Pak J Sci Ind Res 1999 42(3) 133-136

Studies on the Effect of Blanching Media on Yield and Nutritional Quality of Carrot Juice

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(Received 1 July 1996; accepted 7 January 1998)

Effect of various blanching processes on the retention of different nutrients in carrot juice products was investigated. Maximum brix value of the juice was 9.3 when carrots were blanched in 0.05 N acetic acid solution containing 0.2% $CaCl_2$. However, brix values of the juice obtained from unblanched and water blanched carrots were 8.1 and 8.5 respectively. Highest amount of carotene and vitamin C was also found in the juice which was obtained from carrots after blanching in acetic acid and 0.2 % $CaCl_2$ solution. Other blanching processes showed adverse effects on the retention of carotene in carrot juice products compared with unblanched carrot juice.

Key words: Carrot, Blanching processes, Carrot juice, Nutritional value.

Introduction

Carrot (*Daucus carota* L.) is a rich source of carotene, soluble sugars and minerals (Bajaj *et al* 1980). Apart from these nutrients, carrot also contains sufficient amount of dietary fibre (Robertson *et al* 1979). Although carrot is consumed as vegetable in Pakistan but its juice is also used as soft drink due to its delicious taste and high nutritional value. Different types of beverages based on carrot juice are also being prepared in many areas of the world (Lombran and Dias 1985; Kim and Gerber 1988). In order to extract maximum juice from carrots, different blanching processes and extracting techniques have been tried during the past few years (Stephens *et al* 1976; Jan 1987; Sims *et al* 1993). It has been observed by many workers that blanching process improves the extractability of juice from carrots to some extent (Khan *et al* 1975; Bao and Chang 1994). However, very little information is available in the literature regarding the effect of blanching on the nutritional quality of carrot juice. This communication reports the effect of different blanching processes on the availability of various nutrients in 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 min in 12.5 l of boiling solution in each blanching material reported in Table 2, thoroughly drained and then ground through a champion juicer (Plastaket Manufacturing Co, Lodi CA) equipped with a stainless steel screen.

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 1990). 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 pulp products were estimated according to Dinitrosalicylic acid method as described by Miller (1959).

Statistical analysis. All data were subjected to analysis of variance and standard deviation was calculated by the method of Steel and Torrie (1980).

Results and Discussion

Chemical composition of dried carrots is given in Table 1. The amount of proteins, lipids and minerals in dried carrots was 6.64, 2.98 and 7.69% respectively. Significant amount of total water soluble nutrients (49.8%) which mainly consisted of soluble sugars (30.27%) were also present in carrots. Apart from these nutrients, carrots also contained considerable amount of carotene and vitamin C contents.

Effect of blanching on the yield of carrot juice. Table 2 shows the effect of blanching on the yield of juice from carrots. Fresh juice yield from unblanched carrots was 64.0% higher

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than the yield from blanched carrots in almost all the cases except one. Carrots blanched in acetic acid or citric acid produced 63.0 and 61.5% comparatively higher amount respectively than that of the water blanched carrots (54.6%). Similarly carrots blanched in KCl or $CaCl_2$ solutions also yielded more juice (57.0% and 59.1% respectively) than water blanched carrots but yielded lesser juice compared to carrots blanched in organic acid solutions. It seems that texture of whole carrots became soft after blanching, making juice extraction through the stainless steel screen more difficult as already reported by Sims *et al* (1993). However, maximum juice yield was 68.0% after blanching the carrots in acetic acid solution containing 0.2% $CaCl_2$. It seems that solubility characteristics of pectic substances were considerably increased due to greater diffusion of calcium into the carrots in the presence of acetic acid which consequently increased the extractability of juice upto 6%. However, exact mechanism is still unknown. Juice and pulp collection processes caused 1.4-4.5% losses which were comparatively less than those reported by earlier workers (Bao and Chang 1994).

Table 1

Chemical composition* of dried carrot

	Parameters	
1.	Protein %	664 (± 1.5)
2.	Lipids %	2.98 (± 1.0)
3.	Minerals (Ash) %	7.69 (± 2.3)
4.	Total soluble nutrients %	49.8 (±1.9)
5.	Total soluble sugars %	30.2 (±1.8)
6.	Reducing sugars %	9.1 (±0.9)
7.	Non-reducing sugars %	21.1 (±1.3)
8.	Carotene (mg $100g^{-1}$)	17.6 (±1.6)
9.	Vitamin C (mg $100g^{-1}$)	45 (±1.9)

* Average of three replicates along with standard deviation.

Effect of blanching on pH, acidity and brix of juice. pH of carrot juice extracted from unblanched carrots was 6.22, whereas it was 6.18 when extracted from water blanched carrots (Table 3). The pH value of the juice extracted from carrots blanched in KCl or $CaCl_2$ solutions remained almost unchanged. However, a significant decrease in pH of the juice was observed when carrots were blanched in acidic solutions. Titratable acidity of the juice extracted from blanched carrots was higher than the juice of unblanched carrots. The increase in titratable acidity and decrease in pH was probably due to heat decomposition of pectic 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 3). 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 0.2% $CaCl_2$ 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 0.2% $CaCl_2$ were also higher than unblanched carrot juice. 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 carotene and vitamin C contents of juice. Juice from unblanched carrots had carotene contents (170 mg $100g^{-1}$) higher than the juice extracted from blanched carrots (Table 3). However, the juice extracted from the

Table 2

Effect of blanching on the yield of carrot (%)* juice

	Blanching treatment	Juice	Pulp	Loss
1.	Unblanched	64.0 (0.3)	12.2 (0.2)	3.8(0.4)
2.	Distilled water	54.6 (0.3)	43.0 (0.4)	2.4 (0.3)
3.	0.2% KCl solution	57.8 (0.6)	40.0 (0.5)	3.0 (0.1)
4.	0.2% $CaCl_2$ solution	59.1 (0.4)	38.2 (0.3)	2.7 (0.2)
5.	0.05N Acetic acid solution	63.0 (0.7)	33.0 (0.5)	4.0 (0.3)
6.	0.5N Acetic acid + 0.2% $CaCl_2$ solution	68.0 (0.9)	30.6 (0.6)	1.4 (0.3)
7.	0.05N Citric acid solution	61.5 (1.2)	34.0 (0.9)	4.5 (0.4)
8.	0.05N Citric acid + 0.2% $CaCl_2$ solution	64.8(0.9)	32.0 (0.5)	3.2 (0.2)

* Average of three replicates along with standard deviation.

Table 3

Effect of blanching on pH, acidity, brix, carotene and vitamin C contents of carrot juice

Blanching treatment	pH	Titratable acidity (%)	Brix	Carotene (mg $100g^{-1}$)	Vitamin C (mg $100g^{-1}$)
1. Unblanched	6.22(0.01)	0.08(0.02)	8.1(0.1)	170(1.2)	5.00(0.6)
2. Distilled water	6.18(0.01)	0.11(0.01)	8.5(0.1)	155(1.1)	6.66(0.9)
3. 0.2% KCl solution	6.20 (0.02)	0.09 (0.02)	8.3 (0.2)	150 (1.7)	6.90 (0.4)
4. 0.2% $CaCl_2$ solution	6.20 (0.04)	0.10 (0.01)	8.2 (0.3)	153 (1.3)	6.90 (0.6)
5. 0.05N acetic acid solution	5.95 (0.02)	0.15 (0.03)	8.0 (0.2)	167 (1.0)	7.00(0.7)
6. 0.05N Acetic acid + 0.2% $CaCl_2$solution	5.85(0.01)	0.14(0.01)	9.3(0.3)	195(1.2)	8.44(0.9)
7. 0.05N Citric acid solution	5.90(0.02)	0.13(0.02)	8.7(0.2)	165(1.9)	7.00(0.7)
8. 0.05N Citric acid + 0.2% $CaCl_2$ solution	5.90(0.02)	0.13(0.02)	9.1(0.4)	169(1.3)	7.96(0.9)

carrots blanched in acetic acid containing 0.2% $CaCl_2$ 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 possibe 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 (5.0 mg $100g^{-1}$). However, vitamin C contents in juice obtained from blanched carrots varied from 6.66 to 8.44 mg $100g^{-1}$. Juice obtained from carrots blanched in acetic acid containing 0.2% $CaCl_2$ had the highest amount of vitamin C (8.44 mg $100g^{-1}$). It could be the result of easy extraction of vitamin C from the carrot tissues.

Conclusion

It is apparent from these studies that different blanching processes affected the extractability of juice from carrots. About 6% more juice was extracted on blanching the carrots in 0.05N acetic acid solution containing 0.2% $CaCl_2$. Retention of carotene and vitamin C was also the highest in this blanching process. Brix value of unblanched carrot juice was 8.1, whereas 9.3 was the brix value of the juice obtained after blanching carrots in acetic acid solution containing 0.2% $CaCl_2$. Other blanching processes showed adverse effects on the extraction of juice and retention of carotene in carrot juice products.

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