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Studies on Hot Water Treatment under Different Storage Conditions to Extend the Post-Harvest Life of Rasthali (Silk) Banana

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KEYWORDS

Hot Water Treatment, Rasthali Banana, Hard Lumps, Green Life

ABSTRACT:

Hot water treatment has lowered the disease incidence in Rasthali banana. Among the different temperature levels, treatment level at 54ºC recorded the longest green life (18.80 days) and the shortest in the fruits in control (15.50 days) when packed in 200 gauge polyethylene bag. The total soluble solids content was reduced due to hot water treatment (24.62-25.08º Brix) than control (25.48º Brix). The physiological loss in weight was higher in hot water treated fruits than untreated control. In sensory evaluation, the panelists indicated that the skin colour appearance was the best at 50 and 52º C and the fruits in control. The disease index was lower (2.00 to 16.00 per cent) in hot water treated fruits than in untreated control (20.00 per cent). The lowest hard lumps score (1.10) was recorded in 52ºC and 54ºC and the highest score in control (2.30). It was found that under ambient storage condition, hot water treatment at 54ºC scored the highest (4.40) over all acceptability and the lowest in control (2.20).

1. Introduction

The use of medicinal plants emerges as an alternative to synthetic products, which are used not only in traditional medicine but also in a number of food and pharmaceutical industries, due to their nutritional properties and bioactivity (1). Higher plants produce a great variety of secondary products. Although, some of the natural products have been replaced by synthetic substitutes because of cost considerations, a number of commercially important high value chemicals are still being extracted from plants (2,3).The modern pharmaceutical industry is thus still looking for new active compounds from plant secondary metabolites (4).

*Scrophularianodosa*is one of the homeopathic medicines used for the various disorders. It belongs to family Scrophulariaceae and genus Scrophularia. More than 200 species, mostly perennials, make up the genus. The upright stems often resemble those of the Lamiaceae family because they carry lobed blooms and have square, opposite leaves. The terminal branched flowerheads with larger staminodes (non-fertile stamens) and distinctive seed casings are characteristics of Scrophularia species Various species from this genus have been used for traditional medicine. These species were *Scrophularianingpoensis*, *Scrophulariavariegate*, *Scrophularianodosa*, *Scrophulariagrossheimii*, *Scrophulariacanina*, *Scrophulariaoldhamii*, etc. *Scrophularianingpoensis*Hemsl., is extensively used for many inflammatory diseases in traditional Chinese medicine (6,7,8). It is also registered in the Chinese Pharmacopeia against febrile diseases with excessive thirst or eruptions, skin disorders, cough due to exhaustion, constipation, and conjunctivitis (9). Similar activities were reported by other species of Scrophularia such as *Scrophularia auriculata* L. or *Scrophularia canina* L. from the Mediterranean area (10,11,12).In the traditional Iranian medicine, *Scrophularia variegata* M. Bieb. And *Scrophularia striata* Boiss.were used since long time (13,14).

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In Turkish traditional medicine, *Scrophularia nodosa* L. was reported to have diuretic properties, use to treat hemorrhoids, psoriasis, pruritus, wound healing, eruptive skin diseases, and eczema (17,18). Similar activity were also reported for *Scrophularia depauperata* Boiss., *Scrophularia cryptophila* Boiss. et. Heldr. Boiss., and *Scrophularia floribunda* Boiss. et. Bal. in Turkish traditional medicine (19). *Scrophularia oldhamii* Oliv. and as a diuretic for *Scrophularia grossheimiiSchischkin* were evaluated as antipyretic and anti-inflammatory agent (15). The active components were detected by various methods from *Scrophularia* species (23). Phenylpropanoidverbascoside were detected in many species of the Scrophulariaceae family (20,21,22,23). In the present study, the secondary metabolite profiling was carried out using liquid chromatography coupled with mass spectroscopy. Both positive and negative modes were used for metabolite screening.

Even while the Cavendish dominates the international market (10% of worldwide output), the situation is increasingly shifting with the advent of various locally developed unique cultivars. Banana cultivars such as Ney Poovan, Rasthali (Silk), Red banana, Surya Kadali (Pisang Mas), and Nendran (French plantain) have created export potential to Europe, the Gulf, and Japan (Sathiamoorthy, 1995), and vigorous promotion of certain of these indigenous banana varieties can still get a big slice of pie.

Silk (AAB) is a commercial cultivar spread over West Bengal (Mortman); Tamil Nadu (Rasthali); Andhra Pradesh (Amirthapani); Kerala (Poovan); Karnataka (Rasabale); and Bihar (Malbog). It is significant in commercial production with 3.79 per cent in area and 3.77 per cent in production of total area and production by different cultivars of banana grown in India (Singh and Chadha, 2000). Banana remains 'alive', and continues with the metabolic reactions even after harvest. However, harvested fruits must use their own resources in these metabolic processes. Banana, being a tropical and highly perishable fruit, suffers from high post-harvest losses to the extent of about 20-30 per cent (Salunkhe and Desai, 1984; Chadha, 1996; Wasker and Roy, 1996; Magdaline *et al*., 1998). The importance has been given for the need for controlling the postharvest disease control and use of user friendly chemicals in extending the postharvest life for both internal long distance transport bananas and for export trade (Singh and Chadha, 2000).

Heat treatments have been used to manage fungal infections and insect infestations in fruits for many years. Pre storage heating of fruits showed a promise as a non-chemical method for managing both pathological and physiological disorders of fruits and vegetables. Desai *et al*., (1973) demonstrated that hot water treatment at 50ºC for five minutes delayed the progress of decay caused by the common pathogens of banana cv. Mysore and Cavendish. Hot water treatments that are effective typically range in temperature from 46 to 60ºC and last 30 seconds to 10 minutes. Hot water can be useful when desiccation, hydration, and application duration are carefully managed (Golan and Phillips, 1991).

Smock (1969) discovered that Green Lacatan and Dwarf Cavendish bananas may be preserved for 7-10 days in perforated and sealed polyethylene coverings at room temperature (79-950 F). Sen *et al*. (1978) found that ripe banana fruits cv. Kalibau stored in polyethylene bags at room temperature had a shelf life of four to seven days, indicating slower changes in biochemical parameters (changes in skin chlorophyll and carotenoid concentration). Rao and Rao (1979) also recorded a greater loss in weight of fruits stored as such compared to those packed in polyethylene bags tested at room temperature and also at 15ºC.

Hence, this study was made to find the suitable temperature for hot water to treat Rasthali banana in ambient and low temperature conditions.

2. Materials and Method

In this study, Electric coil was used for heating the water at different temperature with the help of multi stem thermometer. 400 gauge low-density polyethylene bags of (30 x 26 cm) were used for packing and sealed with the help of electric sealer. For cool temperature storage, ultralow temperature cabinet was used to store at 13ºC. Banana fruits of 90 per cent maturity were harvested and brought to the laboratory immediately after the harvest. The water was constantly stirred for maintaining uniform temperature throughout the treatment period. For each treatment fruits in one hand were dipped at different temperatures for a period of five minutes and taken out. Fruits were cooled and packed in 200 gauge polyethylene bags with ordinary electric sealing machine and stored

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under ambient and low temperature conditions for observation.

Six levels of temperature (T_1-48ºC, T_2-50ºC, T_3-52ºC, T_4-54ºC, T_5-56ºC, T_6–Control) and two storage environments (1. Ambient storage (SA_1), 2. Low temperature storage (SA_2)) were used in the study. Factorial Completely Randomised Design was used to analysis with five replications.

Observations recorded

The postharvest characters like green life, soluble solids, physiological loss in weight, disease index, days taken for disease incidence, scorching injury and CO_2 injury were recorded.

Total soluble solids (TSS) were measured with an Erma Hand refractometer (ERMA INC., Tokyo, Japan, brix range of 0-32 percent in 0.2 graduations at 20°C) and expressed in ^{0}Brix. The first weight of fresh fruit was recorded, and then the weight was collected on alternating days. The physiological weight loss was calculated as shown below and reported in percentage.

$$\text{PLW (\%)} = \frac{\text{Initial weight of the fruit – final weight of the fruit}}{\text{Initial weight of the fruit}} \times 100 \quad \text{----(3.1)}$$

This is a well-defined time following harvest in which the fruits remain green (until they turn full yellow) and firm. It is also known as pre-climacteric or green life (Blake and Peacock, 1971). In polyethylene packaging tests, green life was regarded to be over when the fruits displayed beginning signs of softening, rotting, and carbon dioxide damage. The yellow life (shelf life) of fruits was determined via regular visual inspection. Shelf life was defined as the time (in days) between the start of ripening and the end of saleable life (i.e. saleable quality) or edible life (of fruit) on the shelf (Dadzie and Orchard, 1997).

There are many postharvest diseases of banana of which crown rot, anthracnose, cigar-end rot and finger rot are important. The infection caused by these organisms were identified based on their symptoms and indexed as follows (Arokiyaraj, 2000)

Observation	**Category**
No symptom	0
Restricted lesion covering 25 per cent of fruit surface	1
Large lesion covering 50 per cent of fruit surface	2
Radiating lesion formed by coalescence of small ones covering 75 per cent of fruit surface	3
Complete rotting of fruit	4

$$\text{Per cent Disease Index} = \frac{\text{Sum of all the individual ratings}}{\text{Total number of fruits}} \times \frac{100}{\text{maximum disease category}} \quad (3.2)$$

The data recorded were subjected to statistical scrutiny by analysis of variance (Panse and Sukhatme, 1967). The significance was tested by 'F' test. The SE (d) and critical difference at five per cent probability level were worked out. In cases where data could not be recorded due to phytotoxicity, the characters were analysed through simple CRD as the case may be, instead of factorial design.

3. Result And Discussion

The data generated on green life and yellow life are presented in Table 1. The green life was significantly influenced by the storage atmosphere and hot water treatments and the interaction effect was found non-significant. Irrespective of hot water treatment, storage under low temperature (13 ºC) condition increased the green life of Rasthali banana (20.87 days). Irrespective of the storage atmosphere, hot water treatment at 54ºC showed higher green life (18.80 days), which was on par with hot water treatment at 56ºC, followed by at 52ºC. The effect of hot water on yellow life was found significant with a mean of 3.27 days. However, hot water treatment at 54 and 56ºC registered the highest yellow life (3.60 days), followed by treatment at 53ºC (3.50 days).

Green life was longer (20.87 days) in low temperatures than in normal conditions (14.37 days). This might be attributed to the low temperature, which delayed the physiological activities of the fruit (respiration and ethylene synthesis) (Lebibet *et al*. 1995). The yellow life was also longer in the hot water treated fruits than the untreated fruits. The longest yellow life (3.60 days) was recorded at 54 and 56ºC. The total soluble solids content was reduced due to hot water treatment from control. This effect increased as the treatment temperature level increased. The cause might be that the heat treatment impaired starch conversion into sugar, resulting in incomplete soluble solids buildup (Dominguez *et al*.,

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1998; Cabrera and Dominguez, 1998). But in the titrable acidity, the trend was opposite in that when temperature level was increased, the acidity also increased (Zambrano and Materano, 1998). Thus clearly indicating that heat treatment slowed down and obstructed the physiological process of ripening.

The physiological weight loss of Rasthali bananas was strongly impacted by hot water treatment and storage conditions (Table 4). Regardless of hot water treatments, physiological weight loss was lower in low temperature storage (1.57%) compared to ambient storage. The physiological weight loss increased as temperature levels rose. The lowest level of water loss was observed in hot water treatment at control (1.97 per cent) and the highest at 56ºC (2.66 per cent). The physiological loss in weight was higher in hot water treated fruits than untreated control. This may be due to the physical and physiological injuries caused by the hot water (Edney and Burchil, 1967). The physiological loss in weight of the fruits in low temperature condition was lesser than in ambient condition (Lebibet *et al*., 1995). On the contrary, Nayak (1999) observed lesser physiological loss in weight in hot water treatment of Robusta banana. This could be due to the thicker skin nature of Robusta, which could tolerate heat.

Colletotrichum musae (Berk and Curtis) von Arx, causes anthracnose (fruit rot) in banana fruit. Fungicides have been used to control the diseases in banana. However, due to the emergence of fungicide-resistant strains of *C. musae,* non-chemical methods are desirable (Wilson and Wisniewski, 1989). Because the infectious agent is latent and does not emerge until the fruit ripens, disease management is extremely difficult. Postharvest heating to kill or weaken the pathogen is a pesticide-free strategy for controlling postharvest illnesses (Golan and Phillips, 1991). Tropical and subtropical fruits are mostly treated with hot water, steam, and/or chemicals, and then kept or delivered under regulated temperature or changed atmospheric conditions. (Qiubo *et al*., 1997).

As an alternative, hot water treatment was used to control the fruit rot in Rasthali banana followed by storing under ambient and low temperature conditions after packing in 200 gauge polyethylene bag.

The results revealed that hot water treatment lowered the disease incidence in Rasthali banana. The disease index was lower (2.00 to 16.00 per cent) in hot water treated fruits than in untreated control (20.00 per cent). Similar results were obtained by Cabrera and Dominguez (1998) and Reyes *et al.(*1998). Even though the disease incidence was low (2.00 per cent) at 56ºC, this treatment may not be a suitable alternative for disease control as it caused scorching injury. However, treatment at 54º C and storage under ambient condition had lower disease incidence (3.00 per cent) without scorching injury. This was in agreement with Nayak (1999) who reported that hot water treatment at 55ºC for 10 minutes controlled the disease incidence in Robusta banana.

Hot water treatment at 56ºC for five minutes resulted in skin scorching under ambient condition. Under low temperature storage, temperature levels at 54 and 56ºC were found to scorch the skin. This might be due to the reason that under low temperature, injury is expressed prominently than under the ambient condition. The temperature range of 50 to 55ºC caused peel darkening and increased the chilling sensitivity of banana (Dominguez *et al*., 1998). Armstrong (1982) reported that temperature treatment with immersion at 52.5 and 55ºC caused some fruit damage even at short period of time. Hot water treatment resulted in increased green life of Rasthali fruit. Among the different temperature levels, 54ºC recorded the longest green life (18.80 days) while the shortest was in control (15.50 days). This might be due to the reason that heat treatment which resulted in a marked decrease in the respiration rate and in ethylene production within a few hours of treatment (Klein, 1989; Ye *et al.*, 1998). Thus the heat-treated fruits had a delayed ripening. The role of hot water in delaying ripening was apparent from the fact that some heat-treated fruits fail to soften on ripening (Couey, 1989).

In sensory evaluation, the panelists indicated that the skin colour appearance was the best at 50 and 52ºC and in control. This might be due to the absence of external injuries (scorching) by hot water treatment. The texture of hot water treated fruits was harder (soft) when compared to untreated fruits (very soft). This might be due to the increased firmness of fruit as a result of increased water loss. The hot water treatment at 52 and 54 degrees Celsius had a better flavor and overall acceptance than previous treatments. In this investigation of hot water treatment to control the fruit rot of Rasthali banana, the hot water treatment at 54ºC was able to control the disease incidence and maintain the green life

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to the longest of 18.80 days when packed in a 200 gauge polyethylene bag, regardless of the storage conditions.

Table 1. Effect of hot water treatment on green life and shelf life of Rasthali banana fruits under cool and ambient storage conditions

Treatments	Green life (days)			Yellow life (days)		
	SA_1 (Ambient)	SA_2 (13ºC)	Mean	SA_1 (Ambient)	SA_2 (13ºC)	Mean
T_1 (48ºC)	13.60	20.60	17.10 ^{b}	3.00	3.20	3.10 ^{ab}
T_2 (50ºC)	14.40	20.80	17.60 ^{bc}	3.00	3.20	3.10 ^{ab}
T_3 (52ºC)	14.60	21.40	18.00 ^{c}	3.40	3.60	3.50 ^{bc}
T_4 (54ºC)	15.80	21.80	18.80 ^{d}	3.60	3.60	3.60 ^{c}
T_5 (56ºC)	15.40	22.00	18.70 ^{d}	3.60	3.60	3.60 ^{c}
T_6 (Control)	12.40	18.60	15.50 ^{a}	3.20	2.20	2.70 ^{a}
Mean	14.37 a	20.87 ^{b}	17.62	3.30	3.23	3.27

Mean values followed by a common letters are not significantly different at five per cent level

Factors	T	SA	T x SA	T	SA	T x SA
SE d	0.27	0.16	*NS*	0.21	NS	NS
CD (P=0.05)	0.55	0.32	NS	0.42	NS	NS

Table 2. Effect of hot water treatment on total soluble solids and titrable acidity of Rasthali banana fruits under cool and ambient storage conditions

Treatments	Total soluble solids (º Brix)			Titrable acidity (per cent)		
	SA_1 (Ambient)	SA_2 (13ºC)	Mean	SA_1 (Ambient)	SA_2 (13ºC)	Mean
T_1 (48ºC)	25.36	24.70	25.03 ^{ab}	0.333	0.343	0.338 ^{a}
T_2 (50ºC)	25.00	24.24	24.62 ^{a}	0.365	0.375	0.370 ^{b}
T_3 (52ºC)	25.16	24.92	25.04 ^{b}	0.386	0.397	0.391 ^{bc}
T_4 (54ºC)	25.28	24.88	25.08 ^{b}	0.397	0.429	0.413 ^{cd}
T_5 (56ºC)	25.12	24.36	24.74 ^{ab}	0.429	0.450	0.439 ^{d}
T_6 (Control)	25.56	25.40	25.48 ^{c}	0.354	0.407	0.381 ^{bc}
Mean	25.25 ^{b}	24.75 ^{a}	25.00	0.377 ^{a}	0.400 ^{b}	0.389

Mean values followed by a common letters are not significantly different at five per cent level

Factors	T	SA	T x SA	T	SA	T x SA
SED	0.19	0.11	NS	0.015	0.009	NS
CD (P=0.05)	0.38	0.22	NS	0.031	0.018	NS

Table 3. Effect of hot water treatment on sugar acid ratio of Rasthali banana fruits under cool and ambient storage conditions

Treatments	Sugar to acid ratio		
	SA_1 (Ambient)	SA_2 (13ºC)	Mean
T_1 (48ºC)	76.51	72.37	74.44 ^{d}
T_2 (50ºC)	69.33	65.14	67.24 ^{c}
T_3 (52ºC)	65.47	63.16	64.32 ^{bc}
T_4 (54ºC)	64.06	58.43	61.24 ^{ab}
T_5 (56ºC)	58.95	54.27	56.61 ^{a}
T_6 (Control)	72.67	63.04	67.86 ^{c}
Mean	67.83	62.74	65.28

Mean values followed by a common letters are not significantly different at five per cent level

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Factors	T	SA	T x SA
SE d	2.64	NS	NS
CD (P=0.05)	5.31	NS	NS

Table 4. Effect of hot water treatment on pH and physiological loss in weight of Rasthali banana fruits under cool and ambient storage conditions

Treatments	pH			Physiological loss in weight (per cent)		
	SA$_1$ (Ambient)	SA$_2$ (13ºC)	Mean	SA$_1$ (Ambient)	SA$_2$ (13ºC)	Mean
T$_1$ (48ºC)	4.22	4.26	4.24 ^{a}	2.62	1.35	1.98 ^{ab}
T$_2$ (50ºC)	4.27	4.30	4.29 ^{a}	2.77	1.43	2.10 ^{ab}
T$_3$ (52ºC)	4.35	4.41	4.38 ^{b}	2.87	1.42	2.15 ^{b}
T$_4$ (54ºC)	4.53	4.60	4.57 ^{c}	3.04	1.70	2.37 ^{c}
T$_5$ (56ºC)	4.63	4.69	4.66 ^{d}	3.25	2.07	2.66 ^{d}
T$_6$ (Control)	4.25	4.30	4.28 ^{a}	2.46	1.47	1.97 ^{a}
Mean	4.38 ^{a}	4.43 ^{b}	4.40	2.84 ^{b}	1.57 ^{a}	2.21

Mean values followed by a common letters are not significantly different at five per cent level

Factors	T	SA	T x SA	T	SA	T x SA
SE d	0.03	0.01	NS	0.08	0.04	NS
CD (P=0.05)	0.05	0.03	NS	0.15	0.09	NS

Table 5. Effect of hot water treatment on disease index, presence of hard lumps and scorching injury of Rasthali banana fruits under cool and ambient storage conditions

Treatments	Disease index (per cent)			Hard lumps (Mean scores)			Scorching Injury	
	SA$_1$ (Ambient)	SA$_2$ (13ºC)	Mean	SA$_1$ (Ambient)	SA$_2$ (13ºC)	Mean	SA$_1$ (Ambient)	SA$_2$ (13ºC)
T$_1$ (48ºC)	19.00	13.00	16.00 ^{c}	1.60	1.80	1.70 ^{b}	Nil	Nil
T$_2$ (50ºC)	12.00	14.00	13.00 ^{bc}	1.20	1.20	1.20 ^{ab}	Nil	Nil
T$_3$ (52ºC)	3.00	7.00	5.00 ^{ab}	1.00	1.20	1.10 ^{a}	Nil	Nil
T$_4$ (54ºC)	3.00	3.00	3.00 ^{ab}	1.00	1.20	1.10 ^{a}	Nil	Present
T$_5$ (56ºC)	2.00	2.00	2.00 ^{a}	1.40	1.80	1.60 ^{ab}	Present	Present
T$_6$ (Control)	21.00	19.00	20.00 ^{c}	2.80	1.80	2.30 ^{c}	Nil	Nil
Mean	10.00	9.67	9.83	1.50	1.50	1.50		

Mean values followed by a common letters are not significantly different at five per cent level

Factors	T	SA	T x SA	T	SA	T x SA		
SE d	4.75	NS	NS	0.25	NS	NS		
CD P=0.05	9.56	NS	NS	0.50	NS	NS		

Table 6. Comparative sensory evaluation for skin colour appearance and flavour of Rasthali banana fruits as influenced by hot water treatment under cool and ambient storage conditions (Mean scores)

Treatments	Skin colour appearance			Flavour		
	SA$_1$ (Ambient)	SA$_2$ (13ºC)	Mean	SA$_1$ (Ambient)	SA$_2$ (13ºC)	Mean
T$_1$ (48ºC)	3.20	3.00	3.10 ^{b}	2.60	1.80	2.20
T$_2$ (50ºC)	4.20	4.00	4.10 ^{c}	2.70	2.90	2.80
T$_3$ (52ºC)	4.20	4.00	4.10 ^{c}	2.80	2.90	2.85
T$_4$ (54ºC)	4.20	3.00	3.60 ^{bc}	2.80	2.70	2.75
T$_5$ (56ºC)	2.20	1.40	1.80 ^{a}	2.80	2.80	2.80
T$_6$ (Control)	4.20	4.00	4.10 ^{c}	2.80	2.80	2.80
Mean	3.70	3.23	3.47	2.75	2.65	2.70

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Factors	T	SA	T x SA	T	SA	T x SA
SE d	0.40	NS	NS	NS	NS	NS
CD (P=0.05)	0.80	NS	NS	NS	NS	NS

Table 6. Comparative sensory evaluation for taste and over all acceptability of Rasthali banana fruits as influenced by hot water treatment under cool and ambient storage conditions (Mean scores)

Treatments	Taste			Over all acceptability		
	SA_1 (Ambient)	SA_2 (13ºC)	Mean	SA_1 (Ambient)	SA_2 (13ºC)	Mean
T_1 (48ºC)	2.40	2.60	2.50 ^{a}	2.40 ^{a}	3.40 ^{b}	2.90 ^{b}
T_2 (50ºC)	3.20	3.40	3.30 ^{b}	2.60 ^{a}	3.40 ^{b}	3.00 ^{b}
T_3 (52ºC)	3.40	3.60	3.50 ^{b}	3.40 ^{b}	4.40 ^{c}	3.90 ^{c}
T_4 (54ºC)	3.80	3.40	3.60 ^{b}	4.40 ^{c}	3.40 ^{b}	3.90 ^{c}
T_5 (56ºC)	2.40	2.40	2.40 ^{a}	2.40 ^{a}	2.40 ^{a}	2.40 ^{a}
T_6 (Control)	2.60	2.80	2.70 ^{a}	2.20 ^{a}	2.20 ^{a}	2.20 ^{a}
Mean	2.97	3.03	3.00	2.90	3.20	3.05

Mean values followed by a common letters are not significantly different at five per cent level

Factors	T	SA	T x SA	T	SA	T x SA
SE d	0.27	NS	NS	0.23	NS	0.33
CD (P=0.05)	0.54	NS	NS	0.47	NS	0.66

Table 6. Comparative sensory evaluation for texture in Rasthali banana fruits as influenced by hot water treatment under cool and ambient storage conditions (Mean scores)

Treatments	Texture		
	SA_1 (Ambient)	SA_2 (13ºC)	Mean
T_1 (48ºC)	1.80	3.20	2.50 ^{ab}
T_2 (50ºC)	1.80	3.20	2.50 ^{ab}
T_3 (52ºC)	2.80	3.20	3.00 ^{bc}
T_4 (54ºC)	2.80	4.20	3.50 ^{cd}
T_5 (56ºC)	3.80	4.20	4.00 ^{d}
T_6 (Control)	1.80	2.20	2.00 ^{a}
Mean	2.47	3.37	2.92

Mean values followed by a common letters are not significantly different at five per cent level

Factors	T	SA	T x SA
SE d	0.37	NS	NS
CD (P=0.05)	0.75	NS	NS

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