International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 118-123
© 2018 IJCS
Received: 04-07-2018
Accepted: 08-08-2018

Ashuqullah Atif
Department of Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Dev Raj
Department of Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

KD Desai
Department of Vegetable Science, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

VM Thumar
Department of Economics, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Tanveer Ahmad
Department of Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Correspondence
Dev Raj
Department of Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Effect of varieties, blanching and sulphitation on yield, rehydration ratio, carotene content, NEB and sensory quality of sweet potato {*Ipomoea batatas* (L.) Lam} powder

Ashuqullah Atif, Dev Raj, KD Desai, VM Thumar and Tanveer Ahmad

Abstract
India is the second largest producer of vegetable in the world. Among different vegetables; tuber crops are the most important food crops after cereals and grain legumes. The present investigation was conducted for dehydration of sweet potatoes into flour using different sweet potato varieties ["Gauri" (V_1), "ST-14" (V_2), "CIP-440038" (V_3) and "Kamala Sundari" (V_4)], blanching pre-treatments [without blanching (B_1) and with blanching at 85ºC for 3 min (B_2)] and sulphitation pre-treatments [Control (K_1), KMS@1000ppm (K_2), KMS@2000ppm (K_3)]. The results of the present investigation indicate that flour obtained from sweet potato variety “ST-14” when prepared without blanching and given pre-treatment with KMS@1000ppm ($V_2B_1K_2$) possess higher flour yield, rehydration ratio, β-carotene, and sensory score while lowest non-enzymatic browning (NEB).

Keywords: sweet potatoes, varieties, sulphitation, blanching and dehydration, quality

Introduction
India is the second largest producer of vegetable in the world. In India Vegetables are grown in 10290 thousand ha area and contributed 175008 thousand MT of production while, in Gujarat vegetable is grown in area 695.84 thousand ha and production is 13401.39 thousand MT (*Anon.* 2017) [4]. Among different tuber crops the sweet potato {*Ipomoea batatas* (L.) Lam} is an important tuber crop belonging to family Convolvulaceae and is an herbaceous perennial but cultivated as annual. It is a natural hexaploid (2n=6x=90), having basic chromosome number ‘x=15’. Sweet potato is an important starchy food crop widely grown throughout the tropical and subtropical countries. It is popularly called "Sakarkand" in India. Sweet potato is an important tuber crop grown all over the world and consumed as a vegetable, boiled, baked or often fermented into food and beverages (Anon., 2011) [2]. Sweet potato starch can be used in textile, paper, cosmetic and food manufacturing industries for the preparation of adhesives and glucose. In the tropics, the major portion of the sweet potato tuber is eaten as a vegetable after boiling, baking or frying. The sweet potato tubers are sometimes sliced and dried in the sun to produce chips, which are often ground into flour (Swarup, 2012) [20]. The sweet potato tubers are sometimes sliced and dried in the sun to produce chips, which are often ground into flour (Swarup, 2012) [20]. However, dehydrated sweet potatoes available in the market are not acceptable with respect to colour and quality. Very limited literature is available on effect of sweet potatoes varieties, blanching and pre-treatments on quality of the dehydrated sweet potato flour besides retention of quality parameters during storage. Thus, there was need to study the effect of sweet potato varieties, blanching and sulphitation pre-treatments to maintain the quality of the dehydrated product.

Material and Methods
Sweet potato tubers were harvested; defective as well as undesirable tubers were removed at the time of sorting. Then tubers were thoroughly washed to remove any adhering dust and dirt particles. After washing, the tubers were peeled to remove peel and trimmed to remove undesirable portions with stainless steel (SS) knife. Then peeled tubers were cut into 2-3mm slice with the help of slicer. The prepared slices were dehydrated into flour as per treatments. A total of 24 treatments were used for dehydration into flour using combinations

of different sweet potato varieties as Factor-1 ["Gauri" (V_1), "ST-14" (V_2), "CIP-440038" (V_3) and "Kamala Sundari" (V_4)]; blanching pre-treatments as Factor-2 [without blanching (B_1) and with blanching at 85ºC for 3 min (B_2)] and sulphitation pre-treatments as Factor-3 [Control (K_1), KMS@1000ppm (K_2), KMS@2000ppm (K_3)]. After blanching and sulphitation pre-treatments, slices were drained to remove adhering moisture followed by loading into mechanical tray dryer for dehydration. The slices were dehydrated in mechanical dehydrator using three stage dehydration temperatures (75ºC for 2 hours, 68ºC for 4 hours and 60ºC for about 11-12 hours) till final moisture content of 5.5±1% as reported by Raj *et al*. (2004) [14] for dehydration of onions. After dehydration, the slices were ground into flour using grinder. Principal steps used for dehydration of sweet potatoes into flour are illustrated ahead in figure 1.

Selection of sweet potatoes
↓
Trimming and Peeling
↓
Slicing
↓
Blanching and Sulphitation (as per treatments)
↓
Dehydration (Dehydration using three stage dehydration temperatures- 75ºC for 2 hours, 68ºC for 4 hours and 60ºC till drying apprx 11-12 hours)
↓
Flour preparation and Packaging (Polypropylene bag 200 gauge)

Fig 1: Principal steps used for dehydration of sweet potatoes into flour

The quality characteristics of sweet potato flour were investigated by rehydration ratio, β-carotene and non-enzymatic browning. Yield of sweet potato flour was calculated by drying known weight of sweet potato slices in a dehydrator. After dehydration, the dehydrated chips were ground to flour and then weight was measured and expressed as per cent yield on fresh weight basis. Rehydration test is done to estimate the quality of the dehydrated product with respect to water absorption. Rehydration ratio is the ratio of dried material to rehydrated material. Carotenoids were extracted with acetone and the intensity of colour measured calorimetrically at 452nm using petroleum ether as blank and contents were calculated by the following formula (Ranganna, 1997) [18]. Nonenzymatic browning of the flour was determined by measuring the optical density of alcoholic extract after 12 hours at 440nm through UV-vis Spectrophotometer using 60 per cent ethanol as blank (Ranganna,1997) [18]. Sensory evaluation of flour was conducted to assess the consumer’s acceptance for the products. The prepared samples of flour were evaluated for sensory qualities on the basis of colour and overall acceptability on a 9 point Hedonic scale according to the method of Amerine *et al*. (1965). Experiments were carried out in Completely Randomized Design with factorial concept (FCRD). The data on quality parameters of sweet potato flour were statistical analyzed by adopting analysis of variance techniques as described by Panse and Shukhatme (1967) [12]. The critical differences (C.D.) at 5 per cent level of probability were worked out to compare treatments mean for predicting significance among treatments.

Result and Discussion

Flour yield

Perusal of data presented pertaining to effect of different varieties and treatments on flour yield have been given in 1. Data shows that among different varieties *viz.* "Gauri", "ST-14", "CIP-440038" and "Kamala Sundari" grand mean yield (V) of flour ranged between 17.42% and 20.95%, with maximum yield in variety "Gauri" (V_1), closely followed by "ST-14" (20.59%) and minimum in "Kamala Sundari" (V_4). Significant differences were observed in flour yield among different varieties. Hagenimana and Owori (2000) [7] reported 27% flour yield of sweet potato in variety Tanzania. The variation in yield of flour may be due to variation in dry matter content as well as peeling and trimming losses among different cultivars. Raj (2004) [14] reported yield of potato flour among different potato cultivars varied from 13.23 to 20.73 per cent, with maximum yield in Kufri Chipsona-2 followed by Kufri Chipsona-1 (20.63%) and Kufri Chandramukhi (18.53%) and minimum in Kufri Jyoti followed by Kufri Badshah (14.70%).

It was observed that mean yield (B) of the flour varied significantly from 17.16% to 21.65% when sweet potato flour was prepared by following different blanching treatments prior to dehydration, with maximum yield (21.65%) of the flour prepared without blanching treatment (B_1) and minimum yield in flour when prepared with blanching treatment (B_2). Leeratanarak *et al*. (2006) [9] reported that blanching help to increase the dehydration ratio of the product which represents the decrease in the yield of the dehydrated product. The increase in dehydration ratio of the flour in blanching treatment might be attributed to leaching losses of the nutrients and solids. Data shows that among different sulphitation treatment, the yield of flour varied non-significantly between 19.20% and 20.55%, with maximum yield in flour which was prepared by giving sulphitation pre-treatment (KMS @ 2000 ppm) and minimum in control (without sulphitation).

Among interaction of varieties and blanching, data depicted that flour of different sweet potato variety prepared by giving different blanching treatment (VxB) resulted variation in the flour yield from 15.18% to 23.69%, with minimum flour yield in variety "Kamala Sundari" when prepared by following pre-treatment of blanching at 85ºC for 3 min (V_4B_2) and maximum in variety "Gauri" when prepared by without blanching pre-treatment. Interactions of VxK, BxK and VxBxK were found to have non-significant effect on yield.

Rehydration ratio

The effect of different varieties and treatments on rehydration ratio of sweet potato flour during six months storage period has been presented in Table 1. Data shows that among different varieties *viz.* "Gauri", "ST-14", "CIP-440038" and "Kamala Sundari"; the grand mean rehydration ratio of flour (V) varied significantly between 2.96 and 3.98, with maximum rehydration ratio in variety "Kamala Sundari" (V_4) followed by "ST-14" (V_2). Loesecke and Willard (1955) [15] reported that the rehydration characteristics of the dehydrated food are influenced by processing conditions as well as sample composition used in dehydration. Similar results were noted by dehydrated onion rings of two red onion varieties *viz.* "Poona Red" and "Bellary Red" as reported by Raj *et al* (2004, 2006 and 2009) [13, 14, 15].

Among blanching pre-treatments, it was observed that grand mean colour retention were observe was prepared by giving different blanching treatments prior to dehydration, Further, data shows that among different sulphitation treatment, the rehydration ratio of flour varied significantly between 2.97 and 3.56, with maximum rehydration ratio in flour which was prepared by giving sulphitation pre-treatment (KMS @2000 ppm). Anon. (2017) [3] reported lowest rehydration ratio of 4.62 for dehydrated onions, 6.29 for dehydrated okra and 6.87 for dehydrated cauliflower when onion, okra and cauliflower pretreated with 2000 ppm KMS along with 500 ppm citric acid, 1500 ppm KMS along with 500 ppm citric acid and 1500 ppm KMS along with 1000 ppm citric acid, respectively.

Carotene content

Data shows that among different varieties *viz.* "Gauri", "ST-14", "CIP-440038" and "Kamala Sundari"; the grand mean ß-carotene content (V) of flour varied significantly between 3.68 mg/100g and 32.64 mg/100g, with maximum ß-carotene in variety "ST-14" (V_2) followed by "Kamala Sundari" (V_4) (24.30 mg/100g) and minimum in "Gauri" (V_1) (Table 2). Burgos *et al.* (2001) [5] also reported beta-carotene in the similar range with slight variations. Mitra (2012) [11] registered significant variations in values for beta carotene in boiled sweet potato tubers of 15 different varieties ranging from 2.58 mg/100g to 9.74 mg/100 g on fresh weight basis and higher values were recorded in ST-14, 362- 7, Kamala Sundari, CIP SWA-2, 440038 and S-128. The values of the beta carotene on dry weight basis in the present study are slightly lower than the values of Mitra (2012) [11].

Among blanching pre-treatments, it was observed that grand mean ß-carotene (B) of the flour varied significantly from 16.61 mg/100g to 18.45 mg/100g when sweet potato flour was prepared by giving different blanching treatments prior to dehydration, with maximum ß-carotene (18.45 mg/100g) in the flour prepared without blanching treatment (B_1) and minimum ß-carotene content in flour when prepared with blanching treatment (B_2). Among interaction of varieties and blanching, data depicted that flour of different sweet potato variety prepared by giving different blanching treatment (VxB) resulted variation in the ß-carotene content from 3.49 mg/100g to 25.57 mg/100g, with maximum ß-carotene content in flour of variety "ST-14" prepared by without blanching pre-treatment (V_2B_1). Further, data shows that among different sulphitation treatment, the ß-carotene content of flour varied significantly between 17.37 mg/100g and 17.66 mg/100g, with maximum ß-carotene in flour which was prepared by giving sulphitation pre-treatment with KMS @2000 ppm at par with KMS @1000 ppm and minimum in control (without sulphitation). Ahmed *et al.* (2010) [1] noticed that ß-carotene content of peeled and unpeeled sweet potato flour obtained following pre-treatment at different drying temperatures varied significantly from 2.68 mg/100g to 3.79 mg/100g on wet weight basis. Similar results were reported by Vimala *et al.* (2011) [21] for orange flesh sweet potato varieties. Highest retention of total β-carotene was observed in the oven drying method (89% to 96%) followed by boiling (84%–90%). Emmanuel *et al.* (2012) [6] reported that boiling and steaming of roots seemed to result in better retention of β-carotene than roasting and dehydration. However, in the present investigations, the blanching pre-treatment has resulted less retention of the beta-carotene content.

Non-enzymatic browning (NEB)

Data in Table 2 shows that among different varieties *viz.* "Gauri", "ST-14", "CIP-440038" and "Kamala Sundari"; the grand mean NEB of flour (V) varied significantly between 0.167 OD_{440nm} and 0.295 OD_{440nm}, with minimum NEB in variety "ST-14" (V_2) and maximum in "Gauri"(V_1). Mean non-enzymatic browning ($OD_{440\ nm}$) in flour prepared from different potato cultivars ranged between 0.026 and 0.104, with minimum NEB in flour of Kufri Chipsona-2 and maximum in Kufri Badshah as reported earlier by Raj (2004) [14] and Raj *et al.* (2011) [16]. Similar observations with slight variation were reported for dehydrated potato chips by Sandhu *et al.* (1987). Among blanching pre-treatments, it was observed that grand mean NEB of the flour (B) varied significantly from 0.192 OD_{440nm} to 0.239 OD_{440nm} when sweet potato flour was prepared by giving different blanching treatments prior to dehydration, with minimum NEB (0.192 OD_{440nm}) of the flour prepared without blanching treatment (B_1) and maximum NEB in flour when prepared with blanching treatment (B_2). The maximum NEB of the flour prepared by blanching treatment might be attributed to easy escape of the bound water (NEB) from the tissues during falling period of drying. Among interaction of varieties and blanching, data depicted that flour of different sweet potato variety prepared by giving different blanching treatment (VxB) resulted variation in the NEB from 0.154 OD_{440nm} to 0.400 OD_{440nm}, with minimum NEB in flour of variety "ST-14" (V_2) prepared by without blanching pre-treatment (V_2B_1). Further, data shows that among different sulphitation treatment, the NEB of flour varied significantly between 0.122 OD_{440nm} and 0.281 OD_{440nm}, with minimum NEB in flour which was prepared by giving sulphitation pre-treatment (KMS @1000 ppm) and maximum in control (without sulphitation). Anon. (2017) [3] reported lowest NEB of 0.219 for dehydrated onions, 0.262 for dehydrated okra and 0.174 for dehydrated cauliflower when onion, okra and cauliflower pretreated with 2000 ppm KMS along with 500 ppm citric acid, 1500 ppm KMS along with 500 ppm citric acid and 1500 ppm KMS along with 1000 ppm citric acid, respectively. Significant variations were also observed in NEB of potato flours of variety "Kufri Chandramukhi" when slices were pretreated with KMS and Enzymes (Glucose oxidase and catalase) when compared with control. Ahmed *et al.* (2010) [1] reported the effects pre-treatment on the physico-chemical properties and nutritional quality of sweet potato flour. Significant differences in browning index (OD_{420nm}) in flours from peeled and unpeeled sweet potatoes without sulphite-treatment ranged from 0.24 to 0.42. Less browning index was observed in peeled and sulphited flour than unpeeled and un-sulphited flour.

Colour (9 point Hedonic score)

Perusal of data presented presented in Table 3 **s**hows that among different varieties *viz.* "Gauri", "ST-14", "CIP-440038" and "Kamala Sundari"; the grand mean colour score (9 point Hedonic scale) of flour (V) varied significantly between 6.62 and 7.67, with maximum colour score in flour of variety "ST-14" (V_2) closely followed by "Kamala Sundari" (7.51) and minimum in "Gauri" (V_2). Hatamipour *et al.* (2007) [8] reported variations in colour score in sweet potato flours of six sweet potatoes varieties *viz.* Santana, Marfona, Santea, Koncord, Diamant, and Renjer. The variation in the visual colour of the flour might be due to variation in the non-enzymatic browning in the flour of the different sweet potato varieties. Raj (2004) [14] reported significance variations in visual colour of the potato flours of the varieties due to variations in the NEB. NEB of the product directly correlated with the colour of the product. Among blanching pre-treatments, it was observed that grand mean colour of the flour (B) varied significantly from 7.05 to 7.28, when sweet potato flour was prepared by giving different blanching treatments prior to dehydration, with maximum colour (7.28) of the flour prepared without blanching treatment (B_1) and minimum colour score (9 point Hedonic scale) in flour when prepared with blanching treatment (B_2). The minimum colour score (9 point Hedonic scale) of the flour prepared by blanching treatment might be attributed higher NEB in the flour due to heat effect. However our results are not in conformity with the observations made by Leeratanarak *et al.* (2006) [6] and Hatamipour *et al.* (2007) [8]. Leeratanarak *et al.* (2006) [6] found that longer blanching time (5 min) at 70ºC resulted in better color retention and led to chips of lower browning index (0.039). Among interaction of varieties and blanching, data depicted that flour of different sweet potato variety prepared by giving different blanching treatment (VxB) resulted variation in the colour score (9 point Hedonic scale) from 6.61 to 7.80, with maximum colour score (9 point Hedonic scale) in flour of variety "ST-14" prepared without blanching pretreatment (V_2B_1).

Further, data shows that among different sulphitation treatment, the colour score (9 point Hedonic scale) of flour varied significantly between 5.46 and 8.04, with maximum colour in flour which was prepared by giving sulphitation pre-treatment of KMS @2000 ppm at par with 1000 ppm KMS and minimum in control (without sulphitation). Raj (2004) [13] reported variations in average colour scores (9 point hedonic scale) of flour of potato cv. Kufri Chandramukhi prepared with using different pre-treatments in the range of 5.0 to 8.2, with maximum score in samples treated with combination of 0.03 per cent (1:1) glucose oxidase and catalase (T8) at par pretreatment of 1000 ppm KMS and minimum in control (T1). Ahmed *et al.* (2010) [1] studied the effect of pretreatments on sensory quality of sweet potato flour and reported higher L value due to sulphitation treatment. They reported that sulphite is a good colour preservative and it retards both enzymatic and non-enzymatic reactions. Among interaction of varieties, blanching and sulphitation data depicted minimum decrease in colour score (9 point Hedonic scale) from initial value of 5.04 to 8.65 in flour of "ST-14" variety prepared without blanching and by giving sulphitation pre-treatment (KMS @2000 ppm) ($V_2B_1K_3$) at par pretreatment of 1000 ppm KMS ($V_2B_1K_2$).

Overall acceptability (9 point Hedonic score)

Perusal of data presented in Table 3 shows that among different varieties *viz.* "Gauri", "ST-14", "CIP-440038" and "Kamala Sundari"; the grand mean overall acceptability score (9 point Hedonic scale) of flour (V) varied significantly between 6.65 and 7.68, with maximum overall acceptability score in flour of variety "ST-14" (V_2) closely followed by "Kamala Sundari" (7.48) and minimum in "Gauri" (V_2). The variation in the overall acceptability of the flour might be due to variation in the non-enzymatic browning, sensory colour as well as texture score of the flour prepared from different sweet potato varieties. Raj (2004) [14] reported significance variations in overall acceptability of the potato flours of the varieties due to variations in the NEB, sensory colour and texture score. NEB, sensory colour and texture score of the product directly correlated with the overall acceptability of the product.

Among blanching pre-treatments, it was observed that grand mean overall acceptability of the flour (B) varied significantly from 7.00 to 7.35 when sweet potato flour was prepared by giving different blanching treatments prior to dehydration, with maximum overall acceptability (7.35) of the flour prepared without blanching treatment (B_1) and minimum overall acceptability score (9 point Hedonic scale) in flour when prepared with blanching treatment (B_2). The minimum overall acceptability score (9 point Hedonic scale) of the flour prepared by blanching treatment might be attributed higher NEB, lower sensory colour and texture sore in the flour due to heating effect. Among interaction of varieties and blanching, data depicted that flour of different sweet potato variety prepared by giving different blanching treatment (VxB) resulted variation in the overall acceptability score (9 point Hedonic scale) from 6.60 to 7.96, with maximum overall acceptability score (9 point Hedonic scale) in flour of variety "ST-14" prepared without blanching pretreatment (V_2B_1).

Further, data shows that among different sulphitation treatment, the overall acceptability score (9 point Hedonic scale) of flour varied significantly between 5.50 and 8.03, with maximum overall acceptability in flour which was prepared by giving sulphitation pre-treatment of KMS @2000 ppm at par with KMS @1000 ppm and minimum in control (without sulphitation). Raj (2004) [13] reported variations in average overall acceptability scores (9 point hedonic scale) of flour of potato cv. Kufri Chandramukhi prepared with different pre-treatments in the range of 6.23 to 8.23, with maximum score in samples treated with combination of 0.03 per cent (1:1) glucose oxidase and catalase (T8) at par with 1000 ppm KMS treatment and minimum in control (T1). Among interaction of varieties, blanching and sulphitation; data depicted minimum decrease in overall acceptability score (9 point Hedonic scale) from initial value of 5.14 to 8.81 in flour of "ST-14" variety prepared without blanching and by giving sulphitation pre-treatment (KMS @2000 ppm) ($V_2B_1K_3$) at par pretreatment of 1000 ppm KMS ($V_2B_1K_2$).

Conclusion

It can be concluded that the best quality sweet potato flour can be obtained from sweet potato variety “ST-14” when prepared without blanching and given pre-treatment with KMS@1000ppm ($V_2B_1K_2$) and flour obtained from this treatment possess higher β-carotene, rehydration ratio and sensory score while lowest non-enzymatic browning (NEB).

Table 1: Effect of different varieties and pre-treatments on the rehydration ratio β-carotene and non-enzymatic browning of sweet potato flour.

Sulphitation (K)	Blanching (B)										Grand Mean (K)
	Control: Without blanching (B_1)					Blanching at 85ºC for 3 min (B_2)					
	Varieties (V)*					Varieties (V)*					
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	
Yield (%)											
Control (K_1)	24.00	23.65	20.36	20.15	22.04	17.75	17.00	16.45	14.25	16.36	19.20
KMS_{1000} (K_2)	23.45	23.20	19.65	19.40	21.43	18.30	18.20	17.88	15.64	17.51	19.47
KMS_{2000} (K_3)	23.62	23.25	19.70	19.42	21.50	18.60	18.22	17.95	15.65	17.61	19.56
Mean	23.69	23.37	19.90	19.66	21.65	18.22	17.81	17.43	15.18	17.16	
Grand mean	20.95	20.59	18.67	17.42							

	$CD_{0.05}$	SEM±			$CD_{0.05}$	SEM		$CD_{0.05}$	SEM		
Varieties (V)	0.403	0.140		VxB	0.570	0.199	VxBxK	NS	0.344		
Blanching (B)	0.285	0.099		VXK	NS	0.243					
Sulphitation (K)	NS	0.122		BxK	0.494	0.172					
Rehydration ratio											
Control (K_1)	2.40	2.49	2.35	2.84	2.52	3.12	3.66	3.05	3.86	3.42	2.97
KMS_{1000} (K_2)	2.66	2.51	2.45	3.66	2.82	3.68	4.52	3.70	4.91	4.20	3.51
KMS_{2000} (K_3)	2.60	2.70	2.54	3.63	2.87	3.82	4.53	3.67	4.97	4.25	3.56
Mean	2.55	2.57	2.45	3.38	2.74	3.54	4.24	3.47	4.58	3.96	
Grand Mean	3.05	3.41	2.96	3.98							
	$CD_{0.05}$	SEM				$CD_{0.05}$	SEM		$CD_{0.05}$	SEM	
Varieties (V)	0.03	0.009			VxB	0.04	0.013	VxBxK	0.06	0.023	
Blanching (B)	0.02	0.007			VxK	0.05	0.016				
Sulphitation (K)	0.02	0.008			BxK	0.03	0.011				
*V_1: Gauri, V_2: ST-14, V_3: CIP- 440038, V_4: Kamala Sundari											

Table 2: Effect of different varieties and pre-treatments on the rehydration ratio β-carotene and non-enzymatic browning of sweet potato flour.

Sulphitation (K)	Blanching (B)										Grand Mean (K)
	Control: Without blanching (B_1)					Blanching at 85ºC for 3 min (B_2)					
	Varieties (V)*					Varieties (V)*					
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	
β- Carotene (mg/100g)											
Control (K_1)	3.83	34.05	9.94	25.30	18.28	3.44	30.66	8.90	22.80	16.45	17.37
KMS_{1000} (K_2)	3.85	34.45	10.02	25.67	18.50	3.48	30.95	9.04	23.06	16.63	17.57
KMS_{2000} (K_3)	3.89	34.54	10.08	25.74	18.56	3.55	31.15	9.10	23.20	16.75	17.66
Mean	3.86	34.35	10.01	25.57	18.45	3.49	30.92	9.01	23.02	16.61	
Grand mean	3.68	32.64	9.51	24.30							
	$CD_{0.05}$	SEM				$CD_{0.05}$	SEM		$CD_{0.05}$	SEM	
Varieties (V)	0.14	0.051			VxB	0.20	0.072	VxBxK	NS	0.125	
Blanching (B)	0.10	0.036			VxK	NS	0.088				
Sulphitation (K)	0.12	0.044			BxK	NS	0.062				
Non-enzymatic browning											
Control (K_1)	0.325	0.207	0.216	0.189	0.234	0.394	0.280	0.378	0.260	0.328	0.281
KMS_{1000} (K_2)	0.166	0.088	0.115	0.106	0.119	0.192	0.079	0.138	0.090	0.125	0.122
KMS_{2000} (K_3)	0.160	0.086	0.110	0.099	0.114	0.188	0.080	0.138	0.094	0.125	0.199
Mean	0.217	0.127	0.147	0.131	0.156	0.258	0.146	0.218	0.148	0.193	
Grand mean	0.238	0.137	0.183	0.140							
	$CD_{0.05}$	SEM				$CD_{0.05}$	SEM		$CD_{0.05}$	SEM	
Varieties (V)	0.005	0.001			VxB	0.00	0.001	VxBxK	0.01	0.002	
Blanching (B)	0.003	0.001			VxK	0.00	0.001				
Sulphitation (K)	0.007	0.001			BxK	0.00	0.001				
*V_1: Gauri, V_2: ST-14, V_3: CIP- 440038, V_4: Kamala Sundari											

Table 3: Effect of different varieties and pre-treatments on the rehydration ratio β-carotene and non-enzymatic browning of sweet potato flour.

Sulphitation (K)	Blanching (B)										Grand Mean (K)
	Control: Without blanching (B_1)					Blanching at 85ºC for 3 min (B_2)					
	Varieties (V)*					Varieties (V)*					
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	
Colour (9 point Hedonic scale)											
Control (K_1)	5.43	6.12	5.62	5.92	5.77	5.17	5.22	5.04	5.14	5.14	5.46
KMS_{1000} (K_2)	7.17	8.63	7.74	8.53	8.02	7.30	8.65	7.48	8.42	7.96	7.99
KMS_{2000} (K_3)	7.24	8.65	7.79	8.54	8.06	7.40	8.72	7.50	8.50	8.03	8.04
Mean	6.61	7.80	7.05	7.66	7.28	6.62	7.53	6.67	7.35	7.05	
Grand mean	6.62	7.67	6.86	7.51							
	$CD_{0.05}$	SEM				$CD_{0.05}$	SEM		$CD_{0.05}$	SEM	
Varieties (V)	0.07	0.025			VxB	0.10	0.035	VxBxK	0.17	0.061	
Blanching (B)	0.05	0.017			VxK	0.12	0.043				
Sulphitation (K)	0.06	0.021			BxK	0.08	0.030				
Overall acceptability (9 point Hedonic scale)											
Control (K_1)	5.37	6.29	5.69	5.96	5.83	5.14	5.24	5.05	5.27	5.17	5.50
KMS_{1000} (K_2)	7.31	8.77	7.77	8.52	8.09	7.30	8.48	7.54	8.26	7.90	7.99
KMS_{2000} (K_3)	7.40	8.81	7.81	8.55	8.14	7.38	8.46	7.55	8.33	7.93	8.03
Mean	6.69	7.96	7.09	7.67	7.35	6.60	7.39	6.71	7.29	7.00	
Grand mean	6.65	7.68	6.90	7.48							
	$CD_{0.05}$	SEM				$CD_{0.05}$	SEM		$CD_{0.05}$	SEM	

Varieties (V)	0.13	0.047			VxB	0.19	0.067	VxBxK	0.12	0.112	
Blanching (B)	0.09	0.033			VxK	0.23	0.082				
Sulphitation (K)	0.11	0.041			BxK	0.16	0.058				
*V_1: Gauri, V_2: ST-14, V_3: CIP- 440038, V_4: Kamala Sundari											

References

1. Ahmed M, Akter MS, Eun JB. Peeling, drying temperatures, and sulphite-treatment affect physicochemical properties and nutritional quality of sweet potato flour. Food Chemistry. 2010; 121(1):112-118.
2. Anonymous. Statistical 2011. Data base. htt://faostat.fao.org/site/567/Des ktop Default. aspx. Date: (5/12/2016).
3. Anonymous. AGRESCO Report of Horticulture Sub – committee. Navsari Agricultural University. In: 13th Combined Joint Agresco Meeting, Sardar Krushinagar Dantiwada Agricultural University, Dantiwada, 2017; 5-7.
4. Anonymous. Horticultural Statistics at a Glance, 2017. www.agricoop.nic.in.
5. Burgos G, Rossemary C, Cynthia S, Sosa P, Porras E, Jorge E *et al.* A color chart to screen for high beta-carotene in orange fleshed sweet potato breeding. International Potato Center. Cairo, Egypt, 2001.
6. Emmanuel H, Vasanthakaalam H, Jean NJ, Mukwantali, C. A comparative study on the β-carotene content and its retention in yellow and orange fleshed sweet potato flours http://www.asareca.org, ISAR, Rwanda, 2012.
7. Hagenimana V, Owori C. Quality evaluation of sweet potato flour processed in different agro-ecological sites using small scale processing technologies. African Potato Association Conference Proceedings. 2000; 5:483-490.
8. Hatamipour MS, Kazemi HH, Nooralivand A, Nozarpoor A. Drying characteristics of six varieties of sweet potatoes in different dryers. Journal of Food and Bio Products Processing. 2007; 85(3):171-177.
9. Leeratanarak N, Devahastin S, Chiewchan N.Drying kinetics and quality of potato chips undergoing different drying techniques. Journal of Food Engineering. 2006; 77(3):635-643.
10. Loesecke V, Willard H. Drying and dehydration of foods. Reinhold Publishing Corporation. 1955; 283-291.
11. Mitra S. Nutritional status of orange-fleshed Sweet Potatoes in alleviating vitamin A malnutrition through a Food-Based Approach. Journal of Food and Nutrition Science. 2012; 2(8):1-3.
12. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers (2nd Ed.). ICAR, New Delhi (India), 1967.
13. Raj D. Screening of Potato (*Solanum tuberosum* L.) cultivars for processing and value addition. Ph.D. Thesis. Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh (India), 2004.
14. Raj D, Huddar AG, Gupta P. Effect of dehydration temperatures on the quality characteristics of dehydrated onion rings during storage. Udyanika Journal of Horticulture Science. 2004; 10(4):47-52.
15. Raj D, Huddar AG, Subbanna VC, Gowda IND. Effect of packaging on the quality characteristics of dehydrated onion rings during storage. Beverages and Food World. 2009; 36(5):33-35.
16. Raj D, Lal BB, Joshi VK. Yield, quality and storability of the potato flour of different Indian cultivars. International Journal of Food and Fermentation. 2011; 1(1):111-117.
17. Raj D, Subanna VC, Ahlawat OP, Gupta P, Huddar AG. Effect of pre-treatments on the quality characteristics of dehydrated onion rings during storage. Journal of Food Science and Technology. 2006; 43(6):571-574.
18. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw Hill Publishing Co. Ltd., New Delhi (India), 1997.
19. Saravaiya SN, Patel MB. Diamond Back Moth. The most notorious pest of cauliflower and its management strategies. Agrobios Newsletter. 2005; 3(9):23-24.
20. Swarup V. Vegetable Science and Technology in India, Kalyani Publishers, New Delhi. 2012; 614-619.
21. Vimala B, Nambisan B, Hariprakash B. Retention of carotenoids in orange-fleshed sweet potato during processing Journal of Food Science. 2011; 48(4):520-524.