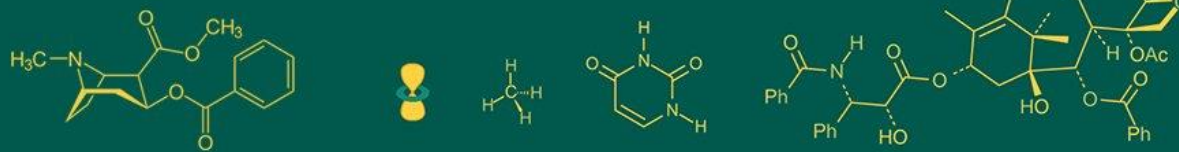


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Enhancing quality of banana by using different post-harvest treatments

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Abstract

The investigation was carried out to study the effect of post-harvest treatment of chemicals, wax emulsion and storage conditions on quality of banana (*Musa paradisiaca* L.) was laid out with six chemical treatments viz., C₁ - Hexanal @ 3%, C₂ - Hexanal @ 4%, C₃ - Hexanal @ 5%, C₄ - Salicylic acid @ 2 mM, C₅ - Salicylic acid @ 3 mM, C₆ - Salicylic acid @ 4 mM, two wax emulsions viz., W₁ - Wax emulsion @ 6%, W₂ - Wax emulsion @ 8%, two different storage conditions viz., S₁ - Ambient temperature and S₂ - Cold storage (13 °C + 1) and fruits were analyzed for physico-chemical parameters at an interval of two days. The treatment combination C₁W₂S₂ i.e. hexanal @ 3% + wax emulsion @ 8% + cold storage (13°C+1) revealed minimum change in TSS (^oBrix), pH, titratable acidity (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and adjudged as the best for these quality parameters at the end of storage period of 24 days.

Keywords: TSS, total sugars, quality, chemical parameters and cold storage

Introduction

Globally and also in Indian condition banana is mostly traded under ambient conditions which caused high post-harvest losses and shorter shelf life. Mature green harvested banana quickly deteriorates under ambient conditions due to faster respiration and higher ethylene production which caused rapid ripening and fruit softening with increased fruit spoilage (Mandal *et al.*, 2019) [16]. Accelerated ripening and short shelf life of banana under tropical climate are the major constraints in postharvest handling. Due to its rapid ripening nature, enormous postharvest losses occur and which in turn affect the farmer's benefit.

Since banana is a climacteric and perishable fruit, application of post-harvest treatments become necessary to delay the ripening to reduce losses and to improve and maintain the colour and quality by slowing down the metabolic activities of the produce which results in increased keeping quality and marketability of the fruits for a longer period of time (Rao and Chundawat, 1986) [22]. Therefore, an experiment has been planned to study the effect of post-harvest treatment of chemicals, wax emulsion and storage conditions on quality of banana (*Musa paradisiaca* L.).

Material and methodology

The experiment was carried out at laboratory of Post-Harvest Technology, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar during 2021 in the month of June and November. The experiment was laid out in Factorial Completely Randomized Design (FCRD) consisting of twenty four treatment combinations along with control. The experiment was replicated twice (2) times.

Details of treatment combination

T ₁	C ₁ W ₁ S ₁	Hexanal 3% + Wax emulsion 6% + Ambient temperature
T ₂	C ₁ W ₁ S ₂	Hexanal 3% + Wax emulsion 6% + Cold storage (13 °C+1)
T ₃	C ₁ W ₂ S ₁	Hexanal 3% + Wax emulsion 8% + Ambient temperature
T ₄	C ₁ W ₂ S ₂	Hexanal 3% + Wax emulsion 8% + Cold storage (13 °C+1)
T ₅	C ₂ W ₁ S ₁	Hexanal 4% + Wax emulsion 6% + Ambient temperature
T ₆	C ₂ W ₁ S ₂	Hexanal 4% + Wax emulsion 6% + Cold storage (13 °C+1)
T ₇	C ₂ W ₂ S ₁	Hexanal 4% + Wax emulsion 8% + Ambient temperature
T ₈	C ₂ W ₂ S ₂	Hexanal 4% + Wax emulsion 8% + Cold storage (13 °C+1)
T ₉	C ₃ W ₁ S ₁	Hexanal 5% + Wax emulsion 6% + Ambient temperature
T ₁₀	C ₃ W ₁ S ₂	Hexanal 5% + Wax emulsion 6% + Cold storage (13 °C+1)
T ₁₁	C ₃ W ₂ S ₁	Hexanal 5% + Wax emulsion 8% + Ambient temperature
T ₁₂	C ₃ W ₂ S ₂	Hexanal 5% + Wax emulsion 8% + Cold storage (13 °C+1)
T ₁₃	C ₄ W ₁ S ₁	Salicylic acid 2 mM + Wax emulsion 6% + Ambient temperature
T ₁₄	C ₄ W ₁ S ₂	Salicylic acid 2 mM + Wax emulsion 6% + Cold storage (13 °C+1)
T ₁₅	C ₄ W ₂ S ₁	Salicylic acid 2 mM + Wax emulsion 8% + Ambient temperature
T ₁₆	C ₄ W ₂ S ₂	Salicylic acid 2 mM + Wax emulsion 8% + Cold storage (13 °C+1)
T ₁₇	C ₅ W ₁ S ₁	Salicylic acid 3 mM+ Wax emulsion 6% + Ambient temperature
T ₁₈	C ₅ W ₁ S ₂	Salicylic acid 3 mM + Wax emulsion 6% + Cold storage (13 °C+1)
T ₁₉	C ₅ W ₂ S ₁	Salicylic acid 3 mM+ Wax emulsion 8% + Ambient temperature
T ₂₀	C ₅ W ₂ S ₂	Salicylic acid 3 mM + Wax emulsion 8% + Cold storage (13 °C+1)
T ₂₁	C ₆ W ₁ S ₁	Salicylic acid 4 mM+ Wax emulsion 6% + Ambient temperature
T ₂₂	C ₆ W ₁ S ₂	Salicylic acid 4 mM+ Wax emulsion 6% + Cold storage (13 °C+1)
T ₂₃	C ₆ W ₂ S ₁	Salicylic acid 4 mM+ Wax emulsion 8% + Ambient temperature
T ₂₄	C ₆ W ₂ S ₂	Salicylic acid 4 mM+ Wax emulsion 8% + Cold storage (13 °C+1)
T ₂₅	Control	Control (Water dipping)

Results and discussion

Chemical parameters

Total soluble solids (°Brix): The data on effect of different postharvest treatment of chemicals, wax emulsion and storage conditions on TSS (°Brix) of banana recorded during storage for trial I, trial II and pooled analysis have been presented in Table 1. TSS content of banana fruits exhibited increasing trend with storage period and declined at the end storage period.

Effect of chemicals

On 6th day of storage, different chemicals showed significant influence on TSS content of banana. The minimum TSS was recorded in C₁ *i.e.* hexanal 3% (6.75 °Brix) which was at par with the treatment C₃ (6.77 °Brix) while maximum TSS was recorded in the treatment C₄ *i.e.* salicylic acid 2 mM (7.13 °Brix) which was at par with the treatment C₅ (7.12 °Brix). On 12th day of storage, TSS was significantly influenced by different chemical treatments. The treatment C₁ *i.e.* hexanal 3% recorded minimum TSS (17.91 °Brix) followed by the treatment C₃ (17.95 °Brix) whereas the treatment C₄ *i.e.* salicylic acid 2 mM was recorded maximum TSS (20.93 °Brix) which was at par with the treatment C₅ (20.91 °Brix). On 18th day of storage, fruits treated with C₁ *i.e.* hexanal 3% showed maximum TSS (20.47 °Brix) while the minimum TSS (19.48 °Brix) observed in C₄ *i.e.* salicylic acid 2 mM. On 24th day of storage, the fruits of all remaining treatments were discarded due to spoilage and were not acceptable. Only fruits treated with C₁ *i.e.* hexanal 3% were remained in storage which recorded TSS content of 18.78 °Brix.

Effect of wax emulsion

On 6th day of storage, wax emulsion showed significant influence on TSS content of banana fruits. The minimum TSS was found in W₂ *i.e.* wax emulsion 8% (6.87 °Brix) while maximum TSS recorded in W₁ *i.e.* wax emulsion 6% (7.00 °Brix). On 12th day of storage, TSS was found to be

significantly varied during storage period. The treatment W₂ *i.e.* wax emulsion 8% recorded minimum TSS (19.22 °Brix) whereas treatment W₁ *i.e.* wax emulsion 6% recorded maximum TSS (19.60 °Brix). On 18th day of storage, fruits treated with W₂ *i.e.* wax emulsion 8% showed minimum TSS (20.19 °Brix) while the fruits treated with W₁ *i.e.* wax emulsion 6% recorded maximum TSS (20.20 °Brix). On 24th day of storage, the treatment W₂ *i.e.* wax emulsion 8% retained maximum TSS (18.78 °Brix) with the advancement of storage period.

Effect of storage conditions

The data with respect to TSS content of fruit was varied significantly among the different storage conditions. In case of storage conditions, a change in TSS was found to be very fast in S₁ than S₂. On 18th day of storage, fruits under ambient conditions *i.e.* S₁ recorded TSS content of 19.31 °Brix which was found to be increased from 2.03 to 19.31 °Brix. On 24th day of storage, S₁ ambient conditions were discarded due to spoilage and the treatment S₂ recorded the TSS content of 18.78 °Brix at the end of storage.

Interaction effect of different chemicals and wax emulsion

The interaction effect of different chemicals and wax emulsion on TSS content of fruit was found to be non-significant during storage. On 6th day of storage, the minimum TSS was recorded in C₁W₂ *i.e.* hexanal 3% + wax emulsion 8% (6.68 °Brix) while maximum TSS was recorded in C₄S₁ *i.e.* salicylic acid 2 mM + ambient temperature (7.21 °Brix). On 12th day of storage, the chemicals and wax emulsion showed significant influence on TSS content of banana fruits. The treatment combination of C₁W₂ *i.e.* hexanal 3% + wax emulsion 8% recorded minimum TSS (17.67 °Brix) followed by the treatment C₃W₂ (17.71 °Brix) whereas the treatment combination of C₄W₁ *i.e.* salicylic acid 2 mM + wax emulsion 6% recorded maximum TSS (21.15 °Brix). On 18th day of storage, fruits

treated with C_1W_2 i.e. hexanal 3% + wax emulsion 8% recorded maximum TSS (20.55 °Brix) while fruits treated with C_4W_2 i.e. salicylic acid 2 mM + wax emulsion 8% recorded minimum TSS (19.48 °Brix). On 24th day of storage, only fruits treated with C_1W_2 i.e. hexanal 3% + wax emulsion 8% were lasted in storage with TSS content of 18.78 °Brix.

Interaction effect of chemicals and storage conditions

On 6th day of storage, interaction effect of chemicals and storage conditions showed significant influence on TSS content of banana. Minimum TSS was recorded in C_1S_2 i.e. hexanal 3% + cold storage (6.49 °Brix) followed by the treatment C_3S_2 (6.52 °Brix) whereas maximum TSS was recorded in C_4S_1 i.e. salicylic acid 2 mM + ambient temperature (7.50 °Brix) followed by the treatment C_5S_1 (7.48 °Brix). On 12th day of storage, the data on TSS of fruits was found significant influence irrespective of chemicals and storage conditions. The treatment combination C_1S_2 i.e. hexanal 3% + cold storage recorded minimum TSS (17.44 °Brix) followed by the treatment C_3S_2 (17.49 °Brix) while the treatment combination C_4S_1 i.e. salicylic acid 2 mM + ambient temperature recorded maximum TSS (21.55) followed by the treatment C_5S_1 (21.51 °Brix). On 18th day of storage, fruits treated with C_1S_2 i.e. hexanal 3% + cold storage showed maximum TSS (21.05 °Brix) whereas the fruits treated with C_4S_2 i.e. salicylic acid 2 mM + cold storage recorded minimum TSS (19.48 °Brix). On 24th day of storage, the fruits treated with C_1S_2 i.e. hexanal 3% + cold storage retained higher TSS content of 18.78 °Brix.

Interaction effect of wax emulsion and storage conditions

On 6th day of storage, two factor interaction effect between wax emulsion and storage conditions also exhibited significant effect on TSS content. The minimum TSS was found in W_2S_2 i.e. wax emulsion 8% + cold storage (6.57 °Brix) while maximum TSS was recorded in W_1S_1 i.e. wax emulsion 6% + ambient temperature (7.33 °Brix). On 12th day of storage, wax emulsion and storage conditions was found significant influenced on TSS. The treatment

combination W_2S_2 i.e. wax emulsion 8% + cold storage recorded minimum TSS (18.64 °Brix) whereas the treatment combination W_1S_1 i.e. wax emulsion 6% + ambient temperature recorded maximum TSS (20.05 °Brix). On 18th day of storage, fruits treated with W_2S_2 i.e. wax emulsion 8% + cold storage showed maximum TSS (20.37 °Brix) while fruits treated with W_2S_1 i.e. wax emulsion 8% + ambient temperature recorded minimum TSS (19.31 °Brix). On 24th day of storage, fruits treated with W_2S_2 i.e. wax emulsion 8% + cold storage recorded TSS content of 18.78 °Brix.

Interaction effect of different chemicals, wax emulsion and storage conditions

The interaction effect of different chemicals, wax emulsion and storage conditions showed significant results with respect TSS. The TSS content of banana fruits was found to be increased fast under ambient condition than cold storage. On 6th day of storage, effect of chemicals, wax emulsion and storage conditions showed non-significant influenced on TSS. The minimum TSS was recorded in $C_1W_2S_2$ i.e. hexanal 3% + wax emulsion 8% + cold storage (6.43 °Brix) followed by the treatment $C_3W_2S_2$ (6.46 °Brix) while maximum TSS was recorded in $C_4W_1S_1$ i.e. salicylic acid 2 mM + wax emulsion 6% + ambient temperature (7.60 °Brix) followed by the treatment $C_5W_1S_1$ (7.54 °Brix). On 12th day of storage, TSS content of fruits were significantly influenced by different chemicals, wax emulsion and storage conditions. The treatment combination of $C_1W_2S_2$ i.e. hexanal 3% + wax emulsion 8% + cold storage recorded minimum TSS (17.00 °Brix) followed by treatment $C_3W_2S_2$ (17.05 °Brix) whereas, the treatment combination $C_4W_1S_1$ i.e. salicylic acid 2 mM + wax emulsion 6% + ambient temperature recorded maximum TSS (21.91 °Brix). On 18th day of storage, fruits treated with $C_1W_2S_2$ i.e. hexanal 3% + wax emulsion 8% + cold storage showed maximum TSS (21.79 °Brix) while the fruits treated with $C_4W_2S_2$ i.e. salicylic acid 2 mM + wax emulsion 8% + cold storage recorded minimum TSS (19.48 °Brix). On 24th day of storage, interaction $C_1W_2S_2$ i.e. hexanal 3% + wax emulsion 8% + cold storage revealed slower changes in TSS and retained the TSS content of 18.78 °Brix.

Table 1: Effect of different post-harvest treatment of chemicals, wax emulsion and storage conditions on TSS (°Brix) of banana fruit during storage

Treatment	Initial days			2 days			4 days			6 days			8 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A. Chemicals															
C ₁	2.06	2.04	2.05	2.37	2.30	2.33	4.87	4.81	4.84	6.78	6.72	6.75	8.82	8.75	8.79
C ₂	2.04	2.03	2.04	2.43	2.29	2.36	4.95	4.89	4.92	6.85	6.78	6.81	8.90	8.81	8.85
C ₃	2.05	2.03	2.04	2.40	2.30	2.35	4.91	4.84	4.88	6.81	6.73	6.77	8.86	8.73	8.79
C ₄	2.04	2.03	2.03	2.63	2.56	2.60	5.60	5.54	5.57	7.18	7.07	7.13	9.21	9.14	9.17
C ₅	2.04	2.02	2.03	2.63	2.56	2.59	5.59	5.52	5.56	7.17	7.06	7.12	9.20	9.13	9.16
C ₆	2.06	2.04	2.05	2.59	2.51	2.55	5.53	5.47	5.50	7.11	6.99	7.05	9.08	8.99	9.03
S.Em. ±	0.50	0.01	0.35	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
CD 1%	NS	NS	NS	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.06	0.06	0.06
B. Wax emulsion															
W ₁	2.05	2.04	2.04	2.55	2.47	2.51	5.31	5.24	5.28	7.04	6.96	7.00	9.09	9.00	9.05
W ₂	2.04	2.02	2.03	2.46	2.37	2.41	5.17	5.11	5.14	6.92	6.82	6.87	8.93	8.85	8.89
S.Em. ±	0.29	0.01	0.20	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01
CD 1%	NS	NS	NS	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
C. Storage conditions															
S ₁	2.04	2.02	2.03	2.71	2.62	2.66	5.75	5.68	5.72	7.30	7.20	7.25	9.41	9.32	9.37
S ₂	2.05	2.04	2.05	2.30	2.22	2.26	4.73	4.67	4.70	6.67	6.58	6.62	8.61	8.53	8.57
S.Em. ±	0.29	0.01	0.20	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01

CD 1%	NS	NS	NS	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Interaction (A x B)															
C ₁ W ₁	2.06	2.04	2.05	2.42	2.35	2.38	4.93	4.86	4.89	6.85	6.78	6.81	8.88	8.80	8.84
C ₁ W ₂	2.05	2.04	2.04	2.33	2.25	2.29	4.81	4.76	4.78	6.71	6.66	6.68	8.77	8.70	8.73
C ₂ W ₁	2.05	2.05	2.05	2.48	2.34	2.41	5.01	4.95	4.98	6.91	6.85	6.88	8.96	8.89	8.92
C ₂ W ₂	2.04	2.01	2.02	2.38	2.23	2.31	4.89	4.84	4.87	6.79	6.71	6.75	8.84	8.74	8.79
C ₃ W ₁	2.06	2.04	2.05	2.45	2.35	2.40	4.97	4.89	4.93	6.88	6.81	6.85	8.91	8.79	8.85
C ₃ W ₂	2.04	2.02	2.03	2.36	2.25	2.30	4.86	4.80	4.83	6.74	6.65	6.69	8.80	8.68	8.74
C ₄ W ₁	2.05	2.04	2.04	2.69	2.63	2.66	5.71	5.65	5.68	7.25	7.17	7.21	9.36	9.28	9.32
C ₄ W ₂	2.04	2.02	2.03	2.58	2.49	2.53	5.49	5.43	5.46	7.11	6.98	7.04	9.07	9.00	9.03
C ₅ W ₁	2.04	2.02	2.03	2.66	2.61	2.63	5.66	5.59	5.62	7.21	7.13	7.17	9.30	9.22	9.26
C ₅ W ₂	2.04	2.01	2.02	2.60	2.51	2.55	5.53	5.46	5.50	7.13	7.00	7.06	9.10	9.03	9.07
C ₆ W ₁	2.07	2.04	2.05	2.63	2.56	2.59	5.62	5.54	5.58	7.16	7.05	7.10	9.14	9.04	9.09
C ₆ W ₂	2.06	2.04	2.05	2.55	2.47	2.51	5.45	5.40	5.42	7.07	6.93	7.00	9.01	8.94	8.98
S.Em. \pm	0.71	0.01	0.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
CD 1%	NS	NS	NS	NS	NS	NS	0.05	0.05	0.05	NS	0.04	NS	0.08	0.09	0.08

Table 1: Continue

Treatment	Initial days			2 days			4 days			6 days			8 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A x C															
C ₁ S ₁	2.05	2.02	2.03	2.58	2.52	2.55	5.58	5.52	5.55	7.04	6.98	7.01	9.24	9.18	9.21
C ₁ S ₂	2.07	2.06	2.06	2.16	2.08	2.12	4.15	4.09	4.12	6.53	6.45	6.49	8.41	8.33	8.37
C ₂ S ₁	2.04	2.03	2.03	2.65	2.50	2.57	5.68	5.62	5.65	7.12	7.03	7.07	9.30	9.21	9.26
C ₂ S ₂	2.05	2.03	2.04	2.21	2.07	2.14	4.23	4.17	4.20	6.58	6.53	6.56	8.49	8.42	8.45
C ₃ S ₁	2.04	2.02	2.03	2.61	2.49	2.55	5.63	5.55	5.59	7.07	6.97	7.02	9.26	9.09	9.17
C ₃ S ₂	2.07	2.05	2.06	2.19	2.12	2.15	4.19	4.14	4.16	6.55	6.49	6.52	8.46	8.38	8.42
C ₄ S ₁	2.04	2.02	2.03	2.83	2.76	2.79	5.91	5.83	5.87	7.56	7.44	7.50	9.65	9.58	9.61
C ₄ S ₂	2.05	2.04	2.04	2.44	2.36	2.40	5.29	5.25	5.27	6.80	6.71	6.76	8.78	8.70	8.74
C ₅ S ₁	2.02	2.00	2.01	2.82	2.75	2.78	5.89	5.82	5.86	7.53	7.42	7.48	9.60	9.51	9.56
C ₅ S ₂	2.05	2.03	2.04	2.44	2.37	2.40	5.30	5.23	5.26	6.81	6.71	6.76	8.80	8.74	8.77
C ₆ S ₁	2.08	2.05	2.06	2.78	2.71	2.74	5.84	5.76	5.80	7.49	7.38	7.44	9.44	9.37	9.40
C ₆ S ₂	2.05	2.03	2.04	2.39	2.32	2.36	5.22	5.18	5.20	6.74	6.60	6.67	8.71	8.62	8.66
S.Em. \pm	0.71	0.01	0.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
CD 1%	NS	NS	NS	NS	NS	NS	0.05	0.05	0.05	0.05	0.04	0.04	0.08	0.09	0.08
B x C															
W ₁ S ₁	2.04	2.03	2.04	2.76	2.68	2.72	5.82	5.74	5.78	7.36	7.29	7.33	9.51	9.41	9.46
W ₁ S ₂	2.06	2.05	2.05	2.35	2.27	2.31	4.81	4.75	4.78	6.72	6.64	6.68	8.67	8.59	8.63
W ₂ S ₁	2.04	2.02	2.03	2.66	2.56	2.61	5.69	5.63	5.66	7.23	7.12	7.17	9.32	9.23	9.27
W ₂ S ₂	2.05	2.03	2.04	2.26	2.17	2.22	4.65	4.60	4.62	6.61	6.52	6.57	8.54	8.46	8.50
S.Em. \pm	0.41	0.01	0.29	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	NS	NS	NS	NS	NS	NS	0.03	0.03	0.03	NS	0.02	0.03	0.05	0.05	0.05
A x B x C															
C ₁ W ₁ S ₁	2.05	2.02	2.04	3.24	3.33	3.37	5.65	5.57	5.61	7.11	7.04	7.08	9.29	9.22	9.26
C ₁ W ₁ S ₂	2.07	2.06	2.07	2.34	2.35	2.38	4.20	4.14	4.17	6.59	6.51	6.55	8.46	8.38	8.42
C ₁ W ₂ S ₁	2.04	2.02	2.03	2.67	2.63	2.67	5.51	5.47	5.49	6.96	6.92	6.94	9.18	9.13	9.16
C ₁ W ₂ S ₂	2.06	2.05	2.06	2.25	2.23	2.28	4.10	4.04	4.07	6.46	6.39	6.43	8.35	8.27	8.31
C ₂ W ₁ S ₁	2.03	2.04	2.04	2.59	2.51	2.55	5.75	5.67	5.71	7.19	7.11	7.15	9.35	9.29	9.32
C ₂ W ₁ S ₂	2.07	2.05	2.06	2.51	2.42	2.46	4.27	4.22	4.25	6.62	6.59	6.61	8.56	8.48	8.52
C ₂ W ₂ S ₁	2.04	2.02	2.03	2.59	2.42	2.51	5.60	5.57	5.59	7.04	6.94	6.99	9.25	9.13	9.19
C ₂ W ₂ S ₂	2.03	2.00	2.02	2.17	2.04	2.11	4.18	4.11	4.15	6.54	6.47	6.51	8.42	8.35	8.39
C ₃ W ₁ S ₁	2.05	2.03	2.04	2.66	2.53	2.60	5.69	5.60	5.65	7.15	7.07	7.11	9.31	9.11	9.21
C ₃ W ₁ S ₂	2.07	2.05	2.06	2.23	2.17	2.20	4.24	4.18	4.21	6.61	6.55	6.58	8.51	8.46	8.49
C ₃ W ₂ S ₁	2.02	2.00	2.01	2.56	2.44	2.50	5.57	5.50	5.54	6.98	6.87	6.93	9.20	9.06	9.13
C ₃ W ₂ S ₂	2.06	2.04	2.05	2.15	2.06	2.11	4.14	4.09	4.12	6.49	6.42	6.46	8.40	8.29	8.35

Table 1: Continue

Treatment	Initial days			2 days			4 days			6 days			8 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
C ₄ W ₁ S ₁	2.04	2.03	2.04	2.88	2.82	2.85	5.98	5.90	5.94	7.63	7.56	7.60	9.86	9.79	9.83
C ₄ W ₁ S ₂	2.05	2.04	2.05	2.50	2.43	2.47	5.43	5.39	5.41	6.87	6.78	6.83	8.85	8.77	8.81
C ₄ W ₂ S ₁	2.03	2.00	2.02	2.77	2.69	2.73	5.83	5.76	5.80	7.48	7.31	7.40	9.43	9.37	9.40
C ₄ W ₂ S ₂	2.05	2.03	2.04	2.38	2.29	2.34	5.15	5.10	5.13	6.73	6.64	6.69	8.70	8.62	8.66
C ₅ W ₁ S ₁	2.01	2.00	2.01	2.85	2.79	2.82	5.93	5.86	5.90	7.57	7.51	7.54	9.74	9.65	9.70
C ₅ W ₁ S ₂	2.06	2.04	2.05	2.47	2.42	2.45	5.38	5.31	5.35	6.85	6.75	6.80	8.86	8.79	8.83
C ₅ W ₂ S ₁	2.03	2.00	2.02	2.79	2.70	2.75	5.85	5.78	5.82	7.49	7.33	7.41	9.46	9.37	9.42
C ₅ W ₂ S ₂	2.04	2.02	2.03	2.40	2.32	2.36	5.21	5.14	5.18	6.76	6.66	6.71	8.74	8.69	8.72

C ₆ W ₁ S ₁	2.08	2.05	2.07	2.82	2.74	2.78	5.89	5.81	5.85	7.53	7.44	7.49	9.49	9.41	9.45
C ₆ W ₁ S ₂	2.05	2.03	2.04	2.43	2.38	2.41	5.34	5.26	5.30	6.79	6.65	6.72	8.79	8.67	8.73
C ₆ W ₂ S ₁	2.07	2.05	2.06	2.74	2.67	2.71	5.79	5.70	5.75	7.45	7.32	7.39	9.39	9.32	9.36
C ₆ W ₂ S ₂	2.04	2.02	2.03	2.35	2.26	2.31	5.10	5.09	5.10	6.68	6.54	6.61	8.63	8.56	8.60
S.Em. ±	1.00	0.02	0.71	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.03	0.03	0.03
CD 1%	NS	NS	NS	NS	NS	NS	0.08	0.07	0.07	NS	NS	NS	0.11	0.12	0.11
Treated	2.05	2.03	2.04	2.51	2.42	2.46	5.24	5.18	5.21	6.98	6.89	6.94	9.01	8.92	8.97
Control	2.03	2.00	2.02	5.81	5.76	5.79	10.48	10.34	10.41	21.14	21.05	21.10	9.71	9.63	9.67
S.Em. ±	0.83	0.02	0.59	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.03	0.02
CD 1%	NS	0.05	NS	0.05	0.05	0.04	0.05	0.04	0.04	0.04	0.03	0.04	0.07	0.07	0.07

Table 1: Continue

Treatment	10 days			12 days			14 days			16 days			18 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A. Chemicals															
C ₁	15.76	15.69	15.73	17.93	17.89	17.91	20.70	20.63	20.66	21.38	21.29	21.33	20.45	20.49	20.47
C ₂	15.85	15.79	15.82	18.01	17.96	17.98	20.82	20.74	20.78	20.92	20.88	20.90	20.18	20.31	20.24
C ₃	15.83	15.75	15.79	17.98	17.92	17.95	20.78	20.71	20.74	21.14	21.12	21.13	20.27	20.41	20.34
C ₄	19.24	19.16	19.20	20.98	20.89	20.93	20.95	20.92	20.94	20.48	20.59	20.54	19.39	19.56	19.48
C ₅	19.02	18.95	18.99	20.95	20.88	20.91	21.11	21.10	21.11	21.13	21.20	21.17	-	-	-
C ₆	19.18	19.12	19.15	20.81	20.72	20.76	22.06	21.98	22.02	20.56	20.68	20.62	19.66	19.73	19.70
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.04	0.04	0.04	0.04	0.04	0.04	-	-	-	-	-	-	-	-	-
B. Wax emulsion															
W ₁	17.52	17.45	17.48	19.63	19.57	19.60	20.83	20.79	20.81	21.12	21.05	21.09	20.14	20.26	20.20
W ₂	17.44	17.37	17.41	19.25	19.18	19.22	21.17	21.10	21.14	20.93	20.96	20.95	20.15	20.23	20.19
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.02	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-
C. Storage conditions															
S ₁	17.94	17.87	17.90	19.96	19.89	19.92	20.99	20.91	20.95	19.79	19.80	19.80	19.35	19.27	19.31
S ₂	17.03	16.95	16.99	18.92	18.86	18.89	21.05	21.01	21.03	22.07	22.05	22.06	20.24	20.37	20.30
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.02	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-
Interaction (A x B)															
C ₁ W ₁	15.85	15.76	15.80	18.17	18.13	18.15	20.78	20.71	20.74	21.21	21.09	21.15	20.26	20.36	20.31
C ₁ W ₂	15.68	15.62	15.65	17.70	17.64	17.67	20.62	20.55	20.59	21.54	21.49	21.52	20.54	20.56	20.55
C ₂ W ₁	15.92	15.87	15.89	18.24	18.21	18.22	20.89	20.81	20.85	21.02	20.98	21.00	20.04	20.17	20.11
C ₂ W ₂	15.79	15.72	15.75	17.77	17.72	17.75	20.75	20.68	20.71	20.81	20.78	20.79	20.32	20.44	20.38
C ₃ W ₁	15.92	15.85	15.88	18.22	18.16	18.19	20.85	20.77	20.81	21.12	21.10	21.11	20.12	20.26	20.19
C ₃ W ₂	15.74	15.66	15.70	17.74	17.68	17.71	20.71	20.65	20.68	21.17	21.15	21.16	20.42	20.55	20.49
C ₄ W ₁	19.35	19.25	19.30	21.19	21.11	21.15	19.60	19.72	19.66	-	-	-	-	-	-
C ₄ W ₂	19.14	19.08	19.11	20.76	20.67	20.71	21.63	21.53	21.58	20.48	20.59	20.54	19.39	19.56	19.48
C ₅ W ₁	18.84	18.75	18.80	21.00	20.94	20.97	19.89	19.97	19.93	-	-	-	-	-	-
C ₅ W ₂	19.21	19.15	19.18	20.90	20.81	20.85	21.72	21.67	21.69	21.13	21.20	21.17	-	-	-
C ₆ W ₁	19.28	19.21	19.24	20.94	20.88	20.91	22.94	22.87	22.91	-	-	-	-	-	-
C ₆ W ₂	19.09	19.03	19.06	20.67	20.56	20.61	21.62	21.53	21.58	20.56	20.68	20.62	19.66	19.73	19.70
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.06	0.06	0.05	0.06	0.05	0.05	-	-	-	-	-	-	-	-	-

Table 1: Continue

Treatment	10 days			12 days			14 days			16 days			18 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A x C															
C ₁ S ₁	16.21	16.15	16.18	18.40	18.36	18.38	21.18	21.10	21.14	20.25	20.16	20.20	19.35	19.27	19.31
C ₁ S ₂	15.32	15.23	15.27	17.47	17.41	17.44	20.22	20.16	20.19	22.51	22.42	22.46	21.00	21.11	21.05
C ₂ S ₁	16.32	16.26	16.29	18.45	18.41	18.43	21.32	21.22	21.27	19.31	19.30	19.30	-	-	-
C ₂ S ₂	15.39	15.33	15.36	17.56	17.52	17.54	20.32	20.27	20.29	22.53	22.45	22.49	20.18	20.31	20.24
C ₃ S ₁	16.27	16.19	16.23	18.44	18.38	18.41	21.28	21.20	21.24	19.84	19.88	19.86	-	-	-
C ₃ S ₂	15.40	15.31	15.35	17.52	17.46	17.49	20.28	20.22	20.25	22.45	22.37	22.41	20.27	20.41	20.34
C ₄ S ₁	19.63	19.57	19.60	21.60	21.49	21.55	20.39	20.31	20.35	19.76	19.84	19.80	-	-	-
C ₄ S ₂	18.85	18.76	18.80	20.35	20.29	20.32	21.23	21.23	21.23	21.20	21.34	21.27	19.39	19.56	19.48
C ₅ S ₁	19.61	19.52	19.57	21.55	21.48	21.51	20.54	20.49	20.52	-	-	-	-	-	-
C ₅ S ₂	18.44	18.38	18.41	20.35	20.28	20.31	21.40	21.41	21.40	21.13	21.20	21.17	-	-	-
C ₆ S ₁	19.58	19.52	19.55	21.31	21.24	21.27	20.45	20.36	20.41	19.81	19.90	19.86	-	-	-
C ₆ S ₂	18.79	18.72	18.75	20.30	20.20	20.25	22.87	22.79	22.83	21.31	21.46	21.39	19.66	19.73	19.70
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.06	0.06	0.05	0.06	0.05	0.05	-	-	-	-	-	-	-	-	-

B x C															
W ₁ S ₁	18.01	17.94	17.97	20.09	20.02	20.05	21.33	21.25	21.29	19.71	19.66	19.68	-	-	-
W ₁ S ₂	17.04	16.95	17.00	19.16	19.12	19.14	20.58	20.57	20.57	22.52	22.45	22.49	20.14	20.26	20.20
W ₂ S ₁	17.87	17.80	17.83	19.83	19.77	19.80	20.82	20.74	20.78	19.84	19.89	19.87	19.35	19.27	19.31
W ₂ S ₂	17.01	16.95	16.98	18.68	18.59	18.64	21.52	21.46	21.49	21.84	21.85	21.85	20.30	20.43	20.37
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.03	0.03	0.03	0.03	0.03	0.03	-	-	-	-	-	-	-	-	-
A x B x C															
C ₁ W ₁ S ₁	16.30	16.24	16.27	18.44	18.40	18.42	21.26	21.18	21.22	19.78	19.67	19.73	-	-	-
C ₁ W ₁ S ₂	15.39	15.27	15.33	17.90	17.86	17.88	20.29	20.24	20.27	22.64	22.51	22.58	20.26	20.36	20.31
C ₁ W ₂ S ₁	16.12	16.05	16.09	18.36	18.32	18.34	21.09	21.02	21.06	20.71	20.65	20.68	19.35	19.27	19.31
C ₁ W ₂ S ₂	15.24	15.19	15.22	17.03	16.96	17.00	20.15	20.08	20.12	22.37	22.33	22.35	21.73	21.85	21.79
C ₂ W ₁ S ₁	16.41	16.36	16.39	18.49	18.45	18.47	21.38	21.29	21.34	19.57	19.48	19.53	-	-	-
C ₂ W ₁ S ₂	15.43	15.37	15.40	17.99	17.96	17.98	20.40	20.33	20.37	22.47	22.47	22.47	20.04	20.17	20.11
C ₂ W ₂ S ₁	16.22	16.15	16.19	18.41	18.37	18.39	21.25	21.15	21.20	19.04	19.12	19.08	-	-	-
C ₂ W ₂ S ₂	15.35	15.28	15.32	17.13	17.07	17.10	20.24	20.20	20.22	22.58	22.43	22.51	20.32	20.44	20.38
C ₃ W ₁ S ₁	16.35	16.29	16.32	18.48	18.42	18.45	21.34	21.27	21.31	19.78	19.82	19.80	-	-	-
C ₃ W ₁ S ₂	15.49	15.40	15.45	17.95	17.89	17.92	20.35	20.27	20.31	22.46	22.37	22.42	20.12	20.26	20.19
C ₃ W ₂ S ₁	16.18	16.09	16.14	18.39	18.34	18.37	21.21	21.13	21.17	19.89	19.94	19.92	-	-	-
C ₃ W ₂ S ₂	15.30	15.22	15.26	17.08	17.02	17.05	20.20	20.17	20.19	22.44	22.36	22.40	20.42	20.55	20.49

Table 1: Continue

Treatment	10 days			12 days			14 days			16 days			18 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
C ₄ W ₁ S ₁	19.70	19.63	19.67	21.97	21.84	21.91	-	-	-	-	-	-	-	-	-
C ₄ W ₁ S ₂	18.99	18.86	18.93	20.41	20.38	20.40	19.60	19.72	19.66	-	-	-	-	-	-
C ₄ W ₂ S ₁	19.56	19.50	19.53	21.23	21.14	21.19	20.39	20.31	20.35	19.76	19.84	19.80	-	-	-
C ₄ W ₂ S ₂	18.71	18.65	18.68	20.29	20.19	20.24	22.86	22.74	22.80	21.20	21.34	21.27	19.39	19.56	19.48
C ₅ W ₁ S ₁	19.63	19.51	19.57	21.61	21.53	21.57	-	-	-	-	-	-	-	-	-
C ₅ W ₁ S ₂	18.05	17.99	18.02	20.38	20.35	20.37	19.89	19.97	19.93	-	-	-	-	-	-
C ₅ W ₂ S ₁	19.59	19.53	19.56	21.48	21.42	21.45	20.54	20.49	20.52	-	-	-	-	-	-
C ₅ W ₂ S ₂	18.82	18.76	18.79	20.31	20.20	20.26	22.90	22.84	22.87	21.13	21.20	21.17	-	-	-
C ₆ W ₁ S ₁	19.64	19.59	19.62	21.53	21.47	21.50	-	-	-	-	-	-	-	-	-
C ₆ W ₁ S ₂	18.91	18.83	18.87	20.35	20.29	20.32	22.94	22.87	22.91	-	-	-	-	-	-
C ₆ W ₂ S ₁	19.52	19.45	19.49	21.09	21.00	21.05	20.45	20.36	20.41	19.81	19.90	19.86	-	-	-
C ₆ W ₂ S ₂	18.66	18.61	18.64	20.25	20.11	20.18	22.79	22.70	22.75	21.31	21.46	21.39	19.66	19.73	19.70
S.Em. ±	0.02	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-
CD 1%	0.08	0.08	0.08	0.08	0.08	0.07	-	-	-	-	-	-	-	-	-
Treated	17.48	17.41	17.45	19.44	19.37	19.41	21.02	20.97	21.00	21.00	20.99	21.00	20.14	20.24	20.19
Control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1: Continue

Treatment	20 days			22 days			24 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A. Chemicals									
C ₁	20.40	20.31	20.36	19.64	19.76	19.70	18.71	18.84	18.78
C ₂	-	-	-	-	-	-	-	-	-
C ₃	20.31	20.23	20.27	19.58	19.69	19.64	-	-	-
C ₄	-	-	-	-	-	-	-	-	-
C ₅	-	-	-	-	-	-	-	-	-
C ₆	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
B. Wax emulsion									
W ₁	-	-	-	-	-	-	-	-	-
W ₂	20.36	20.27	20.31	19.61	19.73	19.67	18.71	18.84	18.78
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
C. Storage conditions									
S ₁	-	-	-	-	-	-	-	-	-
S ₂	20.36	20.27	20.31	19.61	19.73	19.67	18.71	18.84	18.78
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
Interaction (A x B)									
C ₁ W ₁	-	-	-	-	-	-	-	-	-

C ₁ W ₂	20.40	20.31	20.36	19.64	19.76	19.70	18.71	18.84	18.78
C ₂ W ₁	-	-	-	-	-	-	-	-	-
C ₂ W ₂	-	-	-	-	-	-	-	-	-
C ₃ W ₁	-	-	-	-	-	-	-	-	-
C ₃ W ₂	20.31	20.23	20.27	19.58	19.69	19.64	-	-	-
C ₄ W ₁	-	-	-	-	-	-	-	-	-
C ₄ W ₂	-	-	-	-	-	-	-	-	-
C ₅ W ₁	-	-	-	-	-	-	-	-	-
C ₅ W ₂	-	-	-	-	-	-	-	-	-
C ₆ W ₁	-	-	-	-	-	-	-	-	-
C ₆ W ₂	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-

Table 1: Continue

Treatment	20 days			22 days			24 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A x C									
C ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₁ S ₂	20.40	20.31	20.36	19.64	19.76	19.70	18.71	18.84	18.78
C ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₃ S ₁	-	-	-	-	-	-	-	-	-
C ₃ S ₂	20.31	20.23	20.27	19.58	19.69	19.64	-	-	-
C ₄ S ₁	-	-	-	-	-	-	-	-	-
C ₄ S ₂	-	-	-	-	-	-	-	-	-
C ₅ S ₁	-	-	-	-	-	-	-	-	-
C ₅ S ₂	-	-	-	-	-	-	-	-	-
C ₆ S ₁	-	-	-	-	-	-	-	-	-
C ₆ S ₂	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
B x C									
W ₁ S ₁	-	-	-	-	-	-	-	-	-
W ₁ S ₂	-	-	-	-	-	-	-	-	-
W ₂ S ₁	-	-	-	-	-	-	-	-	-
W ₂ S ₂	20.36	20.27	20.31	19.61	19.73	19.67	18.71	18.84	18.78
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
A x B x C									
C ₁ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₁ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₁ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₁ W ₂ S ₂	20.40	20.31	20.36	19.64	19.76	19.70	18.71	18.84	18.78
C ₂ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₂ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₂ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₂ W ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₃ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₃ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₃ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₃ W ₂ S ₂	20.31	20.23	20.27	19.58	19.69	19.64	-	-	-

Table 1: Continue

Treatment	20 days			22 days			24 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
C ₄ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₄ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₄ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₄ W ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₅ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₅ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₅ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₅ W ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₆ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₆ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₆ W ₂ S ₁	-	-	-	-	-	-	-	-	-

C ₆ W ₂ S ₂	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
Treated	20.36	20.27	20.31	19.61	19.73	19.67	18.71	18.84	18.78
Control	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-

C₁: Hexanal (3%), C₂: Hexanal (4%), C₃: Hexanal (5%), C₄: Salicylic acid (2 mM), C₅: Salicylic acid (3 mM), C₆: Salicylic acid (4 mM), W₁: Wax emulsion (6%), W₂: Wax emulsion (8%), S₁: Ambient temperature, S₂: Cold storage (13 °C+1)

TSS content of fruits under control was increased from 2.02 to 9.67 °Brix within 8 days of storage whereas, average content of all treated fruits was increased up to 2.02 to 18.78 °Brix under ambient conditions.

Total soluble solids content of the fruits reached maximum at the ripe stage and started declining towards the end of shelf life. The increase in total soluble solids during ripening was due to breakdown of starch and polysaccharides in to sugars. Further due to over ripening/senescence the sugar is degraded to CO₂ because of respiration (Wills *et al.*, 1989) [25].

The slower changes in TSS level in hexanal treated fruits could be due to reduced the activities of enzymes such as invertase and an amylase involved in the hydrolysis of stored carbohydrates into soluble sugars. Similar finding has been reported by Hutchinson *et al.* (2018) [10] in papaya, Ambuko *et al.* (2006) [11] in banana, Baraza *et al.* (2012) [3] in passion fruit, Mendoza *et al.* (1972) [17] in mango and Ashwini *et al.* (2018) [2] in banana.

Wax coating lowered internal CO₂ and O₂ concentrations which was used for hydrolysis process and lowered the conversion of acids into sugars. These results are in agreement with Maharaj and Sankat (1990) [15] with wax in papaya, Ramakrishna and Haribabu (1999) [20] with CaCl₂ and wax emulsion in papaya, Gautam *et al.* (2003) [8] in mango, Devi and Arumugam (2005) [5], Patel *et al.* (2010) [18] in banana, Dhaka *et al.* (2001) [1] in Totapuri mangoes and Jawadagi *et al.* (2013) [12] in custard apple.

Fruits stored at cold storage condition showed minimum total soluble solids observed that gradual accumulation of total soluble solids compared to ambient temperature. The slowdown of enzymatic activity reported by delayed total soluble solids to reach peak. Finding of this study supported by Crismas *et al.* (2018) [4] in banana.

Total sugars (%)

The data with respect to on changes in total sugars of banana fruits as influenced by different postharvest treatments of chemicals, wax emulsion and storage conditions have been presented in Table 2. Total sugars followed increasing trend and then declined at ripening during storage irrespective of postharvest treatments, wax emulsion and storage conditions.

Effect of chemicals

On 6th day of storage, individual effect of different chemicals was found significant influence on total sugars content of banana fruits. The minimum total sugars were recorded in C₁ *i.e.* hexanal 3% (6.12%) followed by the treatment C₃ (6.18%) while maximum total sugars recorded in C₄ *i.e.* salicylic acid 2 mM (7.04%) which was at par with the treatment C₅ (7.02%) on similar days of storage. On 12th day of storage, total sugars were found to be significantly influence by different chemicals. The treatment C₁ *i.e.* hexanal 3% recorded minimum total sugars (10.70%)

followed by the treatment C₃ (10.78%) whereas the treatment C₄ *i.e.* salicylic acid 2 mM recorded maximum total sugars (13.74%) followed by the treatment C₅ (13.70%). On 18th day of storage, fruits treated with C₁ *i.e.* hexanal 3% showed minimum total sugars (15.72%) while fruits treated with C₄ *i.e.* salicylic acid 2 mM recorded maximum total sugars (16.28%). On 24th day of storage, the treatment C₁ *i.e.* hexanal 3% recorded total sugar content of 16.07%.

Effect of wax emulsion

On 6th day of storage, wax emulsion resulted significant effect on total sugars content of banana fruits during storage. The minimum total sugars were recorded in W₂ *i.e.* wax emulsion 8% (6.50%) while maximum total sugars recorded in W₁ *i.e.* wax emulsion 6% (6.67%). On 12th day of storage, effect of wax emulsion showed significant influenced on total sugars. The treatment W₂ *i.e.* wax emulsion 8% recorded minimum total sugars (12.12%) whereas the treatment W₁ *i.e.* wax emulsion 6% recorded maximum total sugars (12.34%). On 18th day of storage, minimum total sugars were recorded in W₂ *i.e.* wax emulsion 8% (15.87%) while maximum total sugars recorded in W₁ *i.e.* wax emulsion 6% (15.92%). On 24th day of storage, only treatment W₂ *i.e.* wax emulsion 8% retained total sugars content of 16.07%.

Effect of storage conditions

Total sugars content of banana fruits was varied significantly with different storage conditions. Increase in total sugars content was relatively higher in S₁ than S₂. On 18th day of storage, fruits under ambient conditions S₁ recorded total sugars content of 17.71% at the end of shelf life. On 24th day of storage, the fruits stored under S₁ *i.e.* ambient conditions were discarded due to spoilage and less overall acceptability. Fruits under cold storage S₂ recorded total sugar content of 16.07%.

Interaction between different chemicals and wax emulsion

On 6th day of storage, the interaction effect of different chemicals and wax emulsion showed significant influence on total sugars content of banana fruits. Fruits treated with C₁W₂ *i.e.* hexanal 3% + wax emulsion 8% recorded minimum total sugars (6.05%) followed by the treatment C₃W₂ (6.10%) while maximum total sugars (7.16%) recorded in C₄W₁ *i.e.* salicylic acid 2 mM + wax emulsion 6% followed by the treatment C₅W₁ (7.10%). On 12th day of storage, total sugars showed significant variation irrespective of chemicals and wax emulsion. The treatment combination of C₁W₂ *i.e.* hexanal 3% + wax emulsion 8% recorded minimum total sugars (10.60%) followed by the treatment C₃W₂ (10.67%) whereas the treatment combination C₄W₁ *i.e.* salicylic acid 2 mM + wax emulsion 6% recorded maximum total sugars (13.90%). On 18th day

of storage, fruits treated with C₁W₂ i.e. hexanal 3% + wax emulsion 8% recorded minimum total sugars (15.65%) while fruits treated with C₄W₂ i.e. salicylic acid 2 mM + wax emulsion 8% recorded maximum total sugars (16.28%). On 24th day of storage, the treatment C₁W₂ i.e. hexanal 3% + wax emulsion 8% retained total sugar content of 16.07%.

Interaction effect chemicals and storage conditions

On 6th day of storage, the data regarding total sugars content was varied significantly irrespective of different chemicals and storage conditions. The minimum total sugars content was observed in C₁S₂ i.e. hexanal 3% + cold storage (5.61%) followed by the treatment C₃S₂ (5.68%) while maximum total sugars recorded in C₄S₁ i.e. salicylic acid 2 mM + ambient temperature (7.37%) which was at par with the treatment C₅S₁ (7.36%). On 12th day of storage, effect of chemicals and storage conditions showed significant influence on total sugar content of fruits. The treatment combination of C₁S₂ i.e. hexanal 3% + cold storage recorded minimum total sugars (9.84%) followed by the treatment C₃W₂ (9.92%) whereas the treatment combination C₄S₁ i.e. salicylic acid 2 mM + ambient temperature recorded maximum total sugars (14.83%) followed by the treatment C₅S₁ (14.76%). On 18th day of storage, fruits treated with C₁S₂ i.e. hexanal 3% + cold storage observed minimum total sugars (14.72%) while fruits treated with C₄S₂ i.e. salicylic acid 2 mM + cold storage recorded maximum total sugars (16.28%). On 24th day of storage, fruits treated with C₁S₂ i.e. hexanal 3% + cold storage remained storage with total sugar content of 16.07%.

Interactions effect of wax emulsion and storage conditions

On 6th day of storage, the interaction effect of wax emulsion and storage conditions showed significant influence on total sugars. The minimum total sugars were observed in W₂S₂ i.e. wax emulsion 8% + cold storage (6.07%) while maximum total sugars recorded in W₁S₁ i.e. wax emulsion 6% + ambient temperature (7.09%). On 12th day of storage,

the treatment combination W₂S₂ i.e. wax emulsion 8% + cold storage recorded minimum total sugars (11.16%) whereas the treatment combination W₁S₁ i.e. wax emulsion 6% + ambient temperature recorded maximum total sugars (13.31%). On 18th day of storage, fruits treated with W₂S₂ i.e. wax emulsion 8% + cold storage noted minimum total sugars (15.50%) while fruits treated with W₂S₁ i.e. wax emulsion 8% + ambient temperature recorded maximum total sugars (17.71%). On 24th day of storage, the treatment combination W₂S₂ i.e. wax emulsion 8% + cold storage recorded total sugars content of 16.07%.

Interactions effect of chemicals, wax emulsion and storage conditions

The interactions effect of chemicals, wax emulsion and storage conditions revealed significant variation in total sugars throughout the storage period. Fruits stored in ambient conditions exhibited faster increase in total sugars than cold storage irrespective of chemicals, wax emulsion and storage conditions. On 6th day of storage, maximum total sugars were recorded in C₄W₁S₁ i.e. salicylic acid 2 mM + wax emulsion 6% + ambient temperature of storage (7.49%) while minimum total sugars recorded in C₁W₂S₂ i.e. hexanal 3% + wax emulsion 8% + cold storage (5.53%). On 12th day of storage, different chemicals, wax emulsion and storage conditions showed significant influence on total sugar contents of fruits. The treatment combination of C₄W₁S₁ i.e. salicylic acid 2 mM + wax emulsion 6% + ambient temperature was observed maximum total sugars (15.02%) whereas the treatment combination of C₁W₂S₂ i.e. hexanal 3% + wax emulsion 8% + cold storage recorded minimum total sugars (9.74%) followed by the treatment C₃W₂S₂ (9.83%). On 18th day of storage, fruits treated with C₁W₂S₂ i.e. hexanal 3% + wax emulsion 8% + cold storage recorded minimum total sugars (13.60%) while fruits treated with C₄W₂S₂ i.e. salicylic acid 2 mM + wax emulsion 8% + cold storage recorded maximum total sugars (16.28%). On 24th day of storage, fruits treated with C₁W₂S₂ i.e. hexanal 3% + wax emulsion 8% + cold storage were remained in storage with total sugar content of 16.07%.

Table 2: Effect of different post-harvest treatment of chemicals, wax emulsion and storage conditions on total sugars (%) of banana fruit during storage

Treatment	Initial days			2 days			4 days			6 days			8 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A. Chemicals															
C ₁	1.74	1.68	1.71	2.06	2.00	2.03	4.50	4.38	4.44	6.18	6.06	6.12	6.97	6.86	6.92
C ₂	1.77	1.71	1.74	2.14	2.07	2.10	4.63	4.52	4.58	6.31	6.15	6.23	7.08	7.05	7.07
C ₃	1.75	1.70	1.72	2.11	2.04	2.07	4.57	4.45	4.51	6.23	6.13	6.18	7.03	6.92	6.97
C ₄	1.85	1.77	1.81	2.34	2.28	2.31	5.24	5.14	5.19	7.08	6.99	7.04	8.46	8.34	8.40
C ₅	1.84	1.76	1.80	2.33	2.28	2.30	5.22	5.07	5.14	7.08	6.97	7.02	8.44	8.30	8.37
C ₆	1.82	1.75	1.78	2.27	2.20	2.23	5.11	4.98	5.04	6.99	6.87	6.93	8.33	8.20	8.26
S.Em. ±	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	0.10	NS	NS	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
B. Wax emulsion															
W ₁	1.81	1.74	1.78	2.27	2.21	2.24	4.98	4.85	4.91	6.74	6.60	6.67	7.82	7.70	7.76
W ₂	1.77	1.71	1.74	2.14	2.08	2.11	4.78	4.67	4.72	6.55	6.45	6.50	7.61	7.53	7.57
S.Em. ±	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	0.05	NS	NS	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. Storage conditions															
S ₁	1.82	1.75	1.78	2.43	2.37	2.40	5.21	5.09	5.15	7.07	6.95	7.01	8.22	8.11	8.16
S ₂	1.77	1.71	1.74	1.98	1.91	1.95	4.54	4.43	4.49	6.22	6.10	6.16	7.22	7.11	7.16
S.Em. ±	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	0.06	NS	0.06	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Interaction (A x B)															

C ₁ W ₁	1.76	1.71	1.73	2.13	2.05	2.09	4.60	4.49	4.54	6.27	6.11	6.19	7.06	6.94	7.00
C ₁ W ₂	1.72	1.66	1.69	2.00	1.96	1.98	4.41	4.28	4.35	6.09	6.00	6.05	6.88	6.79	6.83
C ₂ W ₁	1.80	1.73	1.76	2.19	2.12	2.15	4.74	4.62	4.68	6.41	6.20	6.30	7.16	7.08	7.12
C ₂ W ₂	1.74	1.69	1.71	2.08	2.03	2.05	4.53	4.43	4.48	6.21	6.11	6.16	7.01	7.02	7.01
C ₃ W ₁	1.76	1.71	1.74	2.17	2.10	2.13	4.67	4.54	4.60	6.32	6.20	6.26	7.13	7.02	7.07
C ₃ W ₂	1.74	1.69	1.71	2.04	1.98	2.01	4.47	4.37	4.42	6.15	6.05	6.10	6.93	6.82	6.87
C ₄ W ₁	1.88	1.79	1.83	2.44	2.38	2.41	5.39	5.28	5.33	7.21	7.11	7.16	8.63	8.48	8.56
C ₄ W ₂	1.82	1.75	1.78	2.25	2.18	2.21	5.09	5.01	5.05	6.96	6.88	6.92	8.29	8.20	8.24
C ₅ W ₁	1.85	1.77	1.81	2.39	2.36	2.37	5.29	5.10	5.19	7.15	7.04	7.10	8.53	8.37	8.45
C ₅ W ₂	1.83	1.75	1.79	2.28	2.20	2.24	5.15	5.05	5.10	7.01	6.90	6.95	8.35	8.24	8.29
C ₆ W ₁	1.85	1.77	1.81	2.34	2.27	2.30	5.20	5.10	5.15	7.08	6.97	7.02	8.44	8.31	8.37
C ₆ W ₂	1.80	1.73	1.76	2.20	2.13	2.16	5.01	4.86	4.94	6.90	6.78	6.84	8.22	8.10	8.16
S.Em. ±	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	NS	NS	NS	NS	0.05	0.05	0.06	0.06	0.05	0.06	0.05	0.05	0.04	0.04	0.04

Table 2: Continue

Treatment	Initial days			2 days			4 days			6 days			8 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A x C															
C ₁ S ₁	1.76	1.70	1.73	2.28	2.22	2.25	4.78	4.64	4.71	6.69	6.56	6.63	7.55	7.48	7.51
C ₁ S ₂	1.71	1.67	1.69	1.85	1.79	1.82	4.23	4.13	4.18	5.67	5.55	5.61	6.39	6.25	6.32
C ₂ S ₁	1.80	1.73	1.76	2.35	2.28	2.32	4.93	4.82	4.88	6.83	6.68	6.75	7.64	7.64	7.64
C ₂ S ₂	1.74	1.69	1.71	1.92	1.86	1.89	4.34	4.23	4.28	5.78	5.63	5.70	6.53	6.46	6.49
C ₃ S ₁	1.77	1.72	1.75	2.32	2.26	2.29	4.84	4.75	4.79	6.75	6.62	6.68	7.59	7.45	7.52
C ₃ S ₂	1.73	1.68	1.70	1.89	1.82	1.85	4.29	4.16	4.22	5.72	5.64	5.68	6.47	6.39	6.43
C ₄ S ₁	1.88	1.79	1.83	2.58	2.52	2.55	5.64	5.54	5.59	7.42	7.32	7.37	8.90	8.77	8.83
C ₄ S ₂	1.82	1.75	1.78	2.10	2.04	2.07	4.84	4.75	4.80	6.75	6.67	6.71	8.02	7.92	7.97
C ₅ S ₁	1.86	1.78	1.82	2.58	2.52	2.55	5.60	5.46	5.53	7.42	7.31	7.36	8.86	8.69	8.77
C ₅ S ₂	1.82	1.74	1.78	2.09	2.03	2.06	4.84	4.69	4.76	6.74	6.63	6.68	8.02	7.92	7.97
C ₆ S ₁	1.85	1.77	1.81	2.50	2.45	2.47	5.49	5.33	5.41	7.32	7.24	7.28	8.77	8.66	8.72
C ₆ S ₂	1.79	1.73	1.76	2.03	1.96	1.99	4.73	4.63	4.68	6.66	6.51	6.58	7.88	7.74	7.81
S.Em. ±	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	NS	NS	NS	NS	NS	NS	0.06	0.06	0.05	0.06	0.05	0.05	0.06	0.06	0.05
B x C															
W ₁ S ₁	1.84	1.76	1.80	2.51	2.44	2.47	5.32	5.19	5.26	7.17	7.02	7.09	8.31	8.17	8.24
W ₁ S ₂	1.79	1.73	1.76	2.04	1.98	2.01	4.63	4.51	4.57	6.31	6.19	6.25	7.34	7.23	7.29
W ₂ S ₁	1.80	1.73	1.76	2.36	2.30	2.33	5.10	4.99	5.04	6.98	6.89	6.93	8.13	8.06	8.09
W ₂ S ₂	1.74	1.69	1.72	1.91	1.85	1.88	4.45	4.35	4.40	6.12	6.02	6.07	7.09	6.99	7.04
S.Em. ±	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CD 1%	NS	NS	NS	NS	NS	NS	0.03	0.03	0.03	NS	0.03	NS	0.03	0.03	0.03
A x B x C															
C ₁ W ₁ S ₁	1.78	1.73	1.76	2.34	2.27	2.31	4.87	4.73	4.80	6.78	6.60	6.69	7.62	7.56	7.59
C ₁ W ₁ S ₂	1.73	1.69	1.71	1.91	1.82	1.87	4.32	4.24	4.28	5.76	5.62	5.69	6.49	6.32	6.41
C ₁ W ₂ S ₁	1.74	1.67	1.71	2.21	2.17	2.19	4.68	4.54	4.61	6.60	6.52	6.56	7.47	7.39	7.43
C ₁ W ₂ S ₂	1.69	1.64	1.67	1.78	1.75	1.77	4.14	4.02	4.08	5.58	5.48	5.53	6.29	6.18	6.24
C ₂ W ₁ S ₁	1.83	1.75	1.79	2.41	2.34	2.38	5.06	4.93	5.00	6.94	6.71	6.83	7.70	7.59	7.65
C ₂ W ₁ S ₂	1.76	1.71	1.74	1.97	1.89	1.93	4.41	4.30	4.36	5.87	5.68	5.78	6.62	6.57	6.60
C ₂ W ₂ S ₁	1.76	1.71	1.74	2.29	2.22	2.26	4.80	4.71	4.76	6.72	6.64	6.68	7.58	7.69	7.64
C ₂ W ₂ S ₂	1.71	1.67	1.69	1.87	1.83	1.85	4.26	4.15	4.21	5.69	5.57	5.63	6.43	6.35	6.39
C ₃ W ₁ S ₁	1.78	1.73	1.76	2.39	2.32	2.36	4.94	4.82	4.88	6.83	6.69	6.76	7.67	7.54	7.61
C ₃ W ₁ S ₂	1.74	1.69	1.72	1.95	1.87	1.91	4.39	4.25	4.32	5.80	5.71	5.76	6.58	6.50	6.54
C ₃ W ₂ S ₁	1.76	1.71	1.74	2.25	2.19	2.22	4.74	4.67	4.71	6.66	6.54	6.60	7.51	7.36	7.44
C ₃ W ₂ S ₂	1.71	1.67	1.69	1.83	1.76	1.80	4.19	4.06	4.13	5.63	5.56	5.60	6.35	6.27	6.31

Table 2: Continue

Treatment	Initial days			2 days			4 days			6 days			8 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
C ₄ W ₁ S ₁	1.90	1.80	1.85	2.67	2.61	2.64	5.80	5.69	5.75	7.55	7.43	7.49	9.05	8.86	8.96
C ₄ W ₁ S ₂	1.85	1.77	1.81	2.20	2.14	2.17	4.97	4.86	4.92	6.87	6.78	6.83	8.21	8.10	8.16
C ₄ W ₂ S ₁	1.85	1.77	1.81	2.49	2.42	2.46	5.47	5.38	5.43	7.29	7.20	7.25	8.74	8.67	8.71
C ₄ W ₂ S ₂	1.78	1.73	1.76	2.00	1.93	1.97	4.71	4.64	4.68	6.62	6.55	6.59	7.83	7.73	7.78
C ₅ W ₁ S ₁	1.87	1.78	1.83	2.64	2.60	2.62	5.66	5.51	5.59	7.49	7.34	7.42	8.92	8.69	8.81
C ₅ W ₁ S ₂	1.83	1.75	1.79	2.14	2.11	2.13	4.91	4.68	4.80	6.81	6.74	6.78	8.14	8.05	8.10
C ₅ W ₂ S ₁	1.85	1.77	1.81	2.52	2.44	2.48	5.53	5.41	5.47	7.35	7.27	7.31	8.80	8.68	8.74
C ₅ W ₂ S ₂	1.80	1.73	1.77	2.03	1.95	1.99	4.76	4.69	4.73	6.66	6.52	6.59	7.90	7.79	7.85
C ₆ W ₁ S ₁	1.87	1.78	1.83	2.58	2.52	2.55	5.60	5.46	5.53	7.41	7.34	7.38	8.87	8.76	8.82
C ₆ W ₁ S ₂	1.82	1.75	1.79	2.09	2.02	2.06	4.80	4.73	4.77	6.75	6.59	6.67	8.00	7.85	7.93

C ₆ W ₂ S ₁	1.83	1.75	1.79	2.42	2.37	2.40	5.37	5.20	5.29	7.23	7.14	7.19	8.67	8.56	8.62
C ₆ W ₂ S ₂	1.76	1.71	1.74	1.97	1.89	1.93	4.65	4.52	4.59	6.56	6.42	6.49	7.76	7.63	7.70
S.Em. ±	0.05	0.06	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CD 1%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.08	NS	6.58	6.50	6.54
Treated	1.79	1.73	1.76	2.21	2.14	2.17	4.88	4.76	4.82	6.64	6.53	6.59	7.72	7.61	7.66
Control	1.92	1.82	1.87	5.61	5.56	5.59	11.82	11.65	11.74	18.66	18.57	18.62	14.71	14.63	14.67
S.Em. ±	0.04	0.05	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.04	0.02	0.02	0.02
CD 1%	0.12	0.13	0.12	0.05	0.05	0.04	0.05	0.05	0.04	0.09	0.13	0.11	0.05	0.05	0.04

Table 2: Continue

Treatment	10 days			12 days			14 days			16 days			18 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A. Chemicals															
C ₁	8.50	8.42	8.46	10.74	10.66	10.70	11.73	11.59	11.66	13.50	13.41	13.45	15.78	15.66	15.72
C ₂	9.39	9.31	9.35	10.90	10.82	10.86	11.76	11.67	11.72	13.63	13.56	13.59	15.94	15.87	15.90
C ₃	9.08	9.00	9.04	10.82	10.73	10.78	11.86	11.75	11.81	13.56	13.46	13.51	15.87	15.77	15.82
C ₄	10.57	10.50	10.54	13.78	13.70	13.74	15.47	15.40	15.44	16.57	16.57	16.57	16.34	16.22	16.28
C ₅	10.57	10.49	10.53	13.73	13.67	13.70	15.54	15.44	15.49	17.65	17.58	17.65	-	-	-
C ₆	10.46	10.37	10.41	13.64	13.56	13.60	15.36	15.28	15.32	16.55	16.55	16.55	16.13	16.05	16.09
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.04	0.04	0.04	0.02	0.03	0.02	-	-	-	-	-	-	-	-	-
B. Wax emulsion															
W ₁	9.91	9.84	9.88	12.38	12.31	12.34	12.71	12.61	12.66	13.67	13.58	13.62	15.96	15.89	15.92
W ₂	9.61	9.52	9.57	12.16	12.07	12.12	13.84	13.74	13.79	14.97	14.91	14.94	15.92	15.81	15.87
S.Em. ±	0.01	0.01	0.01	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
CD 1%	0.02	0.02	0.02	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
C. Storage conditions															
S ₁	10.50	10.42	10.46	13.23	13.15	13.19	14.41	14.30	14.35	14.83	14.77	14.80	17.78	17.64	17.71
S ₂	9.02	8.94	8.98	11.30	11.23	11.27	12.57	12.48	12.52	14.22	14.15	14.22	15.70	15.61	15.66
S.Em. ±	0.01	0.01	0.01	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
CD 1%	0.02	0.02	0.02	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
Interaction (A x B)															
C ₁ W ₁	8.59	8.53	8.56	10.84	10.78	10.81	11.89	11.73	11.81	13.62	13.52	13.57	15.89	15.81	15.85
C ₁ W ₂	8.42	8.32	8.37	10.65	10.55	10.60	11.56	11.44	11.50	13.39	13.30	13.34	15.73	15.58	15.65
C ₂ W ₁	9.75	9.67	9.71	11.02	10.94	10.98	11.73	11.65	11.69	13.73	13.65	13.69	16.04	15.96	16.00
C ₂ W ₂	9.03	8.94	8.99	10.79	10.70	10.74	11.80	11.70	11.75	13.53	13.47	13.50	15.83	15.77	15.80
C ₃ W ₁	9.18	9.10	9.14	10.92	10.84	10.88	11.98	11.87	11.93	13.67	13.57	13.62	15.95	15.89	15.92
C ₃ W ₂	8.98	8.90	8.94	10.72	10.63	10.67	11.75	11.63	11.69	13.46	13.35	13.40	15.79	15.65	15.72
C ₄ W ₁	10.74	10.68	10.71	13.94	13.86	13.90	14.50	14.43	14.47	-	-	-	-	-	-
C ₄ W ₂	10.41	10.32	10.36	13.61	13.54	13.57	15.95	15.89	15.92	16.57	16.57	16.57	16.34	16.22	16.28
C ₅ W ₁	10.67	10.59	10.63	13.81	13.76	13.78	14.43	14.36	14.40	-	-	-	-	-	-
C ₅ W ₂	10.47	10.39	10.43	13.66	13.59	13.62	16.10	15.99	16.04	17.65	17.58	17.62	-	-	-
C ₆ W ₁	10.56	10.46	10.51	13.73	13.67	13.70	14.30	14.21	14.26	-	-	-	-	-	-
C ₆ W ₂	10.36	10.28	10.32	13.55	13.45	13.50	15.90	15.82	15.86	16.55	16.55	16.55	16.13	16.05	16.09
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.05	0.06	0.05	0.03	0.04	0.03	-	-	-	-	-	-	-	-	-

Table 2: Continue

Treatment	10 days			12 days			14 days			16 days			18 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A x C															
C ₁ S ₁	9.37	9.28	9.32	11.61	11.53	11.57	12.73	12.58	12.65	14.49	14.39	14.44	17.78	17.64	17.71
C ₁ S ₂	7.63	7.57	7.60	9.88	9.80	9.84	10.73	10.60	10.66	12.51	12.42	12.47	14.78	14.67	14.72
C ₂ S ₁	9.48	9.40	9.44	11.75	11.66	11.70	12.83	12.74	12.78	14.62	14.56	14.59	-	-	-
C ₂ S ₂	9.30	9.21	9.26	10.06	9.98	10.02	10.70	10.61	10.65	12.64	12.57	12.60	15.94	15.87	15.90
C ₃ S ₁	9.42	9.34	9.38	11.69	11.58	11.63	12.78	12.64	12.71	14.56	14.44	14.50	-	-	-
C ₃ S ₂	8.74	8.66	8.70	9.96	9.89	9.92	10.95	10.86	10.90	12.57	12.48	12.52	15.87	15.77	15.82
C ₄ S ₁	11.63	11.54	11.58	14.87	14.79	14.83	17.63	17.57	17.60	15.60	15.68	15.64	-	-	-
C ₄ S ₂	9.52	9.46	9.49	12.68	12.60	12.64	14.39	14.32	14.35	17.54	17.46	17.50	16.34	16.22	16.28
C ₅ S ₁	11.62	11.54	11.58	14.79	14.74	14.76	17.81	17.73	17.77	-	-	-	-	-	-
C ₅ S ₂	9.53	9.45	9.49	12.68	12.61	12.64	14.41	14.30	14.35	17.65	17.58	17.62	-	-	-
C ₆ S ₁	11.52	11.44	11.48	14.70	14.63	14.67	17.57	17.48	17.53	15.68	15.74	15.71	-	-	-
C ₆ S ₂	9.40	9.30	9.35	12.58	12.49	12.53	14.26	14.18	14.22	17.41	17.35	17.38	16.13	16.05	16.09
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.05	0.06	0.05	0.03	0.04	0.03	-	-	-	-	-	-	-	-	-
B x C															
W ₁ S ₁	10.60	10.52	10.56	13.35	13.27	13.31	12.87	12.72	12.80	14.65	14.56	14.60	-	-	-

W ₁ S ₂	9.23	9.16	9.19	11.41	11.34	11.37	12.64	12.56	12.60	12.69	12.60	12.64	15.96	15.89	15.92
W ₂ S ₁	10.41	10.33	10.37	13.12	13.04	13.08	15.18	15.09	15.13	14.93	14.90	14.92	17.78	17.64	17.71
W ₂ S ₂	8.81	8.72	8.76	11.20	11.11	11.16	12.50	12.40	12.45	14.99	14.92	14.96	15.55	15.44	15.50
S.Em. \pm	0.01	0.01	0.01	0.00	0.01	0.00	-	-	-	-	-	-	-	-	-
CD 1%	0.03	0.03	0.03	0.02	NS	NS	-	-	-	-	-	-	-	-	-
A x B x C															
C ₁ W ₁ S ₁	9.45	9.39	9.42	11.71	11.64	11.68	12.81	12.62	12.72	14.60	14.49	14.55	-	-	-
C ₁ W ₁ S ₂	7.72	7.67	7.70	9.97	9.91	9.94	10.97	10.84	10.91	12.63	12.54	12.59	15.89	15.81	15.85
C ₁ W ₂ S ₁	9.29	9.16	9.23	11.50	11.42	11.46	12.64	12.53	12.59	14.38	14.29	14.34	17.78	17.64	17.71
C ₁ W ₂ S ₂	7.54	7.47	7.51	9.79	9.68	9.74	10.48	10.35	10.42	12.39	12.30	12.35	13.67	13.52	13.60
C ₂ W ₁ S ₁	9.58	9.50	9.54	11.84	11.76	11.80	12.92	12.81	12.87	14.70	14.63	14.67	-	-	-
C ₂ W ₁ S ₂	9.91	9.84	9.88	10.20	10.11	10.16	10.54	10.49	10.52	12.75	12.67	12.71	16.04	15.96	16.00
C ₂ W ₂ S ₁	9.37	9.30	9.34	11.65	11.55	11.60	12.73	12.67	12.70	14.54	14.48	14.51	-	-	-
C ₂ W ₂ S ₂	8.69	8.58	8.64	9.92	9.84	9.88	10.86	10.72	10.79	12.52	12.46	12.49	15.83	15.77	15.80
C ₃ W ₁ S ₁	9.51	9.43	9.47	11.79	11.70	11.75	12.87	12.74	12.81	14.64	14.55	14.60	-	-	-
C ₃ W ₁ S ₂	8.85	8.76	8.81	10.05	9.98	10.02	11.09	11.00	11.05	12.69	12.58	12.64	15.95	15.89	15.92
C ₃ W ₂ S ₁	9.33	9.25	9.29	11.58	11.46	11.52	12.69	12.53	12.61	14.47	14.32	14.40	-	-	-
C ₃ W ₂ S ₂	8.62	8.55	8.59	9.86	9.79	9.83	10.80	10.72	10.76	12.44	12.37	12.41	15.79	15.65	15.72

Table 2: Continue

Treatment	10 days			12 days			14 days			16 days			18 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
C ₄ W ₁ S ₁	11.76	11.67	11.72	15.07	14.97	15.02	-	-	-	-	-	-	-	-	-
C ₄ W ₁ S ₂	9.72	9.69	9.71	12.81	12.74	12.78	14.50	14.43	14.47	-	-	-	-	-	-
C ₄ W ₂ S ₁	11.49	11.40	11.45	14.67	14.61	14.64	17.63	17.57	17.60	15.60	15.68	15.64	-	-	-
C ₄ W ₂ S ₂	9.32	9.23	9.28	12.55	12.46	12.51	14.27	14.21	14.24	17.54	17.46	17.50	16.34	16.22	16.28
C ₅ W ₁ S ₁	11.69	11.61	11.65	14.87	14.82	14.85	-	-	-	-	-	-	-	-	-
C ₅ W ₁ S ₂	9.65	9.57	9.61	12.74	12.69	12.72	14.43	14.36	14.40	-	-	-	-	-	-
C ₅ W ₂ S ₁	11.54	11.46	11.50	14.70	14.65	14.68	17.81	17.73	17.77	-	-	-	-	-	-
C ₅ W ₂ S ₂	9.40	9.32	9.36	12.61	12.53	12.57	14.38	14.24	14.31	17.65	17.58	17.62	-	-	-
C ₆ W ₁ S ₁	11.59	11.49	11.54	14.79	14.72	14.76	-	-	-	-	-	-	-	-	-
C ₆ W ₁ S ₂	9.52	9.43	9.48	12.67	12.62	12.65	14.30	14.21	14.26	-	-	-	-	-	-
C ₆ W ₂ S ₁	11.44	11.38	11.41	14.61	14.54	14.58	17.57	17.48	17.53	15.68	15.74	15.71	-	-	-
C ₆ W ₂ S ₂	9.28	9.17	9.23	12.48	12.36	12.42	14.22	14.15	14.19	17.41	17.35	17.38	16.13	16.05	16.09
S.Em. \pm	0.02	0.02	0.02	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-
CD 1%	0.08	0.08	0.07	0.04	0.05	0.04	-	-	-	-	-	-	-	-	-
Treated	9.76	9.68	9.72	12.27	12.19	12.23	13.36	13.26	13.31	14.51	14.44	14.51	15.94	15.83	15.88
Control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.Em. \pm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2: Continue

Treatment	20 days			22 days			24 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A. Chemicals									
C ₁	16.88	16.75	16.82	17.69	17.54	17.62	16.03	16.11	16.07
C ₂	-	-	-	-	-	-	-	-	-
C ₃	16.94	16.86	16.90	17.78	17.70	17.74	-	-	-
C ₄	-	-	-	-	-	-	-	-	-
C ₅	-	-	-	-	-	-	-	-	-
C ₆	-	-	-	-	-	-	-	-	-
S.Em. \pm	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
B. Wax emulsion									
W ₁	-	-	-	-	-	-	-	-	-
W ₂	16.91	16.81	16.86	17.74	17.62	17.68	16.03	16.11	16.07
S.Em. \pm	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
C. Storage conditions									
S ₁	-	-	-	-	-	-	-	-	-
S ₂	16.91	16.81	16.86	17.74	17.62	17.68	16.03	16.11	16.07
S.Em. \pm	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
Interaction (A x B)									
C ₁ W ₁	-	-	-	-	-	-	-	-	-
C ₁ W ₂	16.88	16.75	16.82	17.69	17.54	17.62	16.03	16.11	16.07
C ₂ W ₁	-	-	-	-	-	-	-	-	-

C ₂ W ₂	-	-	-	-	-	-	-	-	-
C ₃ W ₁	-	-	-	-	-	-	-	-	-
C ₃ W ₂	16.94	16.86	16.90	17.78	17.70	17.74	-	-	-
C ₄ W ₁	-	-	-	-	-	-	-	-	-
C ₄ W ₂	-	-	-	-	-	-	-	-	-
C ₅ W ₁	-	-	-	-	-	-	-	-	-
C ₅ W ₂	-	-	-	-	-	-	-	-	-
C ₆ W ₁	-	-	-	-	-	-	-	-	-
C ₆ W ₂	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-

Table 2: Continue

Treatment	20 days			22 days			24 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
A x C									
C ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₁ S ₂	16.88	16.75	16.82	17.69	17.54	17.62	16.03	16.11	16.07
C ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₃ S ₁	-	-	-	-	-	-	-	-	-
C ₃ S ₂	16.94	16.86	16.90	17.78	17.70	17.74	-	-	-
C ₄ S ₁	-	-	-	-	-	-	-	-	-
C ₄ S ₂	-	-	-	-	-	-	-	-	-
C ₅ S ₁	-	-	-	-	-	-	-	-	-
C ₅ S ₂	-	-	-	-	-	-	-	-	-
C ₆ S ₁	-	-	-	-	-	-	-	-	-
C ₆ S ₂	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
B x C									
W ₁ S ₁	-	-	-	-	-	-	-	-	-
W ₁ S ₂	-	-	-	-	-	-	-	-	-
W ₂ S ₁	-	-	-	-	-	-	-	-	-
W ₂ S ₂	16.91	16.81	16.86	17.74	17.62	17.68	16.03	16.11	16.07
S.Em. ±	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-
A x B x C									
C ₁ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₁ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₁ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₁ W ₂ S ₂	16.88	16.75	16.82	17.69	17.54	17.62	16.03	16.11	16.07
C ₂ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₂ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₂ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₂ W ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₃ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₃ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₃ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₃ W ₂ S ₂	16.94	16.86	16.90	17.78	17.70	17.74	-	-	-

Table 2: Continue

Treatment	20 days			22 days			24 days		
	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled	Trial I	Trial II	Pooled
C ₄ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₄ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₄ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₄ W ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₅ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₅ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₅ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₅ W ₂ S ₂	-	-	-	-	-	-	-	-	-
C ₆ W ₁ S ₁	-	-	-	-	-	-	-	-	-
C ₆ W ₁ S ₂	-	-	-	-	-	-	-	-	-
C ₆ W ₂ S ₁	-	-	-	-	-	-	-	-	-
C ₆ W ₂ S ₂	-	-	-	-	-	-	-	-	-
S.Em. ±	-	-	-	-	-	-	-	-	-

CD 1%	-	-	-	-	-	-	-	-	-
Treated	16.91	16.81	16.86	17.74	17.62	17.68	16.03	16.11	16.07
Control	-	-	-	-	-	-	-	-	-
S.Em. \pm	-	-	-	-	-	-	-	-	-
CD 1%	-	-	-	-	-	-	-	-	-

C₁: Hexanal (3%), C₂: Hexanal (4%), C₃: Hexanal (5%), C₄: Salicylic acid (2 mM), C₅: Salicylic acid (3 mM), C₆: Salicylic acid (4 mM), W₁: Wax emulsion (6%), W₂: Wax emulsion (8%), S₁: Ambient temperature, S₂: Cold storage (13 °C+1)

Average total sugars in treated fruits were ranged from 1.76 to 16.07% up to the end of storage *i.e.* on 24th day under cold storage conditions. Total sugars in fruits of control treatment within 8 days varied from 1.87 to 14.67% at the end of 8th day of storage at ambient conditions.

The initial raise in sugar content may be due to conversion of starch into sugar, while later decrease was due to consumption of sugars for respiration during storage. As the fruit ripening advances, starch, hemicelluloses and organic acid get converted into various forms of sugar. Similar findings were also reported by Venkatachalam *et al.* (2018)^[247] in banana fruits, Jangir *et al.* (2021)^[11] in custard apple and Rajesh *et al.* (2020)^[19] in sapota.

Wax coating forms a thin film over the fruit surface and restricts the gaseous exchange thereby controlling the metabolic rate of fruit tissues (Rao and Chundawat, 1986)^[22]. The results of present findings are in line of earlier research worker such as Mandal *et al.* (2019)^[16] and Devi *et al.* (2021)^[6] in banana.

The lower sugars seen under reduced temperature storage conditions may be due to the inhibition of acid metabolism and dehydration which reduced soluble sugar concentration in fruit. The total sugar was greater at ambient temperature due to higher rate of hydrolysis and higher rate of respiration (Shakila and Anburani, 2010)^[23]. Similar findings were reported by Mahajan *et al.* (2009)^[14] in guava, Khanbarad *et al.* (2012)^[13], Hossain *et al.* (2013)^[9] and Venkatachalam *et al.* (2018)^[24] in banana.

Conclusion

Overall the results indicated that the treatment combination, C₁W₂S₂ *i.e.* hexanal @ 3% + wax emulsion @ 8% + cold storage (13°C+1) was found to be the best treatment regarding chemical parameters *viz.*, TSS (°Brix), pH, titratable acidity (%), total sugars (%), reducing sugars (%) and non-reducing sugars (%) content of banana.

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