

Sensory Analysis on Steeping Methods of Preservation of Broccoli var. Sadhana

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Abstract- The research work was taken up to study the sensory characteristics of broccoli var. Sadhana preserved by steeping methods in the region of Mohanpur, West Bengal. Different steeping solutions were prepared by formulating 5% brine, 8% glacial acetic acid and 1000ppm KMS (potassium metabisulphite). Broccoli samples were prepared by hot water blanching (30 seconds), steam blanching (1 minute) and microwave blanching (800Watt) for 30 seconds and preserved in steeping solution for storage and sensory analysis for colour, texture, smell, taste and overall acceptability were carried out during the 5 months storage period. The highest score for smell, taste and overall acceptability was recorded in broccoli microwave blanched and steeped in 5% brine + 8% glacial acetic acid + 1000KMS during the four months storage period.

Keywords:- Broccoli, brine, colour, glacial acetic acid, smell, taste, texture

I. INTRODUCTION

Broccoli is one of the highly perishable crops which has a very short shelf life. The season of availability of this crop is very short so it becomes very important to preserve it for offseason. Broccoli can grow well during winter season in India. So there is good scope for export during this period if grown abundantly to Gulf and other developed countries with unsuitable climatic conditions [1]. Broccoli is a highly priced vegetable and famous for its vitamin, antioxidants and anticancerous content and health promoting phytochemicals [2]. Broccoli contains on an average 1.20-6.24 μ mol of glucosinolates/g fresh weight [3].

Preservation of fruits and vegetables in a steeping solution involving permissible chemical preservatives and other food additives is one of the easiest and cheapest processing technologies in developing countries like India. Brining or salting is the oldest and cheapest way of preserving vegetables, meat, fish and other foods whilst maintaining a fair amount of their nutritional value [4]. Steeped products can be utilised further for making various value-added products. Preserved material can be stored for 6-8 months at ambient temperature and beyond one year at low temperature (1-3°C) for the preparation of various products. So, the research work was carried out to preserve broccoli in steeping solutions to determine the best steeping solution by studying the sensory characteristics of the product during the storage.

II. MATERIALS AND METHOD

Broccoli cv. Sadhana grown in the Horticultural Research Farm, Mondouri, WB was collected for the study carried out in the laboratory of the department of Post Harvest Technology of Horticultural Crops, Bidhan Chandra Krishi Viswavidyalaya, WB. Broccoli cv. Sadhana were harvested when they were fully grown but tender and dark green in colour with unopened florets weighing about 500-600g and brought to the laboratory immediately. Leaves were trimmed and cooled to room condition for 3 hours. Fresh broccoli heads were chopped into pieces (4 \times 2.5cm² dimension) along with the stalk and blanched by different methods separately filled in steeping preservative solutions as stated below:

T₁ – Hot water blanching for 30sec followed by steeping in 5% brine solution

T₂ - Hot water blanching for 30sec followed by steeping in 5% brine solution + 8% glacial acetic acid

T₃ - Hot water blanching for 30sec followed by steeping in 5% brine solution + 8% glacial acetic acid + 1000 ppm KMS

T₄ - Steam blanching for 1 min followed by steeping in 5% brine

T₅ - Steam blanching for 1 min followed by steeping in 5% brine + 8% glacial acetic acid

T₆ - Steam blanching for 1min followed by steeping in 5% brine + 8% glacial acetic acid + 1000ppm KMS

T₇ – Microwave blanching in 800W (ordinary oven) for 30 sec followed by steeping in 5% brine

T₈ - Microwave blanching in 800W (ordinary oven) for 30 sec followed by steeping in 5% brine + 8% glacial acetic acid

T₉ - Microwave blanching in 800W (ordinary oven) for 30 sec followed by steeping in 5% brine + 8% glacial acetic acid + 1000ppm KMS

Blanched pieces were then dipped in cool running water and spread evenly on a plate lined with tissue paper for few minutes under fan to remove excess moisture, after which they were immersed in jars filled with steeping solutions prepared from boiled and cooled filter water and the following solutions were made and filled.

The jars were sealed properly and stored in dark room for 5 months with temperature ranging from 19-38.9°C and RH 100-79% during the storage period.

III. SENSORY ANALYSIS

Sensory evaluation for colour, smell, texture, taste, browning and overall acceptability (5 point Hedonic scale) were recorded at regular interval during the entire storage

period [5]. The scores for each parameter were randomly collected from students in the college campus in respect to the score card being formulated for the analysis of the product.

A. Colour

- 5 = green
- 4 = light faded
- 3 = moderately faded
- 2 = very much faded
- 1 = extremely faded

B. Texture

- 5 = intact
- 4 = bit intact
- 3 = soft
- 2 = very much soft
- 1 = extremely soft

C. Smell

- 5 = acceptable
- 4 = slightly acceptable
- 3 = moderately acceptable
- 2 = dislike
- 1 = extremely dislike

D. Taste

- 5 = acceptable
- 4 = slightly acceptable
- 3 = moderately acceptable
- 2 = dislike
- 1 = extremely dislike

E. Overall acceptability

- 5 = acceptable moderately
- 4 = acceptable slightly
- 3 = neither acceptable nor unacceptable
- 2 = unacceptable slightly
- 1 = unacceptable moderately

IV. STATISTICAL ANALYSIS

Score for various sensory value were analysed by completely randomised design (CRD) for three replications for each treatment.

V. Results and Discussion

A. Colour

Colour score decreased progressively during the storage of steeped broccoli in Table 36 irrespective of the types of blanching methods and the steeping solutions. However, treatments consisting of 5% brine + 8% GAA+1000 ppm KMS reduced the rapid decrease of colour score as compared to those using only 5% brine. All treatments gave significant effect on the colour score of steeped broccoli during the storage period. However, microwave blanched broccoli + 5% brine+8%GAA+1000ppm KMS (T₉) gave the highest scores of 4.73 and 4.47 on 3 and 4days after storage, respectively followed by hot water blanched broccoli + 5% brine + 8% GAA+1000 ppm KMS (T₃) during the storage study while the minimum score of 4.10 was noted in steam blanched broccoli + 5% brine+8%GAA (T₅) on the 4th month of storage.

Just after blanching the colour of broccoli was visually observed to be bright green colour. The brightening of the green colour after blanching is due to the elimination

of intracellular air and ingres of blanch water and cellular fluids as a result of cell disruption. The addition of acid during the equilibration process had a profound effect on green colour producing an olive green colour. The addition of citric acid sufficiently lowered pH to induce and accelerate pheophytinization [6]. Pheophytinization is a process wherein two H⁺ ions displace Mg⁺⁺ from the porphyrin ring of chlorophyll, and convert chlorophyll (green) into pheophytin (olive green). This acid effect was most detrimental to broccoli colour.

Green colour was maintained for all the treatments during the storage period except it T₄ (steam blanching + 5% brine) except which showed the lowest score of 3.73 at the end of storage. The combination of 5% brine and 8% GAA with 1000ppm KMS gives the best colour for every type of blanching given. The common way of preventing enzymatic browning in fruits and vegetables was achieved by dipping or immersing them in antibrowning agents[7]. It was mentioned that microwave blanching preserves better the nutritional value of the product [8].

Smell

Table 1 indicated the score for smell decreased steadily during the storage of steeped broccoli irrespective of the blanching and the steeping solutions. However steeped broccoli reduced the smell score in storage as compared to that which used only 5% brine. During the last month, the smell score was maximum in microwave blanched broccoli + 5% brine+8% GAA+ 1000 ppm KMS (T₉) with 3.77 on 4 MAS followed by steam blanched broccoli + 5% brine+8%GAA (T₅) while the lowest score of 2.57 was recorded in steam blanched broccoli+ 5% brine (T₄) on 4(MAS) month after storage. Decreasing trend of smell score was found during the storage period. The highest smell score of 3.77 was retained in T₉ (MWB+ 5% brine+8% GAA+ 1000 ppm KMS) at the end of storage. Acidic smell was prominent among the good sample which can be removed by washing in plain water. Most of the aroma came from acetic acid which consists of numerous volatile and heterogenous chemicals that easily evaporate at ambient [9].

Texture

Table 1 showed the decreasing trend of smell score during the storage period. There was significant change of texture due to different blanching and steeping solutions used. Steeping blanched broccoli with 5% brine, 8% GAA and 1000ppm KMS resulted in higher texture score as compared to those where only 5% brine was used. The highest score of 4.53 was recorded in steam blanched broccoli + 5% brine+8% GAA+1000ppm KMS (T₆) on the last month of storage followed by microwave blanched broccoli + 5% brine+8% GAA+1000ppm KMS (T₉) while the lowest score in steam blanched broccoli+ 5% brine (T₄) on 4MAS.

The texture remained good in all the treatment combinations having 5% brine + 8% GAA+1000 ppm KMS irrespective of type blanching done. However, among the treatments, the best was obtained in T₃ (HW blanching + 5% brine + 8% GAA+1000 ppm KMS) at the end of storage. There was some evidence that acidified vegetables retain a better texture than non-acidified ones in turnip so acidification contributed to retention of firmness[10]; in vegetables [11] and in carrots [12].

B. Taste

From Table 2, it was indicated that various steeping solutions had significant effect on the taste score of steeped broccoli during the storage study. The taste score reduced with the progress of storage days. Combination of various steeping solution reduced the rate of decrease of taste score as compared to those where only 0.5% brine was used as steeping solution and combined steeping solution was observed to be more effective than only 0.5% brine in reducing the decrease of taste score. The highest taste score (4.90 to 3.70) throughout the storage period was noted in microwave blanched broccoli + 5% brine+8% GAA+1000ppm KMS (T₉) followed by 3.63 in steam blanching +5% brine+8%GAA+1000ppm KMS(T₆) while the least score was observed in taste score that the highest score for taste on month 1 was evident in T₃ (HW blanching + 5% brine + 8% GAA+1000 ppm KMS) with 4.77 followed by), and T₈ (MWB+ 5% brine+8%GAA) having score of 4.73, 4.70 and 4.60 respectively while the lowest score was in steam blanched broccoli+ 5% brine (T₄) which reduced from score 5 to 2.33 throughout the storage period.

At the end of storage, the best taste score (3.70) was in MWB+5% brine+8% GAA+1000ppm KMS (T₉). Taste also remained moderately acceptable for hot water blanching + 5% brine + 8% GAA+1000 ppm KMS (T₃) among other treatment of hot water blanched and steam blanching+5% brine+8%GAA+1000ppm KMS (T₆) among the steam blanched broccoli treatments. Pretreatment of brussels sprout by microwave (700 watt for 5minutes) have been effective for preserving product properties compared to hot water blanched (100°C for 3 minutes) [13].

C. Overall acceptability

Steeping method gave significant effect on overall acceptability score of broccoli during the storage period in Table 2. The score decline with the advance in storage period. With the inclusion of all the steeping solution, the rate of decrease of score was lower as compared to those where only brine solution was used. Among different treatments of blanching and steeping methods, microwave blanching and steeped in 5% brine along with 8% GAA and 1000ppm KMS gave the highest score on the last month of storage followed by steam blanched broccoli and steeped in 5% brine, 8% GAA and 1000ppm KMS and broccoli hot water blanched and steeped with 5% brine, 8% GAA and 1000ppm KMS with scores 4.50, 4.43 and 4.37, respectively on 4th month. There was no visible decay in the samples during the period of study. The high acidic condition due to GAA maybe responsible for the inhibition of any microbial growth. The lower value of acceptance may also be related to the bitterness of cruciferous crop [14]. One objective of the acidification is to prevent growth of *Clostridium botulinum* which does not produce toxin at pH below 4.6 [15]. No visual evidence of spoilage was found in acidified vegetable packs for 60 days storage when examined for turbidity, gas production and mould growth visually while chemical test showed no lactic acid or ethanol in the sample [16].

VI. CONCLUSION

Among the various steeping preservative solution for broccoli during the 5 months storage period study, it was

found that broccoli blanched in microwave(800Watt) for 3 minutes and steeped in brine solution with glacial acetic acid with 1000ppm KMS gave the best sensory score (overall acceptability) followed by broccoli blanched in steam and hot water with same steeping preservative solution. Consumer preference is always directed towards the colour, texture and appearance of any product. This method could prove to be an alternative method to prevent the loss during glut season of broccoli which could otherwise contribute to the post harvest loss while at the same time ensure the availability during the offseason if the preservation could be done in the steeping solution without much loss in the sensory characteristics.

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Fig.1. Samples of broccoli steeped in different steeping preservative solutions.

Table 1: Effect of steeping method for preservation of broccoli var. Sadhana on sensory characteristic for colour, smell, texture, taste and overall acceptability during storage period

Treatment	Sensory evaluation of colour				Smell				Texture			
	Months in storage				Months in storage				Months in storage			
	1	2	3	4	1	2	3	4	1	2	3	4
T ₁ (HW blanching + 5% brine)	4.90	4.77	4.5	4.00	4.93	4.60	4.07	3.23	5.00	4.27	4.37	3.83
T ₂ (HW blanching + 5% brine +8%GAA)	4.83	4.80	4.47	4.30	4.93	4.60	4.23	3.20	4.87	4.73	4.67	4.40
T ₃ (HW blanching + 5%brine+8%GAA+1000ppmKMS)	4.87	4.77	4.67	4.37	4.97	4.53	4.17	3.43	4.97	4.83	4.77	4.63
T ₄ (SB+ 5% brine)	4.83	4.77	4.37	3.73	4.97	4.47	3.80	2.57	4.87	4.27	4.20	3.80
T ₅ (SB+ 5% brine+8%GAA)	4.83	4.77	4.40	4.10	4.90	4.57	4.20	3.63	4.90	4.57	4.47	4.20
T ₆ (SB+ 5% brine+8%GAA+1000ppm KMS)	4.87	4.60	4.53	4.30	5.00	4.73	4.43	3.60	4.90	4.83	4.77	4.53
T ₇ (MWB+ 5% brine)	4.87	4.80	4.67	4.27	4.90	4.47	3.93	2.93	4.97	4.00	4.17	3.97
T ₈ (MWB+ 5% brine+8%GAA)	4.87	4.73	4.60	4.27	4.90	4.63	4.20	3.20	4.90	4.57	4.53	4.43
T ₉ (MWB+ 5% brine+8%GAA+1000ppm KMS)	4.87	4.77	4.73	4.47	4.90	4.77	4.47	3.77	4.90	4.77	4.63	4.50
SEm±	0.04	0.04	0.4	0.12	0.04	0.08	0.11	0.19	0.44	0.09	0.06	0.08
CD(P=0.05)	NS	0.13	0.33	0.38	NS	NS	0.32	0.59	NS	0.29	0.19	0.25

Colour score: 5 = green; 4 = light faded; 3 = moderately faded; 2 = very much faded; 1 = extremely faded

Smell score: 5 = acceptable; 4 = slightly acceptable; 3 = moderately acceptable; 2 = dislike; 1 = extremely dislike

Texture score: 5 = intact; 4 = bit intact; 3 = soft; 2 = very much soft; 1 = extremely soft, NS= non significant, Sem=Standard error of mean, CD= Critical difference

Table 2: Effect of steeping method for preservation of broccoli var. Sadhana on taste and overall acceptability during storage period

Treatment	Sensory evaluation of taste				Overall acceptability			
	Months in storage				Months in storage			
	1	2	3	4	1	2	3	4
T ₁ (HW blanching + 5% brine)	4.93	3.97	3.27	2.87	4.93	4.43	4.27	4.13
T ₂ (HW blanching + 5% brine +8%GAA)	4.93	4.53	3.67	3.23	4.93	4.57	4.33	4.20
T ₃ (HW blanching + 5% brine +8%GAA+1000ppmKMS)	4.97	4.70	3.93	3.53	4.97	4.67	4.57	4.37
T ₄ (SB+ 5% brine)	4.97	4.10	3.17	2.33	4.97	4.23	4.00	3.90
T ₅ (SB+ 5% brine+8%GAA)	4.90	4.53	3.27	3.23	4.90	4.30	4.07	4.00
T ₆ (SB+ 5% brine+8%GAA+1000ppm KMS)	5.00	4.73	3.93	3.63	5.00	4.70	4.60	4.43
T ₇ (MWB+ 5% brine)	4.90	4.27	3.00	2.73	4.90	4.23	4.17	4.07
T ₈ (MWB+ 5% brine+8%GAA)	4.90	4.60	3.37	3.07	4.90	4.57	4.43	4.27
T ₉ (MWB+ 5% brine+8%GAA+1000ppm KMS)	4.90	4.77	4.20	3.70	4.90	4.77	4.73	4.50
SEm±	0.04	0.06	0.12	0.13	0.04	0.07	0.04	0.06
CD(P=0.05)	NS	0.18	0.37	0.40	NS	0.20	0.13	0.18

*Score for taste : 5 = acceptable; 4 = slightly acceptable; 3 = moderately acceptable; 2 = dislike; 1 = extremely dislike

Score for overall acceptability: 5 = acceptable moderately; 4 = acceptable slightly; 3 = neither acceptable nor unacceptable; 2 = unacceptable slightly; 1 = unacceptable moderately; NS=non significant, Sem=Standard error of mean, CD= Critical difference