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IMPACT OF DIFFERENT BAKING TEMPERATURES FOR ON BAKING QUALITY OF PLUMS STORED UNDER LOW TEMPERATURE REGIME FOR PLUM CAKE

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ABSTRACT

European plum (Prunus domestica L.) fruits harvested freshly and stored at 2°C for 4 weeks were subjected to baking tests at weekly interval to assess the effect of low temperature and duration of storage on baking quality of plums. Fruits were cut half along longitudinal axis and baked in baking cups (size 3.25 x 5 cm) at 120°C, 150°C, 180°C for 60, 40 and 20 minutes, respectively. Plums baked at 120°C and 180°C could not attain desired condition and were unacceptable. Fruits baked at 150°C for 40 minutes were further assessed for sap loss, hue angle, total soluble solids (TSS), acidity and ascorbic acid. Fruits lost more than 50% fruit sap while baking. Maximum sap loss (66.12%) was recorded from fruits stored for 2 weeks at 2°C. Hue angle of plum fruits decreased from 73.46 (initial) to 65.41 (after 4 weeks of cold storage (before baking). Mean TSS increased from 15.66% (before baking) to 61.30% (after baking). Fruit acidity increased from 0.97% (before baking) to 11.92% after baking. A mean ascorbic acid content of 28.84 mg/100g fresh fruit was recorded during storage (before baking) which could not be detected after baking. During sensory evaluation it was observed that that plum fruits stored for 3 weeks at 2°C are more suited for baking.

KEYWORDS: Baking temperature, Plum cake, Quality, Sensory evaluation

INTRODUCTION

Plum is one of the important stone fruit crops of the world. *Prunus domestica* is the most significant source of commercial plum cultivars and said to be native of Eastern Europe or Western Asia. It is a delicious juicy fruit prized for its exquisite sweet-sour taste. The fruit is used mainly for table purpose and to small extent for drying purpose. In European countries, plum cake is very popular. Being soft and fleshy, plums exhibit short shelf life. Cold storage is one of the most popular methods to extend the duration of its availability. The objective of this experiment was to assess the effect of duration of storage on baking quality of plums.

MATERIALS AND METHODS

Fully mature European plum (cv. Hauszwetschge) fruits harvested fresh and were stored at 2°C. Fruits were cut open along longitudinal axis in two halves and subjected to baking tests at 120°C for 1hr, 150 °C for 40 min and 180°c for 20 minutes in baking cups (size 3.25 x 5cm). Plums baked at 120°C and 180°C were in unacceptable state thus further analysis were carried on plums baked at 150°C. The tests were performed at Institut für Gartenbauwissenschaft, Universität Bonn, Bonn (Germany). Sap loss (%) was calculated as ((Weight of fruit before baking – weight of fruit after baking)/ fresh weight of fruit) x100)).Hue angle (in degrees) is measure of an objects colour in a* - b* plane and was calculated as ((180/pi) x ($\cos^{-1}$(a*/C*))), where a* represents green-red axis, b* represents yellow – blue axis and C* is the chroma value (Sacks and Francis, 2001). Total soluble solids (TSS), acidity and ascorbic acid were assessed as per A.O.A.C. methods Plum baking quality was assessed on 10 sensorial traits (Table 3) on a 1 to 5 point scale (i.e. low to high). Each trait was assigned a multiplication factor (1 to 3) to highlight its importance in assessment. Overall assessment (mean score) was calculated as (sum of each single quality trait/Total number of traits). There were 10 judges in the panel for assessment (Rein-Schaub *et al.*,1988).

RESULTS

Sap loss (%)

Sap loss of more than 50% was recorded from fresh fruits when baked (54.86%, Table 1). Amount of sap lost during baking test increased upto 2 weeks of storage and then decreased thereafter. Maximum sap loss (66.12%) was observed from plums stored at 2ºC for 2 weeks. This could be due to the reason that during the process of ripening after harvest, tissue and cell

structure softening might be there. Soft cells responded to heat and got ruptured releasing the sap easily but at later stage there might be some hardening due to persisting evaporational loss giving a concentration effect and leading to less release of sap from damaged tissue (Rein-Schaub et al., 1988).

Change in colour pigments

The change in colour pigments during storage was assessed as change in hue angle of fruit flesh (Table 1). Plum fruits have been reported to be rich in anthocyanin pigments and carotenoids which imparts true colour to the fruit (Gross, 1984). Hue angle of stored plums was found decreasing after 1 week of storage upto 4^{th} week. Before baking, fruits exhibited a hue angle of 73.46 (initial) which reduced to 65.41 after 4 weeks of storage at 2ºC. The results are in conformity with findings of Wesche-Ebeling et al. (1996). Colour measurements after baking could not be recorded due to sticky condition of baked plums.

Total soluble solids

Fresh fruits exhibited total soluble solids content of 14.95% (Table 2). TSS was found increasing with increasing duration of cold storage.The increase in TSS of fruits (before baking) might be due to conversion of insoluble carbohydrates to soluble sugars (Dundar et al., (1997). TSS content of plum fruits after baking also showed increasing trend i.e. from 54.74% (week 0) to 65.23% (week 4), although increase being statistically non-significant. Mean TSS of baked plums (61.30%) was significantly higher than mean TSS content (15.66%) before baking. This could be attributed to concentration effect of cell sap after excessive moisture depletion at higher temperature (Rein and Schaub, 1988 and Dikeman et al., 2004).

Acidity

Fresh fruits exhibited acid content of 1.21% (Table 2). Acidity was found decreasing with increasing in duration of storage; however a significant increase in mean acidity (11.92%) was observed in plum fruits after performing baking tests as compared to 0.97% acidity content in fruits before baking. Decrease in acidity could be attributed to utilization of acids as respiratory substrates or to some extent conversion into simple sugars (Pool et al., 1972). After baking, mean acidity content was more than 11% which could be attributed to concentration of juice to high moisture loss during baking (Rein and Schaub et al. (1988).

Ascorbic acid

Fresh European plum fruits exhibited 25.70 mg ascorbic acid per 100g fresh fruit weight (Table 2). Ascorbic acid content was found increasing upto 2nd week of storage (36.11 mg/100g fruit) followed by gradual decrease. Increase in ascorbic and may be attributed to conversion of sugars in ascorbic acid as sugars are reported to be precursor of ascorbic acid (Srinivasan et al., 1973). Decrease in ascorbic acid may be due to enzymatic oxidation of L-ascorbic acid to dehdyro-ascorbic acid (Mapson, 1970). Ascorbic acid was not detected in baked plums. Ascorbic acid is known to be highly heat sensitive thus might have been destroyed completely during process of baking at high temperature.

Sensory evaluation

Highest score for harmony, overall acceptance and highest mean score for baked plums was recorded from fruits subjected to baking after 3 weeks of storage at 2ºC (10.20, 13.20 and 9.88, respectively, Table 3).

CONCLUSIONS

The results of present experiment indicated that duration of cold storage affects the quality of plum cake. Longer storage periods were accompanied by increase in sweetness and decrease in acidity giving highest scores for sugar-acid blend and overall acceptance. The plum fruits stored for about 3 weeks were more preferred for baking plum cake as compared to fresh harvested fruits.

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Table 1: Effect of baking on European plum cv. Hauszwetschge on amount of sap loss and change in colour pigments

Week in storage	Sap Loss (%)	Hue angle	
	After Baking	**Before Baking**	**After Baking**
0	54.86	73.46	- NA -
1	59.00	75.49	- NA -
2	66.12	73.64	- NA -
3	63.69	69.57	- NA -
4	62.15	65.41	- NA -
Mean	**61.27**	**71.61**	
CD at 5 %	4.36	3.79	

NA: Not available as it was difficult to take colorimetric assessments after baking owing to sticky condition of plums.

Table 2: Effect of baking on European plum cv. Hauszwetschge on total soluble solids, acidity and ascorbic acid

Week in storage	Total Soluble Solids (%)		Acidity (%)		Ascorbic acid (mg/100 g fruit)	
	BB	**AB**	**BB**	**AB**	**BB**	**AB**
0	14.95	54.74	1.21	13.92	25.70	- NA -
1	15.34	59.92	1.10	13.20	27.49	- NA -
2	15.85	62.52	0.93	11.01	36.11	- NA -
3	16.05	64.12	0.84	10.85	31.71	- NA -
4	16.11	65.23	0.78	10.60	23.19	- NA -
Mean	**15.66** [a]	**61.30** [b]	**0.97** [a]	**11.92** [b]	**28.84**	
CD at 5 %	0.31	NS	0.06	NS	1.56	

NA: Not available, BB: Before baking, AB: After baking

For Mean TSS and Acidity columns with different letters indicate significant difference at p=0.05% (Tukey HSD[ab] test, SPSS ver. 11.0))

Table 3: Sensory evaluation score card of baked plums

Quality traits	Week in storage at 2ºC				
	0	**1**	**2**	**3**	**4**
1. Optical assessment	9.55	10.64	11.18	11.73	11.45
2. Wateriness	9.00	11.18	12.27	12.00	10.09
3. Skin taste	3.70	3.80	4.20	4.00	3.30
4. Flesh firmness	4.80	5.60	7.60	6.00	4.60
5. Juiciness	4.60	5.40	5.80	7.00	7.60
6. Aroma	9.60	10.50	12.60	11.40	9.90
7. Sweetness	10.20	10.80	12.00	11.70	10.80
8. Sourness	6.30	7.20	9.90	10.20	9.30
9. Harmony (sugar/acid blend)	6.90	9.60	10.20	12.60	9.30
10. Overall acceptance	9.00	9.90	11.40	13.20	9.30
ean score	**7.36**	**8.46**	**9.72**	**9.98**	**8.62**