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Stabilization of watermelon squash with xanthan gum and its organoleptic evaluatoin

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SUMMARY : **Squash of watermelon var. Arka Manik was prepared with 25 per cent pulp, 40^{0}B (Brix) T.S.S (Total soluble solids), 1 per cent acidity and with different concentration levels (0.1 to 0.5 per cent) of xanthan gum, an exocellular polysaccharide produced by obligatory aerobic microorganism, *Xanthomonas campestris*. The prepared squash was subjected to physico-chemical analysis at 0, 30, 60, 90, 120, 150 and 180 days of storage and sensory evaluation at 180 days of storage. An increasing trend in pH and total soluble solids and decreasing trend in titrable acidity and ascorbic acid were noticed during storage period. Viscosity of squash increased with increased concentration of xanthan gum and decreased with increase in temperature. Squash containing 0.2 per cent xanthan gum, 25 per cent pulp, 40^{0}B TSS and 1 per cent acidity was adjudged the best for overall acceptability by sensory evaluation at 180 days of storage period. Utilization of watermelon fruits in the preparation of watermelon squash has advantages in attracting the consumers with feel of healthy product throughout year.**

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Watermelon (*citrullus lanatus*) is an important summer season crop and is highly relished due to its cool and thirst quenching property. The pulp is juicy and sweet, with an attractive red colour that attracts consumers. The edible portion of the fruit forms about 60 per cent of the whole fruit and juice is the major product for which the fruit is processed (Teotia *et al.*, 1988). Watermelon juice contains a fare amount of vitamin C, vitamin 'A' precursor (Lycopene) and a high content of potassium which is believed to have valuable diuretic properties (Gusina and Trostinskaya, 1974).The content of edible flesh of watermelon fruit per 100g is 92 per cent water, 0.2 per cent protein, 0.3 per cent minerals and 7.0 per cent carbohydrates (Chadha, 2001).

Gowda and Jalali (1995) reported that the use of water melon for processing has not received much attention. Watermelon is used in juice based drinks, particularly as an ingredient in mixed fruit drinks (Hooper, 1995). Watermelon is largely grown and is available in plenty especially during the summer (Bose *et al.*, 2001). Utilization of watermelon fruits during the season to make value added products avoids the seasonal scarcity. Moreover, there is always a demand for a new product, which is rich in nutrients and delicately flavoured. In this context, the present study was undertaken to utilize watermelon fruit to prepare squash by supplementing with xanthan gum.

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EXPERIMENTAL METHODS

Watermelon (var. Arka Manik) was procured from the New Market of Kolkata. Fruits which are uniform in shape, free from bruises and anthracnose with a nice sheen on their outer skin and creamy yellow spot under side giving dull sound on thumping with knuckle were selected. Fruits were washed with filter water and sliced into quarters. Each quarter was cut into half again with sharp stainless steel knife. The flesh that is full of seeds was removed by a cut along the seed line. The remaining seeds were removed with the tip of utility knife and a sharp knife was run along the rind to separate the flesh. The seedless flesh thus separated was sliced for juice extraction by mashing in grinder. Watermelon squash was prepared

Table A : Recipies for watermelon squash

Recipie no.	Pulp content (%)	TSS (^{0}Brix)	Acidity (%)	Xanthan gum levels (%)
W_1	25	40	1	0.0
W_2	25	40	1	0.1
W_3	25	40	1	0.2
W_4	25	40	1	0.3
W_5	25	40	1	0.4
W_6	25	40	1	0.5

as described in flow chart (Fig. A) with the following recipies.

Watermelon fruits were washed by filter water
↓
Fruits were sliced into quarters and each quarter into half again with sharp stainless steel knife
↓
Seeds were removed
↓
Flesh without seeds was sliced into pieces
↓
Pieces were mashed in a grinder
↓
Juice thus obtained was passed through a muslin cloth.
↓
Xanthan gum was added to the extracted juice
↓
Syrup was prepared by mixing the water, sugar and acid
↓
Extracted juice with xanthan gum was added to the syrup and mixed well
↓
Preservative (Potassium metabisulphite (KMS), 350 ppm) was added
↓
Prepared squash was filled into pre-sterilized bottles of 200 ml capacity (Sterilization at 25lb/p.s.i. for 15 minutes)
↓
Squash was heated to 85^{0}C
↓
Capping was done
↓
Product was processed in boiling water for 20 minutes and cooled immediately.
↓
Bottles were stored at room temperature (18 – 25^{0}C) for further observation

Fig. A: Preparation scheme for watermelon squash

The prepared squash recipies were subjected to physico-chemical analysis at 0, 30, 60, 90, 120, 150 and 180 days of storage and organoleptic evaluation at 180 days of storage.

The pH of the squash was recorded with Toshniwal digital pH meter (Model DI 707). Total soluble solids content was recorded with Erma hand refractometer. Acidity (as citric acid) was estimated by titration method (Ranganna, 1977). Ascorbic acid was determined by 2, 6-dichlorophenol indophenol titration method (Ranganna, 1986). Viscosity is one of the important rheological characters of liquid foods which offer resistance to flow. The viscosity in fresh watermelon squash was determined over a range of temperature (30^0 – 50^{0}C) as well as at constant concentration (40^{0}Brix) by using the viscometer bath (Model No. - SVB, S.L. No.-S/01 Simco Brand, Kolkata, West Bengal) and capillary viscometer tube (Cannon fenske viscometer).

Watermelon squash was evaluated at 180 days of storage for organoleptic parameters such as appearance, aroma and flavour, taste and overall acceptability by a panel of 8 judges by numerical scoring method (Amerine *et al.*, 1965). The prepared squash was observed for mould growth by visual methods at monthly intervals throughout the storage period.

In this experiment, factorial completely randomized design (factorial CRD) was adopted. The data was analyzed and main interaction effects were presented (Sundararaj *et al.,* 1972). Observations on various parameters were recorded with three replications and significance was tested using F-test method.

EXPERIMENTAL FINDINGS AND ANALYSIS

The physical parameters of watermelon fruits var. Arka Manik were determined to assess the quality characters. Fruits were oval in shape.The average diameter, height and weight of the fruits were found to be 29 cm, 25 cm and 5.5 kg, respectively. The rind of fruits was green with dull green stripes and flesh was deep red in colour. pH of fresh watermelon juice was recorded to be 5.11. Chemical analysis indicated that fresh juice had the total soluble solids 10^{0}Brix, acidity 2.34 per cent and ascorbic acid 9.1mg/100g (Table 1).

Table 1: Physico-chemical characteristics of watermelon fruit var. Arka Manik (n=4)

Sr. No.	Parameters	Observation
1.	Colour of rind	Green with dull green stripes
2.	Colour of flesh	Deep red
3.	Diameter (cm)	29
4.	Height (cm)	25
5	Fruit weight(g)	5.5
6.	pH	5.11
7.	Total soluble solids (^{0}Brix)	10.0
8.	Acidity as citric acid (%)	2.34
9.	Ascorbic acid (mg/100g)	9.1

Total soluble solids content of watermelon squash increased during storage period (Table 2). This might be due to increase in total soluble sugars caused by hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances. Similar results were observed in squash prepared from kiwi fruit (Thakur and Barwal, 1998) and amla fruit (Reddy and Chikkasubbanna, 2008).

Table 2: Influence of different levels of xanthan gum and storage period and their interaction on TSS, pH, acidity and ascorbic acid in watermelon squash

Description	TSS (^{0} Brix)	pH	Acidity (%)	Ascorbic acid (mg/100)
Initial values	40	5.94	1.00	2.31
Xanthan gum levels (%)				
0.0 (W_1)	42.89	6.86	0.91	1.66
0.1 (W_2)	42.21	6.72	0.89	1.80
0.2 (W_3)	39.92	6.73	0.87	1.97
0.3 (W_4)	39.98	6.71	0.83	1.94
0.4 (W_5)	40.86	6.65	0.89	2.11
0.5 (W_6)	40.01	6.04	0.93	2.31
S.Em (±)	0.04	0.00	0.00	0.00
CD at 5%	0.13	0.02	0.00	0.02
Storage in days				
30 days (D_1)	40.18	6.08	0.96	2.19
60 days (D_2)	40.52	6.20	0.93	2.05
90 days (D_3)	40.90	6.42	0.91	1.96
120 days (D_4)	40.97	6.76	0.87	2.02
150 days(D_5)	41.45	7.02	0.84	1.82
180 days (D_6)	41.87	7.42	0.82	1.74
F test	*	*	*	*
S.Em (±)	0.04	0.00	0.00	0.00
CD at 5%	0.13	0.02	0.00	0.02
Interaction				
$W_1 \times D_1$	40.36	6.12	0.97	2.07
$W_1 \times D_2$	41.56	6.24	0.95	1.82
$W_1 \times D_3$	42.43	6.47	0.94	1.71
$W_1 \times D_4$	43.10	6.83	0.91	1.63
$W_1 \times D_5$	44.36	7.45	0.87	1.46
$W_1 \times D_6$	45.53	8.05	0.85	1.31
$W_2 \times D_1$	40.39	6.05	0.97	2.18
$W_2 \times D_2$	41.10	6.12	0.95	1.92
$W_2 \times D_3$	42.30	6.24	0.92	1.80
$W_2 \times D_4$	42.56	6.82	0.88	1.72
$W_2 \times D_5$	43.20	7.17	0.85	1.62
$W_2 \times D_6$	44.00	7.91	0.80	1.58
$W_3 \times D_1$	40.26	6.04	0.95	2.23
$W_3 \times D_2$	41.16	6.14	0.92	2.07
$W_3 \times D_3$	42.03	6.27	0.88	2.01
$W_3 \times D_4$	42.82	6.82	0.85	1.91
$W_3 \times D_5$	43.21	7.20	0.83	1.85
$W_3 \times D_6$	43.96	7.90	0.80	1.75
$W_4 \times D_1$	40.36	6.14	0.95	2.20
$W_4 \times D_2$	41.28	6.54	0.89	2.05
$W_4 \times D_3$	42.52	7.03	0.84	1.96
$W_4 \times D_4$	43.02	7.10	0.80	1.88
$W_4 \times D_5$	43.21	7.31	0.77	1.81
$W_4 \times D_6$	43.96	7.33	0.73	1.72
$W_5 \times D_1$	40.30	6.14	0.96	2.23
$W_5 \times D_2$	41.50	6.23	0.94	2.18
$W_5 \times D_3$	42.70	6.45	0.92	2.14
$W_5 \times D_4$	43.76	6.93	0.88	2.07
$W_5 \times D_5$	44.26	7.03	0.85	2.06
$W_5 \times D_6$	44.63	7.23	0.83	2.01
$W_6 \times D_1$	40.21	6.01	0.97	2.26
$W_6 \times D_2$	40.83	6.33	0.93	2.28
$W_6 \times D_3$	41.38	6.96	0.91	2.17
$W_6 \times D_4$	42.36	7.17	0.90	2.15
$W_6 \times D_5$	43.06	7.42	0.89	2.11
$W_6 \times D_1$	43.93	7.51	0.88	2.08
F test	*	*	*	*
S.Em (±)	0.11	0.02	0.00	0.02
CD at 5%	0.89	0.06	0.02	0.05

Table 2 : Contd…

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An upward trend in pH during storage of watermelon squash was noticed. A corresponding decrease in acidity of squash could be responsible for change in pH. Similar trend was observed by Bhatnagar *et al*. (1984) in muskmelon jam and Reddy and Chikkasubbanna (2009) in amla syrup.

Acidity of watermelon squash decreased during storage period.This could be attributed to acid hydrolysis of polysaccharides and non-reducing sugars to hexose sugars (reducing sugars) or complexing in the presence of metal ions. Analogous observations were recorded by Bawa and Bains (1977) in watermelon nectar and Teotia *et al*. (1997) in nectar prepared from enzyme clarified muskmelon juice.

A declining trend in the ascorbic acid content of watermelon squash was noticed during storage. The decline in ascorbic acid concentration could be due to thermal degradation during processing and subsequent oxidation in storage as it is very sensitive to heat, pressure treatment, and light (Brock *et al*., 1998). Similar trend of declining in ascorbic content of stored products was noticed by Katiyar *et al*. (1967) in muskmelon jam and nectar and Lester and Nella (2000) in watermelon nectar.

Viscosity increased with increased concentration of xanthan gum in watermelon squash (Table 3). This behavior is attributed to the intermolecular interaction or entanglement, increasing the effective macromolecule dimensions and molecular weight (Garcia-Ochoa *et al*., 2000).There was

Table 3 : Variation in viscosity with varied levels of xanthangum at three levels of temperature (30^{0}C, 40^{0}C and 50^{0}C) in watermelon squash

Xanthangum levels (%)	Viscosity(pa-sec)		
	Temperature (in °C)		
	30	40	50
0.0 (W_1)	0.110	0.073	0.050
0.1 (W_2)	0.343	0.217	0.100
0.2 (W_3)	0.847	0.530	0.250
0.3 (W_4)	1.407	1.110	0.807
0.4 (W_5)	1.657	1.227	0.880
0.5 (W_6)	2.433	2.033	1.247
F test	*	*	*
S.Em (±)	0.00	0.00	0.00
CD at 5%	0.02	0.02	0.02

significant decrease in viscosity as temperature increased at different levels of xanthan gum. Loss of viscosity on heating was reported by Rao *et al.* (1981).

The separation of serum (watery layer) and settlement of pulp particles at the bottom of bottles was noticed in the treatments W_1 (25% of pulp, 40^0 Brix TSS, 1% acidity, 0% of xanthan gum level) and W_2 (25% of pulp, 40^0 Brix TSS, 1% acidity, 0.1% of xanthan gum). Doodnath and Badriel (2000) reported that on reducing the percentage of xanthun gum from 0.25 per cent in the preliminary treatments to 0.10 per cent resulted in separation of the suspension into layers within 16 hrs of bottling.The addition of 0.2 per cent , 0.3 per cent , 0.4 per cent and 0.5 per cent of xanthan gum to watermelon squash treatments W_3, W_4, W_5 and W_6, respectively resulted in the stability of the suspension up to 180 days experimental storage.

Squash containing 0.2 per cent xanthan gum, 25 per cent pulp, 40^{0}B TSS and 1 per cent acidity was adjudged the best for overall acceptability by organoleptic evaluation panel at 180 days of storage period (Table 4).Watermelon squash prepared with different treatment combinations was found completely free from spoilage due to higher total soluble solids (40°Brix) and effective processing of the product.

Table 4: Organoleptic scores of watermelon squash at 180 days of storage

Xanthan gum levels (%)	Organoleptic scores			
	Aroma and flavor	Colour and appearance	Taste	Overall acceptability
0.0 (W_1)	1.25	2.50	1.81	1.31
0.1 (W_2)	3.00	2.50	3.12	2.12
0.2 (W_3)	3.16	3.81	3.42	3.41
0.3 (W_4)	3.18	3.22	3.28	3.20
0.4 (W_5)	3.20	3.77	2.93	2.97
0.5 (W_6)	3.25	3.10	2.18	2.75
F test	*	*	*	*
S.Em (±)	0.09	0.10	0.07	0.06
CD at 5%	0.27	0.29	0.20	0.17

Addition of xanthan gum to watermelon squash resulted in stability, improved appearance and mouth feel of the product.

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