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NUTRITIONAL VALUE OF CARROT JUICE AS AFFECTED BY DIFFERENT BLANCHING MEDIA

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ABSTRACT

Effects of different blanching media on the yield and nutritional value of carrot juice was investigated in this study. Each blanching medium showed different effect on the yield and nutritional value of carrot juice. Maximum amount of carrot juice (76.0%) was obtained on blanching carrots in 0.5 % acetic acid solution containing 1.0% $CaCl_2$. However, 66.0% juice was obtained from unblanched carrots. Highest amount of protein (1.34%) minerals (2.50%) and soluble sugars (5.46%) were found in carrot juice, which was obtained after blanching carrots in acetic acid solution containing 1.0% $CaCl_2$. Similarly, this blanching media also showed highest amount of carotene (195 mg 100^{-1} g) and vitamin C (8.0 mg 100^{-1} g) contents in carrot juice. However, 0.88% protein, 1.26% minerals and 4.81% soluble sugars along with carotene (175 mg 100^{-1} g) and vitamin C (44.0 mg 100^{-1} g) contents were present in juice from un-blanched carrots.

Keywords: Blanching Process, Carrot juice, Nutritional value

INTRODUCTION

Carrot (*Daucus carota*) is a rich source of carotene, soluble sugars, minerals and dietary fibre (Bajaj *et al*., 1980, Robertson *et al*., 1979). In Pakistan and around the world, carrot is consumed as vegetable whereas its juice is also being used as soft drink due to its delicious taste and high nutritional value (Lombran and Dias, 1985, Kim and Gerber, 1988). It has been reported in the literature that blanching process and extraction technique affect the extractability and nutritional quality of carrot juice (Stephens *et al*., 1976, Jan 1987, Sim *et al*., 1993). Bao and Chang (1994) observed that extractability of juice from carrots was improved by the addition of salt in blanching media. However, very little information is available in the literature regarding the effect of blanching on the yield and nutritional quality of carrot juice. Therefore, present work was undertaken to study the effect of various blanching processes on the nutritional quality and yield of carrot juice.

MATERIALS AND METHODS

Juice Extraction

Fresh mature carrots of red variety, free from blemishes, were washed thoroughly and peeled after removing their heads and tails with a sharp knife manually. The carrots were cut longitudinally into two halves and then blanched according to the method of Stephens *et al*., (1976). 5 kg cleaned carrots were treated for 5 minutes in 12.5 litre of boiling solution in each blanching media reported in Table 1, thoroughly drained and then ground through a champion juicer (Plastaket Manufacturing Co., Lodi C.A.) equipped with a stainless steel screen. The pulp residue from the juicer was collected and dried at 60^{o}C for 24 hours. Juice and pulp from unblanched carrots was used as control.

Analysis

pH of the juice was determined using a glass electrode pH meter (PYE Unicam, England). Titratable acidity of the samples was estimated by titration against 0.1 NaOH solution using phenolphthalein as indicator (AOAC 2005). Brix of juice samples was measured with a Bausch and Lomb refractometer. Carotene was estimated using the method of Valaden and Mummery (1975) after extracting it in petroleum ether and acetone mixture. Vitamin C content in carrot juice was determined on spectrophotometer according to Bajaj and Gurdeep method (1981). Total soluble sugars of carrot juice were estimated according to Dinitrosalicylic acid method as described by Miller (1959). Protein was estimated by micro Kjeldahl method (A.OA.C. 2005). Total ash contents (minerals) were determined with a muffle oven.

Statistical Analysis

The data were subjected to analysis of variance and standard deviation was calculated by the method of Steel and Torrie (1980). Duncan's multiple range tests was used to determine significant differences ($P< 0.05$).

RESULTS AND DISCUSSION

Different blanching media affected the yield of juice carrots to various extents (Table 1). About 66.0% juice was extracted from unblanched carrots. However, the yield of carrot juice was 54.0%, 60.0%, and 62.5% on blanching carrots in water, citric acid and acetic acid solution respectively. The yield of the carrot juices was found to be only 56.0 & 54.0% on blanching carrots in 0.5 & 1.0% $CaCl_2$ solution. These results show that carrots blanched in $CaCl_2$ solutions yielded more juice than water blanched water but yielded lesser juice compared to carrots blanched in organic acids solutions. It seems that textures of whole carrots became soft after blanching making juice extraction through the stainless steel screen were difficult as reported by Sim *et al.* (1993). Maximum amount (76.0%) of carrot juice was obtained on extracting the carrots blanched in acetic acid solution containing 0.5% $CaCl_2$. This blanching treatment increased the extractability of juice by 15%. It seems that solubility characteristics of pectic substances were greatly increased due to greater diffusion of calcium into the carrots in the presence of acetic acid.

Table 1. Effect of blanching on the yield pH, Acidity, Brix, of carrot juice.

Blanching Treatment	Juice %	pH	Titratable acidity (%)	Brix
Unblanched	66.0	6.32 (0.01)	0.08 (0.02)	8.1 (0.1)
Distilled water	54.0	6.20 (0.01)	0.11 (0.01)	8.5 (0.1)
0.5% $CaCl_2$ solution	56.0	6.30 (0.02)	0.09 (0.02)	8.3 (0.2)
1.0% $CaCl_2$ solution	54.0	6.30 (0.04)	0.10 (0.01)	8.2 (0.3)
0.5% Acetic acid solution	62.5	5.95 (0.02)	0.15 (0.03)	8.9 (0.2)
0.5% Acetic acid + 1.0% $CaCl_2$ solution	76.0	5.85 (0.01)	0.14 (0.01)	9.3 (0.3)
0.5% Citric acid solution	60.0	5.90 (0.02)	0.13 (0.02)	8.7 (0.2)
0.5% Citric acid + 1.0% $CaCl_2$ solution	68.0	5.90 (0.02)	0.13 (0.02)	9.1 (0.4)

* Average of three replicates along with standard deviation.

Table 2. Effect of blanching on the protein, minerals and sugar contents of carrot juice.

Blanching Treatment	Protein (%)	Minerals (%)	Total Soluble sugars
Unblanched	1.28 (0.01)	2.01 (0.09)	4.81
Distilled water	1.11 (0.08)	2.25 (0.05)	5.14
0.5% $CaCl_2$ solution	1.20 (0.09)	2.30 (0.05)	4.80
1.0% $CaCl_2$ solution	1.20 (0.07)	2.28 (0.07)	4.72
0.5% Acetic acid solution	1.00 (0.06)	2.00 (0.07)	5.00
0.5% Acetic acid + 1.0% $CaCl_2$ solution	1.34 (0.07)	2.50 (0.08)	5.46
0.5% Citric acid solution	1.27 (0.09)	2.48 (0.08)	4.95
0.5% Citric acid + 1.0% $CaCl_2$ solution	1.33 (0.08)	2.51 (0.07)	5.26

* Average of three replicates along with standard deviation.

Effect of Blanching on pH, Acidity and Brix of Carrot Juice

pH of carrot juice extracted from unblanched carrots was 6.32, whereas it was 6.20 when extracted from water blanched carrots (Table 1). The pH value (6.30) of the juice extracted from carrots blanched in different concentrations of $CaCl_2$ solutions remained almost unchanged. However, a significant decrease in pH of the juice was observed when carrots were blanched in acidic solution (5.90 & 5.95). Titratable acidity of the juice extracted from blanched carrots (0.09 – 0.15%) was higher than the juice of unblanched carrots (0.08%)s. The increase in titratable acidity and decrease in pH was probably due to heat decomposition of prectic substances into pectic acid and absorption of organic acids by carrots (Stephens *et al.*, 1971). The changes in pH and titratable acidity were found significant ($P<0.05$).

Blanching process also affected the brix of the juice (Table 1). Brix of the juice obtained from unblanched and water blanched carrots was 8.1 and 8.5 respectively. The brix of juices obtained from carrots blanched in acetic acid

with or without 0.5% $CaCl_2$ was 9.3 and 8.9 respectively whereas the brix values of the juices extracted from those carrots blanched in citric acid with or without 0.5% $CaCl_2$ (9.10 and 8.70) were also higher than unblanched carrot juice (8.1). The results were in agreement with the findings of Stephens *et al*., (1971) who reported that the juice from acetic acid blanched carrots was slightly higher in brix than juice from carrots blanched in water. It seems that combined treatment of acetic acid or citric acid with $CaCl_2$ retarded tissue softening effect and cleaved glycosidic as well as ionic linkages of pectin molecules, resulting in greater water solubility of pectic substances, which may be responsible for increasing brix values of the juice.

Effect of Blanching on the Nutrients of Carrot Juice

Table 2 data show that 1.11 – 1.34% protein, 2.01 – 2.51% minerals and 4.72 – 5.46% total soluble sugars were present the juice of the blanched carrots. On the other hand, 1.28% Protein, 2.01% minerals and 4.81 % sugars were found in the un-blanched carrot juice. However, maximum amount of protein (1.34% and 1.33%) minerals (2.50% and 2.51%) and total sugars (5.46% and 5.26%) were found in carrot juice on blanching carrots in acetic acid and citric acid solution containing $CaCl_2$ respectively. Blanching processes increased the extractability of the nutrients (Protein, mineral, sugars) in carrot juice to various extents.

Juice from unblanched carrots had carotene contents (175 mg 100 g^{-1}) higher than the juice extracted from blanched carrot (Table 3). However, the juice extracted from the carrots blanched in acetic acid containing 1.0% $CaCl_2$ retained the highest amount of carotene (195 mg $100g^{-1}$) among all other juices ($P<0.05$). This might be due to easy extractability of carotene from the tissues. It is also possible that carotene was being protected from destruction in the presence of acetic acid and $CaCl_2$ during high temperature blanching process. Other blanching processes reduced the carotene in the juice to some extent.

It is apparent from Table 3 that blanching processes showed significant effect on the extraction of vitamin C in carrot juice products. Fresh juice from unblanched carrots had the lowest vitamin C retention (4.0 mg $100g^{-1}$). However, vitamin c contents in juice obtained from blanched carrots varied from 6.66 to 8.00 mg 100 g^{-1}. Juice obtained from carrots blanched in acetic acid containing 1.0% $CaCl_2$ had the highest amount of vitamin C (8.0 mg 100 g^{-1}). It could be the result of easy extraction of vitamin C from the carrot tissues.

Table 3. Effect of blanching on carotene and vitamin C contents of carrot juice.

Blanching Treatment	Carotene (mg $100g^{-1}$)	Vitamin C (mg $100g^{-1}$)
Unblanched	175 (1.2)	4.0 (0.6)
Distilled water	155 (1.1)	6.66 (0.9)
0.5% $CaCl_2$ solution	150 (1.7)	6.90 (0.4)
1.0% $CaCl_2$ solution	153 (1.3)	6.90 (0.6)
0.5% Acetic acid solution	167 (1.0)	7.00 (0.7)
0.5% Acetic acid + 1.0% $CaCl_2$ solution	195 (1.2)	8.00 (0.9)
0.5% Citric acid solution	165 (1.9)	7.00 (0.7)
0.5 % Citric acid + 1.0% $CaCl_2$ solution	169 (1.3)	7.80 (0.9)

* Average of three replicates along with standard deviation.

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