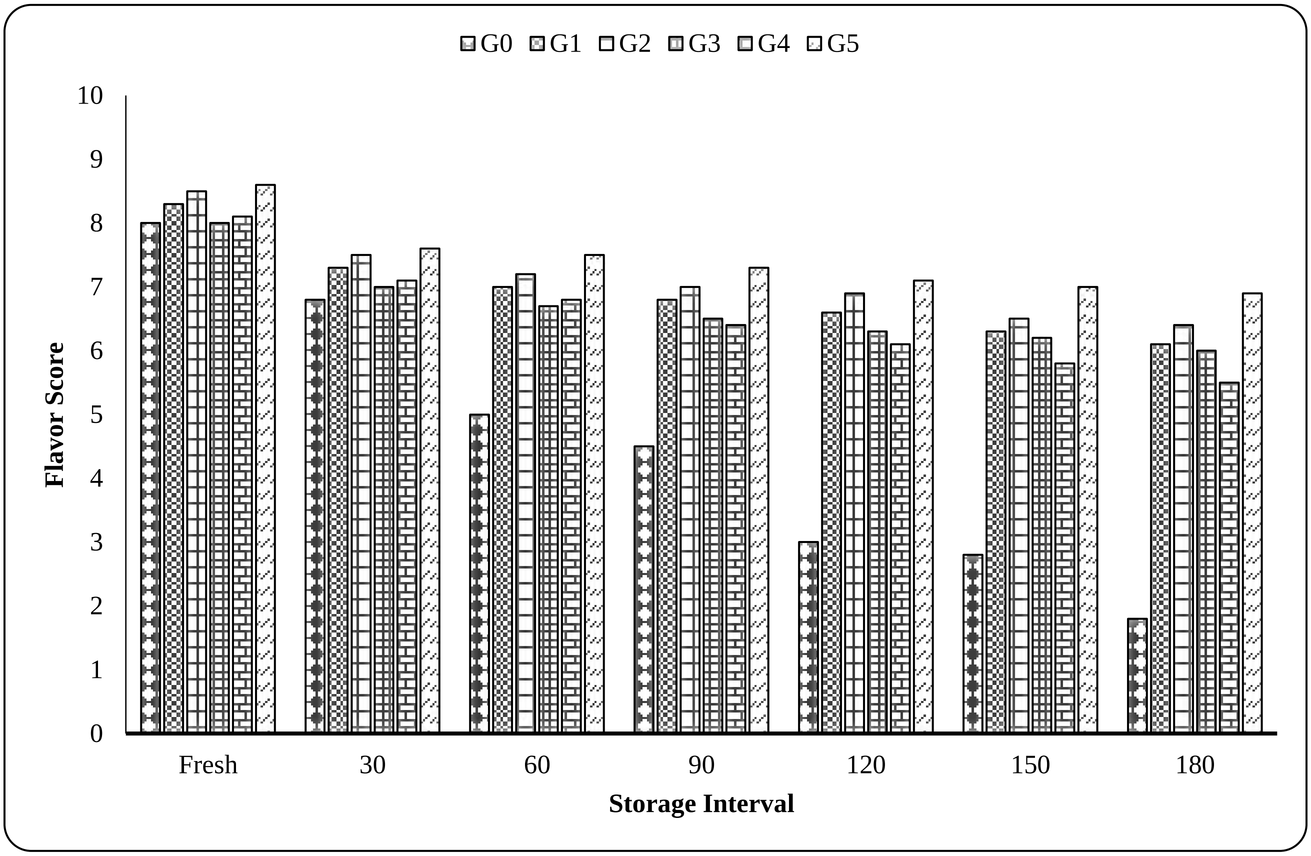

Fig.8 Mean score of judges for Flavor of whole grape juice

Overall acceptability

Fig.9 shows that significant (P<0.05) decrease was observed in mean score for overall acceptability from 8.15 to 5.63 during 180 days of storage. For treatments in G_5 highest mean values were recorded that is (7.67) go behind G_4 (7.17) while in G_0 lowest mean score was recorded that was

(3.63), followed by G_1 (6.7). During storage highest reduction occurred in G_0 (85%) followed by G_1 (30%) while lowest reduction occurred in sample G_5 (13.25%) followed by G_2 (18.75%) The findings of Rosario (1996) agreement with these result who observed that progressive degradation occurred in overall acceptability by increasing temperature and storage duration. The loss of overall acceptability was due to the loss of ascorbic acid and furfural production as analyzed by Shimoda and Osajima (1981) reported that the degradation of ascorbic acid and furfural production causes the loss of overall acceptability.

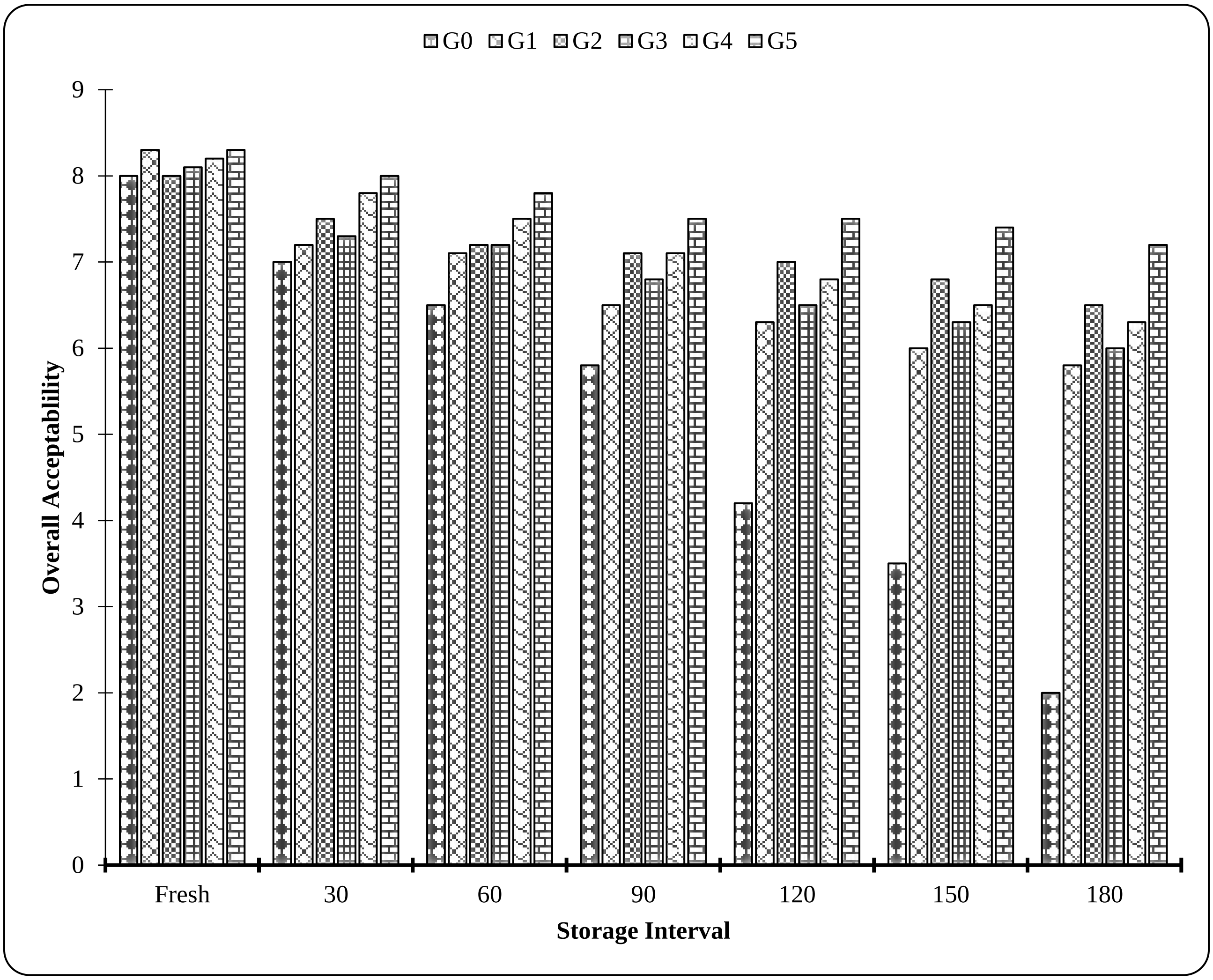

Fig.9 Mean score of judges for Overall Acceptability of whole grape juice

Conclusion

The effect of mixed chemical preservatives and different stabilizers on the storage stability of whole grape juice was studied in this work. From this research work it was concluded that sample T_5 (pure whole grape juice, potassium sorbate 0.05% + sodium benzoate 0.05%, and pectin with homogenization) were observed most suitable during physico chemical and sensory evaluation.

Data availability

The data that support the findings of this study are listed in the article and are available from the corresponding authors upon reasonable request.

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Declaration of Interest

We declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere. The authors certified that there is no conflicts of interest associated with this publication, and there has been no significant financial support for publishing this work that could have influenced its outcome. As corresponding Author, I conform that the manuscript has been read and approved for submission by all the named authors.

REFRENCES

AOAC. (2000) Official methods of analysis Association of Official Analytical Chemists 13th edi. Washington, DC. USA

Armero E, Collar C (1996) Antistaling additive effect on fresh wheat bread quality. Food Sci and Tech. Int. 2: 323–333.

Awan JA, Rehman S (2008) Food Analysis Manual. Uni Tech communication, Faisalabad Pakistan.

Ayub M, Khan MB (2001) Effect of different light conditions and colored glass bottles on the retention of quality characteristics of pomegranate syrup during storage at room temperature. Sarhad J. Agric. 17(4): 629-632.

Bayindirli L (1993) Density and viscosity of grape juice as a function of concentration and temperature. J. of Food Processing and Preservation, 17:147–151.

Brenes, C H, Infran DDP, Talcot ST (2005) Stability of copigmented anthocyanins and ascorbic acid in a grape juice model system. J. of Agric. of Food Chem. 53(1):49-56.

Brenndor K, Oswin CO, Trim DO, Mrema GC, Werek C (1985) Solar driers and their role in post harvest processing. Common Wealth Sci. Council. : 78-83.

Cecilia E, Maia GA (2002) Storage stability of cashew apple juice preserved by hot fill and aseptic process. Deptt. of Food Tech. Univ. of Ceara, Brazil CEP. 60: 511-110.

Cerdan TG, Gil MA, Fontanet ARM, Azpilicueta CA, Belloso OM (2007) Effects of thermal and non thermal processing treatments on fatty acids and free amino acids of grape juice. Food Control. 18: 473-479.

Dickinson E (2003) Hydrocolloids at interfaces and the influence on the properties of dispersed systems. Food Hydrocolloids. 17:25–39.

Dziezak JD (1991) A focus on gums. Food Tech. 45: 115–132.

El-Warraki AG, Abdel Rehman NR, Abdallah MR, Abdel Fattah TA, (1976) Physical and chemical properties of locally canned orange juice. Annual of Agric. Sci. Moshtohor. 6(21): 195-209.

FAO Statistical Database. (2005) http://www.fao.org 23-2-2006.

Freedman J, Parker CL. Li, Perlman J, B. Frei B, Ivanov V, Deak L, M. Iafrati M, Folts j, (2001) Select Flavonoids and Whole Juice From Purple Grapes Inhibit Platelet Function and

Enhance Nitric Oxide Release. Dept of Pharmacology and Medic, Georgetown Uni. Medi. Center. Circulation.103 (23): 2792-2798.

Girard, B, Mazza G, (1998) Produtos funcionales derivados de lãs uvas y de loscítricos. Cap 5. In: Mazza, G., Acribia, S.A. (Eds.), Alimentos Funcionales: aspectos bioquímicos e de procesado. Zaragoza, Espana. :141–182.

Gonzalez C, Alfaro C, Rambla J, Padilla A, Gutierrez A, (2009) Headspace based techniques to identify the principal volatile compounds in red grape cultivars. Int. J. of Food Sci. and Tech. 44(3): 510-518.

Hashmi MS, Alam S, Riaz A, Shah AS, (2007) Studies on microbial and sensory quality of mango pulp storage with chemical preservatives. Pak. J. of Nutr. 6 (1): 85-88.

Heikal HA, Sidawi MH, (1988) Some factors responsible for the browning of lime and orange juices. Agric. Res. Rev. 50(5):199-214.

Imran A, Rafiullah K, Ayub M, (2000) Effect of added sugar at various concentrations on the storage stability of guava pulp. Sarhad. J. Agric. 7(25): 35-39.

Imtiaz H, Zeb A, Shakir I, Shah AS, (2008) Combine effect of potassium sorbate and sodium benzoate on individual and blended juices of apricot and apple fruit grown in Azad Jammu Kashmir. Pak. J. Nut. 7: 181-185.

Kammerer D, Claus A, Carle R, A. Scieber A, (2004) Polyphenol screening of pomace from red to white grape varieties by HPLC-DAD-MS/MS. J. Agric. Food Chem. 52 (14):4360–4367.

Kinh, A.E., H. Shearer, C.P. Dunne and D. G. Hoover. 2001. Preparation and preservation of apple pulp with chemical preservatives and mild heat. J. Food Prot. 28(6): 111-114.

Malik M, (1994) General Horticulture 1st Edi. National book foundation. :481-482

Mazarotto V, (2005) Suco de uva. Cap. 14. In: Venturini, W.G.F. (Ed.), Tecnologia de Bebidas: matéria-prima, processamento, BPF/APPCC, legislaçãoe mercado. Edgard Blücher, São Paulo.

Mehmood Z, Zeb A, Ayub M, Bibi N, Badshah A, Ullah I, (2008) Effect of pasteurization and chemical preservatives on the quality and shelf stability of apple juice. Amer J. Food Tech. 3(2): 147-153.

Muhammad R, (1986) Effect of light and packaging material on ascorbic acid content and other physico chemical and organolyptic characteristics of citrus during storage. Sarhad J. Agri.15 (3): 23-25.

Oztürk BA, Öner MD, 1999. Production and evaluation of yogurt with concentrated grape Juice. J. of Food Sci. 64:530–532.

Park YK, Park E, Kim JS, Kang MH, (2003) Daily grape juice consumption reduces oxidative DNA damage and plasma free radical levels in healthy Koreans. Mutation Res. 52:77–86.

Parke DV, Lewis DF, (1992) Safety aspects of food preservatives. Food Addit. Contam. 9:561–577.

Patil NS, Kotecha PM Chavan JK (2007) Wine making quality of different grape cultivars. J. Food Sci. Tech. 44(2):125–126.

Pilizota V, Subaric D, Lovric T, (1996) Rheological properties of CMC dispersions at low temperatures. Food Tech and Biotech. 34: 87–90.

Rao PG, Balaswamy K, Velu V, Jyothirmayi T, Satyanarayana A, (2009) Products from grapes of low soluble solids to their quality evaluation. J. Food Sci. Tech. 46(1):77–79.

Riaz RA, Ali A, Saleem M, (1988) Studies on the preparation and storage stability of comminuted kinow fruit beverage bees. Pak. J. Sci. Ind. Res. 32(8): 574-578.

Rosario MJG, (1996) Formulation of ready to drink blends from fruits and vegetable juices. J. Philippines. 9(3): 201-209.

Ryu D, Holt DL, (1993) Growth inhibition of penicillium expansum by several commonly used food ingredients. J. Food Production. 56(10): 862-867.

Sahin H, Ozdemir F, (2004) Effect of some hydrocolloids on the rheological properties of different formulated ketchups. Food Hydrocolloids. 18:1015–1022

Sahin H, Feramuz O, (2004) Effect of some hydrocolloids on the rheological properties of different formulated Ketchup. Food Hydrocolloids, 2005: 1015-1022.

Sattar A, Rehman (1987) Effect of canning and storage on pectin and pectic fractions of kinnow juice. Pak. J. Sci. 4:315-323.

Shah WH, Sufi NA, Zafar SI, (2008) Studies on the storage stability of guava fruit juice. Pak. J. Sci. Ind. Res. 18(3-4): 179-183.

Shimoda M, Osajima Y (1981) Studies on off flavor formed during storage of Satsuma mardrin juice. J. Agric. Chem. Soc. Japan. 55(4):319-324.

Sims CA, Eastridge JS, Keefe SFO, Bates RB. (1995) Stability of non pasteurized refrigerated muscadine grape juice. J. of Food Sci. 60(3):506-508.

Valvardo JM, Guillen F, D. Martinez Romero D, Eastillo S, Serrano M, (2005) Improvement of table grapes quality and safety by the combination of modified atmosphere packaging and eugenol, menthol, or thymol. J. Agric of Food Chem. 53 (19): 7458–7464.

Zeb A, Ullah I, Ahmad A, Ali K, Ayub M, (2008) Grape juice preservation with benzoate and sorbate. J. Advances in Food Sci. 31(1): 17-21.