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RESEARCH PAPER

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Physico-chemical characteristics of dehydrated *Kachnar* (*Bauhinia variegata*)

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● ABSTRACT ●

An attempt was made to dehydrate the buds and flowers of *Kachnar*. Whole buds and flowers of *Kachnar* were taken and divided into two lots. One lot was subjected to sulphuring by dipping overnight in 2 per cent potassium metabisulphite solution. The other lot was subjected to hot water blanching for 2-3 minutes. The treated samples were dried in the mechanical tray drier (50, 55 and 60^{0}C), in solar drier and under sun until constant weight was achieved. The results of the study revealed that samples dried at 60°C took minimum time for drying and were low in moisture content. Blanched samples took more drying time and were high in moisture content when compared with sulphur treated samples. Also the sulphur treated *Kachnar* samples dried at 50°C in tray drier rehydrated much better than others whereas, the rehydration of blanched samples dried at other temperatures was comparatively lower. The values of various chemical quality attributes of dried samples were significantly (p=0.05) higher in sulphur treated samples dried at 50°C than other samples. Thus, it can be concluded that drying *Kachnar* ensures its better availability and utilization throughout the year.

KEY WORDS : *Kachnar*, Buds, Flower, Sulphuring, Blanching, Dehydration

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● INTRODUCTION ●

India is a natural reservoir of fruit and vegetable species. Some of these species are wildly grown and remain underutilized inspite of their high nutritional and therapeutic value. *Kachnar* (*Bauhinia variegata*) is one of them which belongs to the category of underutilized vegetables and are well known for their therapeutic and nutritive values. It belongs to the family *Caesalpiniaceae.* Its known by various local names as *Karal, Kandla and Kanolla* (Rao, 1914). The tree flowers in March and fruits in rainy season. The tree is small to moderate in size and bears white to pinkish coloured flowers. On an average a tree yields 20-25 kg flowers. The buds are collected 2-3 times during a season. Young buds of *Kachnar* are used for preparation of a variety of tasty broth and pickles (Noatay, 2001). Flowers and seeds of *Kachnar* have medicinal value. Dried buds are used in dysentery, piles and worms. The buds have high phenolic content and provide antioxidants (Sharma, 2003).

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● MATERIALS AND METHODS ●

Procurement of raw materials:

The buds (unopened flower) and petals of flowers (opened, fully developed flower petals) of *Kachnar* were procured from local market.

Dehydration of *Kachnar*:

For dehydration, whole *Kachnar* buds (KB) and *Kachnar* flowers (KF) were taken and divided into two lots. One lot was subjected to sulphuring by dipping overnight in 2 per cent potassium metabisulphite solution.

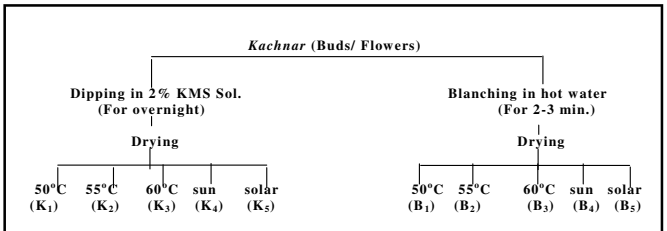

Fig. 1 : Operations involved in drying of *Kachnar*

The other lot was subjected to hot water blanching for 2-3 minutes. The treated samples were dried in the mechanical tray drier at 50, 55 and 60^{0}C, respectively and in sun and solar drier until constant weight was achieved (Fig. 1). The dried /dehydrated samples were packed in polythene bags for further physico- chemical evaluation.

Physico-chemical evaluation of dehydrated *Kachnar*:

The drying rate and product yield of the dehydrated *Kachnar* was calculated. The dehydrated products were evaluated for rehydration characteristics and rehydration ratio by partial modification of the method described by Ranganna (2007). The values of rehydration characteristics were reported as "Water absorption ml/g". The dehydrated *Kachnar* flowers and buds were evaluated for various chemical parameters. The moisture content was determined by standard method (AOAC, 1990) whereas acidity, ascorbic acid, total sugars and reducing sugars were evaluated by method given by Ranganna (2007).

● RESULTS AND DISCUSSION ●

The drying behaviour of blanched and sulphured *Kachnar* buds and flowers under different treatments, temperatures and drying durations is presented in Table 1. A perusal of data reveal that buds and flowers dried at 50°C after blanching and sulphuring took more than 12 hours for attaining equilibrium weight of 330 g/kg, 245 g/kg and 324 g/kg, 240 g/kg, respectively. As the temperature of drying increased the time for attaining equilibrium decreased. Maximum time was required for drying blanched buds in sun *i.e.* more than 19 hours and 18 hours for drying of sulphur treated buds to attain equilibrium weight of 342 and 337 g/kg, respectively. The buds dried at 50°C in tray drier after sulphuring were good in colour than their counterparts. While blanched buds dried at different temperatures were brownish in colour whereas sulphured samples were green in colour nearest to fresh (Plate 1). *Kachnar* flowers dried in solar drier and in sun took less time than *Kachnar* buds to attain equilibrium weight. Sulphured and blanched flowers dried with in about 14 hours and attained equilibrium weight of 248 g/kg and 243 g/kg with water loss of 75.20 and 75.70 per cent, respectively. Sulphured samples were good in colour especially dried in tray drier at 50^{0}C followed by 55^{0}C and 60^{0}C while solar and sun dried samples were slightly yellow. All blanched flowers were brownish in colour as shown in Plate- 2. The drying rate was significantly higher for sample dried in tray drier at high temperature (60^{0}C) than for samples dried under sun and in solar drier. This may be due to the redistribution of internal moisture which is rate determining factor in this phase as the material

Table 1 : Effect of treatments, drying temperatures and time on dried weight (g) of blanched and sulphured *Kachnar* buds and flowers

Treatments		Time (hours)										
		0	2	4	6	8	10	12	14	16	18	20
KB	B_1	1000	764	578	450	389	357	330	-			
	K_1	1000	711	506	418	369	348	324	-			
KF	B_1	1000	756	577	419	348	297	245	-	-	-	-
	K_1	1000	707	537	337	286	258	240	-	-	-	-
KB	B_2	1000	749	548	438	365	320	-	-	-	-	-
	K_2	1000	691	498	398	331	318	-	-	-	-	-
KF	B_2	1000	715	491	349	258	225	-	-	-		
	K_2	1000	680	453	305	247	221	-	-	-		
KB	B_3	1000	727	536	427	316	-	-	-	-	-	-
	K_3	1000	668	477	376	310	-	-	-	-	-	-
KF	B_3	1000	629	417	298	219	-	-	-	-	-	-
	K_3	1000	602	492	277	210	-	-	-	-	-	-
KB	B_4	1000	801	674	570	483	425	386	369	349	338	-
	K_4	1000	769	615	499	448	391	367	354	333	-	-
KF	B_4	1000	796	605	474	39	305	269	248	-	-	-
	K_4	1000	779	590	468	357	319	261	243	-	-	-
KB	B_5	1000	856	724	601	518	453	416	391	358	349	342
	K_5	1000	854	684	557	479	424	386	364	341	337	-
KF	B_5	1000	848	666	548	419	376	336	303	253	-	-
	K_5	1000	852	628	481	404	358	322	288	250	-	-

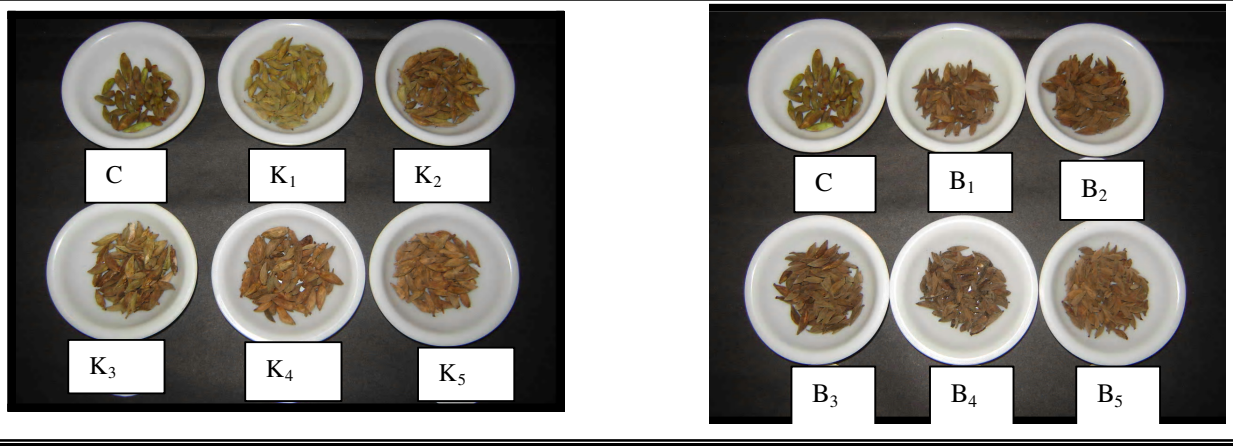

Plate 1 : KMS treated and blanched dehydrated *Kachnar* Buds

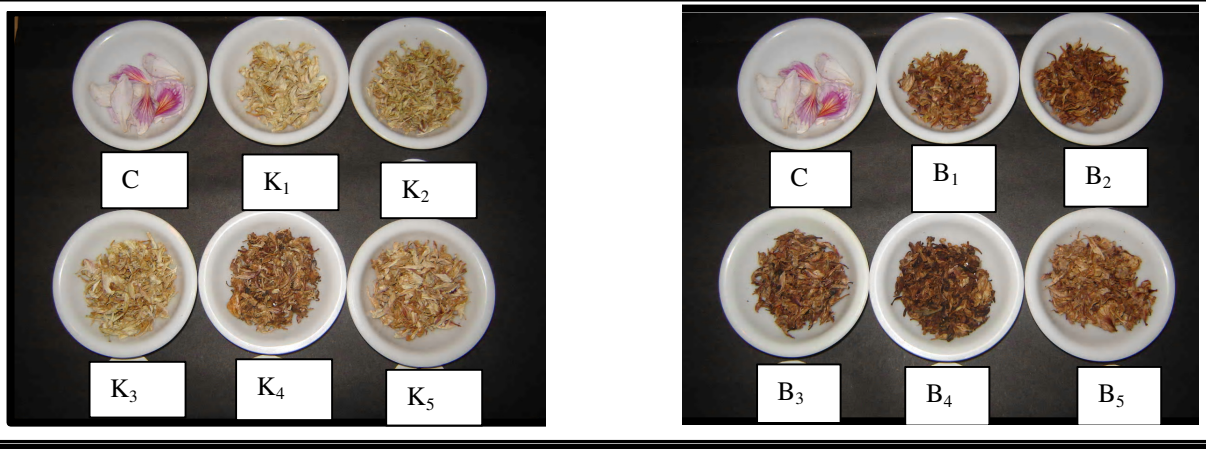

Plate 2 : KMS treated and blanched dehydrated *Kachnar* flowers

attains the dry bulb temperature of air during this region of drying. High temperature of material can be an accelerating factor for internal movement of moisture. Also the rate of drying was low in sun drying and solar drier due to low temperature. It is very clear from the data that sulphured samples have higher drying rate than blanched samples. Similar observations have already been made by Deshpande and Tamhane (1981), Jayaraman *et al.* (1991), Suguna *et al.* (1995) and Kar and Gupta (2003). The drying of samples was satisfactory at 50°C with sulphuring treatment but it may be costly due to high energy costs for running the drier for longer time to achieve equilibrium weight.

Table 2 depicts the data pertaining to the product yield of *Kachnar*. To achieve satisfactory drying blanched *Kachnar* buds required 12.30 hours at 50°C, 10.10 hours at 55^{0}C and 8.30 hours at 60^{0}C in tray drier and 17.05 hours in solar drier and 19.45 hours in sun drying, respectively with equilibrium yields of 33.00, 32.40, 31.60, 33.80 and 34.20 per cent, respectively. While the time required and yield for sulphured bud samples was less than that of blanched samples. Similarly, blanched *Kachnar* flowers required more time for satisfactory drying and the time required was maximum (16.10 hrs) in samples dried under sun with product yield of 25.30 per cent. The sulphured flower samples also exhibited similar

Table 2 : Effect of drying temperature and treatments on product yield (%) of dehydrated *Kachnar*

Treatments		B_1	K_1	B_2	K_2	B_3	K_3	B_4	K_4	B_5	K_5
KB	Product yield	33.0	32.40	32.40	31.80	31.60	31.00	33.80	33.30	34.20	33.70
	Time of drying (h)	12.30	12.15	10.10	10.05	8.30	8.10	17.05	16.15	19.45	18.15
KF	Product yield	24.50	24.00	22.50	22.10	21.90	21.00	24.80	24.30	25.30	25.00
	Time of drying (h)	12.30	11.50	9.20	9.10	7.15	7.00	14.10	13.45	16.10	15.30

trends with respect to product yield as well as drying time and the equilibrium product yields were high in solar drying (24.30%) followed by sun drying (25.30%) and was less at high temperatures of mechanical drier *i.e.* 21.00 per cent at 60^{0}C. It is evident from the data that per cent yield is increasing as the temperature of drying is decreasing due to incomplete drying of samples. The blanched samples exhibited more moisture which caused an increase in weight of *Kachnar* buds and flowers. Yield of sample is also relating to the time of drying. As the time of drying is decreasing the per cent yield is decreasing.

The water absorption characteristics of blanched and sulphured *Kachnar* buds and flowers are depicted in Table 3. The sulphured *Kachnar* buds dried in tray drier had more rehydration value (4.03 ml/g) than blanched buds dried at same temperature (3.58 ml/g). Blanched samples dried at 55 and 60^{0}C in tray drier had water absorption of 3.53 ml/g and 3.5 ml/g, whereas for sulphured samples dried at same temperature had corresponding values towards higher side. The blanched bud samples dried in solar drier and under sun had water absorption values to the tune of 3.40 and 3.45, respectively which were slightly towards lower side when compared with samples dried in tray drier. However, the sulphured samples dried in same condition had comparatively higher water absorption. The blanched and sulphured *Kachnar* flower dried at 50 °C in tray drier had higher water absorption *i.e.* 6.34 and 6.81 ml/g, respectively. When compared with solar and sun dried samples, the uptake of water was higher in sulphured flower samples (6.55 ml/g) dried in solar drier while corresponding values for sun dried samples was 6.53 ml/g. In comparison, the blanched flower samples dried in solar drier and under sun had slightly lower water absorption (6.23 and 6.13 ml/g). It is also evident from the data that *Kachnar* flowers had higher water absorption than buds. Scrutiny of data shows that irrespective of blanching and sulphuring, time required for attaining equilibrium weight for *Kachnar* bud was 7 hours and it was 8 hours for *Kachnar* flowers. The rate of water absorption increased with time for *Kachnar* and was maximum for sulphured samples dried at 50°C. While the water absorption decreased for solar and sun dried samples. Similar results have been reported by Deshpande and Tamhane (1981); Suguna *et al.* (1995) and Lal *et al.* (2004).

The data pertaining to the chemical characteristics of the dehydrated *Kachnar* are presented in Table 4. The moisture content in *Kachnar* flowers was towards a higher side when compared with that of *Kachnar* buds. Among various treatments, sulphuring treatment was found better as it resulted in complete drying of samples than blanching in both buds and flowers. Maximum values of moisture were reported 11.01 per cent for flowers and 8.68 per cent for buds (blanched samples) dried under sun while

Table 3 : Effect of drying temperature and treatments on water absorption (ml/g) characteristics of dried *Kachnar* buds and flowers

Treatments		Time (hours)							
		1	2	3	4	5	6	7	8
B_1	KB	2.33	2.73	3.05	3.31	3.45	3.55	3.58	-
	KF	4.13	4.91	5.45	5.82	6.05	6.20	6.32	6.34
K_1	KB	2.85	3.25	3.60	3.80	3.90	3.95	4.03	-
	KF	4.81	5.55	5.95	6.32	6.50	6.65	6.75	6.81
B_2	KB	2.23	2.52	2.93	3.21	3.35	3.48	3.53	-
	KF	4.02	4.75	5.36	5.72	5.96	6.15	6.32	6.35
K_2	KB	2.70	3.15	3.52	3.71	3.80	3.85	3.86	-
	KF	4.65	5.50	5.92	6.21	6.40	6.55	6.71	6.75
B_3	KB	2.12	2.42	2.76	3.10	3.34	3.41	3.51	-
	KF	3.95	4.61	5.27	5.63	5.91	6.13	6.21	6.24
K_3	KB	2.61	3.05	3.43	3.62	3.71	3.75	3.79	-
	KF	4.50	5.32	5.81	6.12	6.32	6.45	6.70	6.74
B_4	KB	2.01	2.35	2.75	3.01	3.21	3.35	3.45	-
	KF	3.85	4.51	5.15	5.55	5.81	6.05	6.21	6.23
K_4	KB	2.53	2.91	3.30	3.45	3.55	3.59	3.63	-
	KF	4.41	5.23	5.65	6.02	6.25	6.40	6.51	6.55
B_5	KB	1.91	2.25	2.60	2.95	3.15	3.33	3.40	-
	KF	3.80	4.44	5.12	5.46	5.75	5.98	6.12	6.13
K_5	KB	2.41	2.83	3.23	3.41	3.55	3.62	3.65	-
	KF	4.25	5.04	5.55	5.92	6.15	6.35	6.50	6.53

the minimum moisture was 5.87 for blanched buds dried at 55^{0}C and 6.34 per cent for buds and flower dried at 60°C. This may be due to complete drying of sample at higher temperature and in tray drier. Similar results have been reported by Suguna *et al.* (1995) and Kar and Gupta (2003).

As is evident from the Table 4 that among the two stages of maturity *i.e.* buds and flowers, dried flowers were higher in acidity than dried buds. In general, blanched samples had less of acidity than sulphured samples of both buds (0.37 to 0.30 %) and flowers (0.60 to 0.52 %). Samples dried under tray drying retained more acidity than those dried in solar drier and under sun. Acidity of dried *Kachnar* (buds and flower) varied significantly with treatments. Maximum acidity was found to be attained in samples dried in tray drier followed by solar and sun drying. It may be due to loss of acidity during drying for longer periods. Within treatments, sulphuring was found to be significantly better in retaining more acidity than blanching which may be due to loss of acidity during blanching in hot water. Another reason may be oxidation of SO2 to H2SO3 in the intercellular spaces which has increased acid content in sulphur treated sample. Similar results have been obtained by Khurdiya (1980) and Bhardwaj and Kaushal (1990). Also acidity content in buds was higher than flowers. Reason for this may be the more surface area of flowers subjected to heat that has probably promoted the neutralization of acid destructed the acidity.

There was a significant loss of ascorbic acid in dried *Kachnar* (buds and flowers) but this was towards a higher side in flowers. Among different treatments and drying temperatures, maximum loss of ascorbic acid was recorded for samples dried in sun after blanching. In *Kachnar* buds minimum ascorbic acid of 6.66 mg/100 g for blanched sun dried samples and maximum of 7.63 mg/100 g for sulphur treated samples dried at 50^{0}C in tray drier was recorded. While the corresponding values for *Kachnar* flower dried under same conditions were 3.99 and 5.29 mg/100 g, respectively. The content of ascorbic acid was found to be higher at 50^{0}C in tray drier followed by 55^{0}C and 60^{0}C and for the solar drier values were in decreasing trend (Kaur and Bawa, 2002). The ascorbic acid content was more in sulphured *Kachnar* samples than blanched samples. The reason for this may be attributed to the retardation of non-enzymatic browning by sulphur which may destroy ascorbic acid. Another reason for this could be as ascorbic acid loss in blanching due to its heat sensitive nature.

Table 4 : Effect of drying temperatures and treatments on chemical characteristics of dried *Kachnar*

Treatments		Moisture	Acidity	Ascorbic acid	Total sugars	Reducing sugars
B_1	KB	7.46	0.32	6.89	2.58	2.64
	KF	10.02	0.54	4.52	14.39	7.26
K_1	KB	6.80	0.37	7.63	4.70	3.84
	KF	9.44	0.60	5.29	15.53	7.90
B_2	KB	6.77	0.32	6.82	3.06	2.80
	KF	7.74	0.54	4.41	13.90	6.77
K_2	KB	6.11	0.36	7.49	4.24	3.04
	KF	7.28	0.60	5.09	15.03	7.41
B_3	KB	5.87	0.32	6.79	2.99	2.40
	KF	6.94	0.52	4.23	13.56	6.54
K_3	KB	5.92	0.35	7.34	4.17	3.44
	KF	6.34	0.59	4.79	14.80	7.38
B_4	KB	8.55	0.31	6.73	2.83	2.60
	KF	10.44	0.53	4.01	12.84	6.46
K_4	KB	7.88	0.34	7.12	3.88	2.64
	KF	9.87	0.56	4.71	14.83	7.34
B_5	KB	8.68	0.30	6.66	2.71	2.35
	KF	11.01	0.52	3.99	12.22	6.28
K_5	KB	8.36	0.33	6.89	3.71	3.39
	KF	10.57	0.54	4.52	14.70	7.00
CD ($P \leq 0.05$)		(a) 0.34	(a) 0.007	(a) 0.08	(a) NS	(a) 0.05
		(b) 0.34	(b) 0.007	(b) 0.08	(b) NS	(b) 0.05
		(c) 0.53	(c) 0.01	(c) 0.13	(c) NS	(c) 0.08

(a) Stages of maturity, (b) Treatments, (c) Temperatures

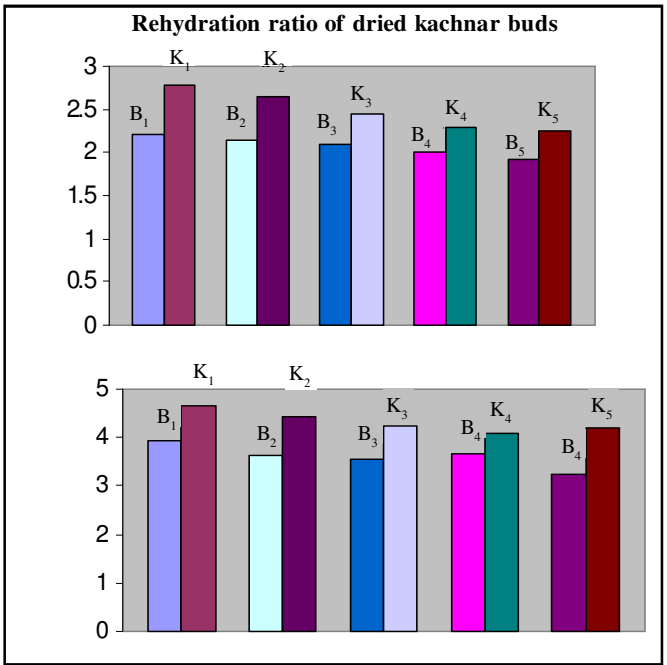

Fig. 2 : Effect of treatments and drying temperatures on the rehydration ratios of dried *Kachnar* buds and flowers

Different treatments and temperatures had no significant difference in the total sugar content of both buds and flowers. There was maximum retention of total sugars in sulphured *Kachnar* bud and flower samples (4.70 and 15.53 %) dried at 50^{0}C in tray drier and minimum for blanched samples dried in sun (2.71 and 12.22%). Among the two treatments; blanching retained minimum amount of total sugars than sulphuring which may be due to leaching of sugars in blanching water thereby causing loss of sugar. Similar results have been obtained by Khurdiya (1980), Bhardwaj and Kaushal (1990) and Machewad *et al.* (2003). The reducing sugars in both buds and flowers also followed almost the same pattern as of total sugars.

Among buds and flowers of *Kachnar*, flowers rehydrated more than buds in all treatments and maximum rehydration (2.78 and 4.67) was recorded for samples dried at 50^{0}C in tray drier after sulphuring and minimum rehydration (1.91, 3.23) was recorded for sun dried samples with blanching treatment. Further scrutiny of data reveal that the values of rehydration ratio were increasing with decrease in temperature in case of tray drying and are higher at 50^{0}C. On the contrary, rehydration values were low for solar and sun drying when compared with samples dried in tray drier. This may be attributable to toughening of tissues on exposure to heat for longer time. These reasons are supported by Jayaraman (1991) and Kar and Gupta (2003) who inferenced in their studies that rehydration was maximum for tray dried samples than sun and solar dried. Within treatments, blanched samples were significantly low in rehydration than sulphured samples which may be due to rupturing of tissues by heat treatment during blanching (Deshpande and Tamhane, 1991; Suguna *et al.*, 1995 and Lal *et al.*, 2004).

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