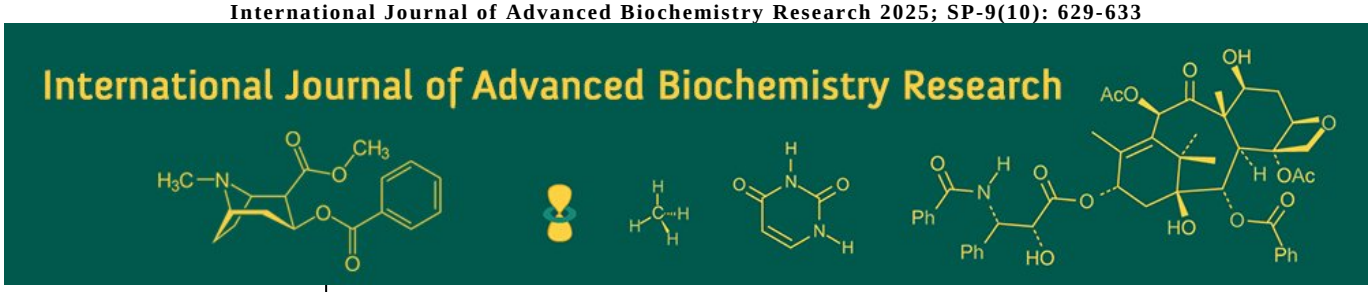


ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(10): 629-633
www.biochemjournal.com
Received: 13-08-2025
Accepted: 16-09-2025

Sripogula Nithya
PG Scholar, Department of Postharvest Management Dr. YSRHU - College of Horticulture, Anantharajupeta, Railway Kodur (M), Annamaya District, Andhra Pradesh, India

C.N. Byanna
Principal, SSPG Horticultural Polytechnic, Madakasira, Sri Sathya Sai District, Andhra Pradesh, India

M. Siva Prasad
Professor and Head, Department of Fruit science Dr. YSRHU - College of Horticulture, Anantharajupeta, Railway Kodur (M), Annamaya District, Andhra Pradesh, India

Ch. Ruth
Associate Director of Research, Rayalaseema Zone, Tirupati, Andhra Pradesh, India

Corresponding Author:
Sripogula Nithya
PG Scholar, Department of Postharvest Management Dr. YSRHU - College of Horticulture, Anantharajupeta, Railway Kodur (M), Annamaya District, Andhra Pradesh, India

Evaluation of fining agents for clarification of kinnow mandarin juice

Sripogula Nithya, CN Byanna, M Siva Prasad and Ch. Ruth

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i10Sh.5895

Abstract
The current investigation entitled "Evaluation of fining agents for clarification of kinnow mandarin juice" was conducted with Completely Randomized Block Design (CRD) at the Department of Postharvest Management Laboratory in Dr. YSRHU - College of Horticulture, Anantharajupeta, Annamaya district, Andhra Pradesh, during the period of 2024- 2025. Kinnow juice was clarified by using different fining agents at 2 % viz., T_1 Bentonite, T_2 Gelatin, T_3 Albumin, T_4 Activated charcoal, T_5 Silica gel, T_6 Without fining agent at refrigerated (4°C) condition and T_7 Without fining agent at ambient temperature - control. The results revealed that, across the treatments, the physico-chemical parameters including pH, TSS, clarity, titratable acidity, ascorbic acid T_2 (2% Gelatin) was found to be the best in terms of quality and clarity during the 15 days of storage at 5 days interval.

Keywords: Kinnow mandarin, fining agents, gelatin, clarity, physico-chemical

Introduction
Citrus (Citrus *spp*.) belongs to the family Rutaceae. These fruits are immensely popular worldwide for their flavour and nutrition. Citrus originated in South East Asia and is now grown in tropical-subtropical belt from 40° latitude North to 40° latitude South, in both humid and arid regions. Citrus has an important place in world fruit production (Cooper and Chapot, 1977) [2]. Plants in this genus produce citrus fruits, which includes important crops such as orange, mandarin, lemon, lime and tangerines.

Among the citrus group, Kinnow is a high yielding mandarin hybrid cultivated extensively in Punjab, Haryana and Rajasthan in India and also the main horticulture crop of Pakistani Punjab. Kinnow mandarin is a hybrid between *C. nobilis* and *C. deliciosa*. The fruit has distinct aroma and flavour, which makes it highly suitable for table fruit and for processing (Ilame and Singh, 2018) [4].

Fruit juices are widely consumed beverages valued for their nutritional and health-promoting properties, containing essential bioactive compounds such as flavonoids, carotenoids, vitamins, minerals, and polyphenols that help prevent chronic diseases and support overall well-being (Ahmed *et al*., 2018) [1]. Kinnow juice is a rich source of vitamin C and various antioxidant compounds that are required to sustain healthy life. It is also a rich source of primary metabolites such as amino acid, vitamins (ascorbic acid, provitamin- A, and folate) as well as secondary metabolites.

However, the presence of suspended particulate matter reduces their clarity, quality, and consumer acceptability. Clarification is therefore a crucial step in juice processing, ensuring stability, visual appeal, flavor enhancement, and extended shelf life. Various clarifying methods such as microfiltration, enzymatic treatment, and fining agents including gelatin, bentonite, activated carbon, silica gel, and albumin are employed to remove proteins, phenolics, and other colloidal substances (Deshmukh, K.Y).

Protein-based agents like gelatin and albumin bind with tannins and proteins, while bentonite and colloidal silica effectively eliminate proteins, preventing haze formation. Application of fining agents improves clarity, enhances consumer acceptance, and prolongs storage stability, making the process pivotal for fruit juice industry sustainability and marketability.

Kinnow mandarin juice, though nutritionally rich, is often turbid due to suspended particles and colloidal substances, which lower its consumer acceptability and market value. Clarification using fining agents improves clarity, colour, and stability by removing haze-

forming compounds, thereby enhancing sensory qualities, shelf life, and overall marketability of the juice. Hence, the present study was carried out to develop a high-quality, stable, and consumer-acceptable kinnow mandarin juice through clarification using suitable fining agents.

Material and methods

The research was carried out in the Postharvest Management Laboratory at the College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh. The following methodology was followed for the preparation of Kinnow mandarin juice and the steps are described below:

Selection of fruits

Fresh, fully ripened and high-quality kinnow mandarin fruits were selected and procured from the local market at Railway kodur. The fruits were sorted to eliminate any damaged or spoiled ones. After sorting, the selected fruits were washed and peeled to remove any impurities.

Preparation of Kinnow mandarin juice

The peeled fruits were sliced into pieces for processing. Clear juice extracted by separating the pulp and seeds using the Hurrom H-100 juicer. The obtained juice was filtered to remove minor impurities and sodium benzoate was added as a preservative to extend the shelf life. 2% of different fining agents were added and the juice was pasteurized at 85 °C for 1 min. The pasteurized juice was immediately cooled and stored at 3°C to 5°C for further use.

Filling, Bottling and capping

The prepared juice was filled into glass bottles according to the treatments and replications, followed by capping and stored at room temperature for 15 days to conduct storage experiments.

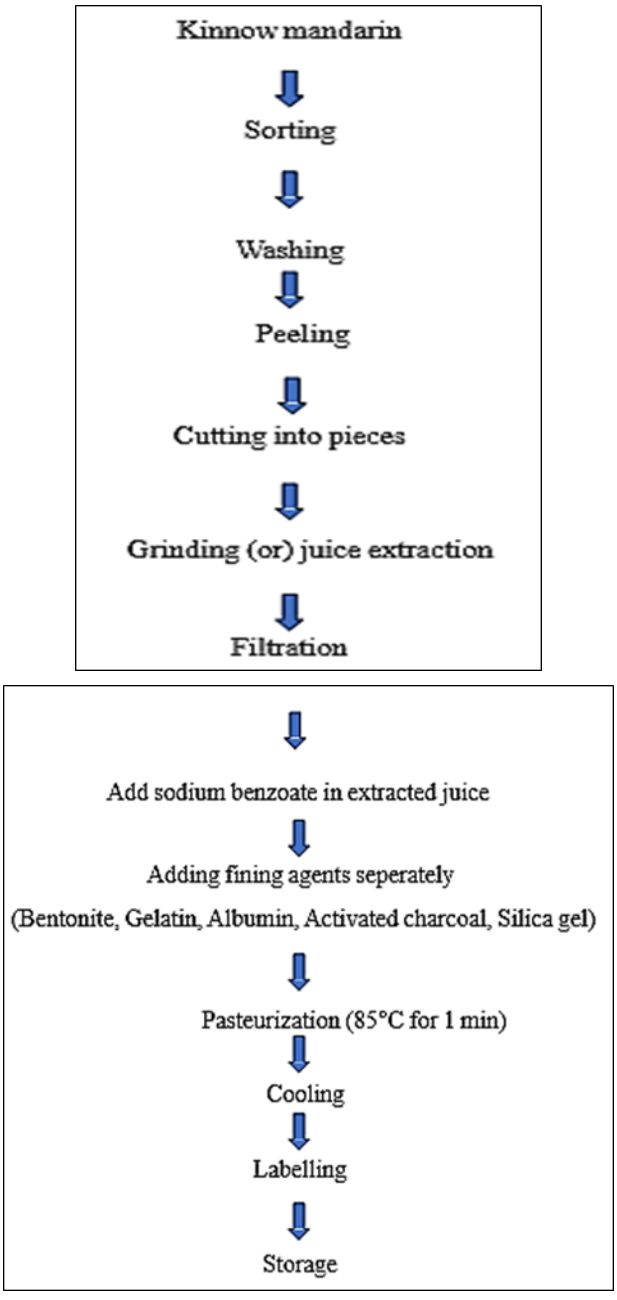
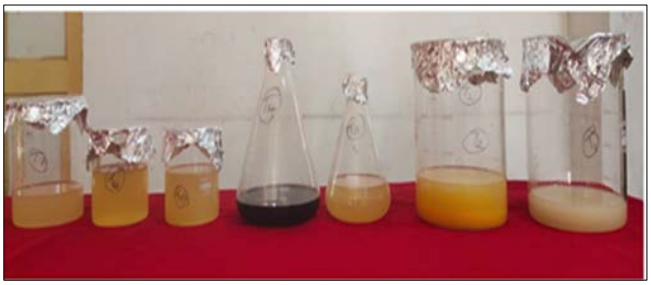


Fig 1: Flow chart of preparation of kinnow mandarin juice

Before clarification of kinnow juice



After clarification of kinnow juice

Fig 2: Before and after Clarification of kinnow mandarin juice.

Treatment details

- **T_1:** 2% Bentonite
- **T_2:** 2% Gelatin
- **T_3:** 2% Albumin
- **T_4:** 2% Activated charcoal T_5: 2% Silica Gel
- **T_6:** Fining by refrigeration (at 4°C) without adding fining agent
- **T_7:** Fining at ambient temperature without adding fining agent - Control

Physico - chemical Analysis

The physico - chemical parameters of clarified kinnow mandarin juice were estimated and analyzed. The pH of the samples was measured with a digital pH meter (ELICO LI-127) as described by Nidhi *et al.* (2007) [7]. Total soluble solids, expressed in °Brix, were measured using an Atago RX1000 digital refractometer (HRN-18). Titratable acidity was estimated using a titration method with NaOH as the neutralizer and phenolphthalein as the indicator for endpoint detection. Ascorbic acid content was estimated by using the 2,6-dichlorophenol indophenol titration technique described by Sadasivam and Manickam (1992). Juice clarity was measured according to the methods of Krop and Pilnik (1974) [6] and Ough and Crowell (1979) [8].

Results and discussion

Data related to physico - chemical parameters which include pH, total soluble solids, were presented in Table 1 and titratable acidity, ascorbic acid were detailed in Table 2. Clarity were detailed in Table 3 during 15 days of storage at 5 days interval.

pH

The pH of clarified kinnow mandarin juice was declined during storage. T_2 (2% Gelatin) shows the minimum pH followed by T_1 (2% Bentonite). The maximum pH was recorded in T_7 (Without fining agent at ambient temperature - control) which is on par with T_6 (Without fining agent at refrigerated (4°C) condition) during the 15 days of storage. The similar findings were observed in Jafari *et al.*, (2024) [5] in Indian gooseberry juice.

TSS (°Brix)

With regard to TSS of kinnow mandarin clarified juice, a gradual decline was observed during storage. The maximum TSS was recorded in T_7 (Without fining agent at ambient temperature - control), while the minimum was observed in T_2 (2% gelatin). A similar trend continued throughout the 15 days of storage. The results aligned with the findings of Jafari *et al.*, (2024) [5] in Indian gooseberry juice. Similar results were reported by Taştan and Baysal (2017) [9] in apple juice.

Table 1: Changes in pH and TSS during the storage of clarified mandarin juice as influenced by fining agents.

Treatments		Days after storage (DAS)							
		pH				TSS (°Brix)			
		0	05	10	15	0	05	10	15
T_1	2% Bentonite	3.68	3.64	3.58	3.51	9.34	9.27	9.19	9.10
T_2	2% Gelatin	3.40	3.36	3.32	3.28	9.11	9.05	8.90	8.83
T_3	2% Albumen	3.78	3.75	3.70	3.63	9.54	9.49	9.41	9.32
T_4	2% Activated charcoal	3.89	3.82	3.77	3.72	9.61	9.57	9.52	9.44
T_5	2% Silica gel	3.71	3.66	3.62	3.57	9.47	9.40	9.32	9.21
T_6	Fining by refrigeration (at 4 °C) without adding fining agent	3.91	3.87	3.84	3.79	9.69	9.63	9.58	9.51
T_7	Control - Fining at ambient temperature without adding fining agent	3.97	3.94	3.92	3.89	9.82	9.75	9.68	9.61
S.E m ±		0.02	0.03	0.02	0.01	0.03	0.03	0.03	0.02
CD at 5%		0.08	0.09	0.06	0.05	0.11	0.10	0.09	0.08

Titratable acidity (%)

The titratable acidity of clarified kinnow mandarin juice showed a gradual increase during storage. The percentage of titratable acidity, significantly highest acidity of was found in T_2 (2% Gelatin) followed by T_1 (2% Bentonite). Lowest acidity of was found in T_7 (Without fining agent at ambient temperature - control). Similar findings were recorded in Jafari *et al.*, (2024) [5] in Indian gooseberry juice.

Ascorbic acid (mg/ml)

Regarding the percentage of ascorbic acid, significantly highest was found in T_2 (2% Gelatin) followed by T_1 (2% Bentonite). Lowest was found in T_7. The ascorbic acid of clarified kinnow mandarin juice showed a gradual increase during storage. A similar trend continued throughout the 15 days of storage, with T_2 (2% Gelatin) consistently exhibiting the highest ascorbic acid (31.00, 31.09, 31.17 and 31.22 at 0, 5, 10, and 15 DAS, respectively), followed by T_1 (2% Bentonie). In contrast, T_7 (Without fining agent at ambient temperature - control) maintained the lowest ascorbic acid (21.50, 21.60, 21.65 and 21.71) at 0, 5, 10, and 15 DAS, respectively. The results aligned with the findings of Jafari *et al.*, (2024) [5] in Indian gooseberry juice.

Table 2: Changes in Titratable acidity (%) and Ascorbic acid (mg/ml) during the storage of clarified mandarin juice as influenced by fining agents.

Treatments		Days after storage (DAS)							
		Titratable acidity (%)				Ascorbic acid (mg/ml)			
		0	05	10	15	0	05	10	15
T_1	2% Bentonite	3.20	3.25	3.45	3.58	28.80	28.88	29.93	30.13
T_2	2% Gelatin	3.54	3.70	3.90	3.98	31.00	31.09	31.17	31.22
T_3	2% Albumen	2.61	2.80	2.92	3.00	26.30	26.41	26.49	26.57
T_4	2% Activated charcoal	2.05	2.16	2.30	2.45	25.50	25.57	25.63	26.05
T_5	2% Silica gel	2.90	3.00	3.19	3.40	28.00	28.12	28.21	28.26
T_6	Fining by refrigeration (at 4 °C) without adding fining agent	1.45	1.55	1.73	1.93	24.00	24.08	24.19	24.25
T_7	Control - Fining at ambient temperature without adding fining agent	1.20	1.32	1.56	1.69	21.50	21.60	21.65	21.71
S.E m ±		0.02	0.02	0.02	0.03	0.23	0.25	0.26	0.29
CD at 5%		0.06	0.07	0.07	0.09	0.71	0.78	0.81	0.90

Clarity (%)

The clarity of clarified kinnow mandarin juice showed a gradual decline during storage. At 0 to 15 days, the maximum clarity was recorded in (2% Gelatin), while the minimum was observed in T_7 (Without fining agent at ambient temperature - control). A similar trend continued throughout the 15 days of storage, with T_2 consistently exhibiting the highest clarity (9.70, 9.65, 9.61 and 9.60 at 0, 5, 10, and 15 DAS, respectively), followed by T_1 (2% Bentonite). In contrast, T_7 (Without fining agent at ambient temperature - control) maintained the least clarity (8.30, 8.24, 8.18 and 8.11 at 0, 5, 10, and 15 DAS, respectively). Therefore, during storage, the clarity of kinnow mandarin juice was reported to decrease, possibly because of protein deterioration or aggregation of proteins, phenolic compounds and polysaccharide compounds. Results were in line with the findings of Jafari *et al*., (2024) [5] in Indian gooseberry juice.

Table 3: Changes in Clarity (%) during the storage of clarified mandarin juice as influenced by fining agents.

Treatments		Days after storage (DAS)			
		Clarity (%)			
		0	05	10	15
T_1	2% Bentonite	9.40	9.36	9.30	9.20
T_2	2% Gelatin	9.70	9.65	9.61	9.60
T_3	2% Albumen	9.10	9.04	9.00	8.95
T_4	2% Activated charcoal	9.01	8.92	8.87	8.81
T_5	2% Silica gel	9.20	9.12	9.07	9.00
T_6	Fining by refrigeration (at 4 °C) without adding fining agent	8.50	8.41	8.39	8.32
T_7	Control - Fining at ambient temperature without adding fining agent	8.30	8.24	8.18	8.11
S.E m ±		0.09	0.05	0.06	0.06
CD at 5%		0.30	0.16	0.19	0.20

Conclusion

The present study concluded that the use of 2% gelatin significantly improved the clarity and physicochemical quality of kinnow mandarin juice. These findings provide valuable insights for the large-scale production of high-quality clarified juices, which can be further utilized in the preparation of value-added products.

Acknowledgement

I would like to express my heartfelt gratitude to my chairperson, Dr. C.N. Byanna, Co- chairperson Dr. M. Siva Prasad and Dr. Ch. Ruth for their invaluable support throughout this research work. I also extend my thanks to the Department of Postharvest Management, College of Horticulture, Anantharajupeta, for providing essential resources and to my family and friends for their unwavering encouragement.

References

1. Ahmed T, Das KK, Uddin MA. The microbiological quality of commercial fruit juices—current perspectives. Bangladesh Journal of Microbiology. 2018;35(2):128-133.
2. Cooper WC, Chapot H. Fruit production with special emphasis on fruit for processing. Citrus Science and Technology. 1977;2:1-127.
3. Deshmukh KY. Impact of clarifying agents in processed horticultural products. Greenaria. 2002;2(10):217-219.
4. Ilame SA, Singh SV. Physico-chemical properties of ultrafiltered kinnow (*Citrus reticulata* Blanco) fruit juice. Journal of Food Science and Technology. 2018;55(6):2189-2196.
5. Jafari S, Shiekh KA, Mishra DK, Kijpatanasilp I, Assatarakul K. Combined effects of clarifying agents improve physicochemical, microbial and sensorial qualities of fresh Indian gooseberry (*Phyllanthus emblica* L.) juice during refrigerated storage. Foods. 2024;13(2):290.
6. Krop JJ, Pilnik W. Effect of commercial protease preparations on cloud loss of citrus juice. Lebensmittel-Wissenschaft und Technologie. 1974;7:125-126.

7. Nidhi, Rakesh G, Singh R, Siddiqui S, Rana MK. Changes in chemical composition of bael-guava blends ready-to-serve beverage and squash during storage. Haryana Journal of Horticultural Sciences. 2007;36(2):46-48.
8. Ough CS, Crowell EA. Pectic-enzyme treatment of white grapes: temperature, variety and skin-contact time factors. American Journal of Enology and Viticulture. 1979;30(1):22-27.
9. Taştan Ö, Baysal T. Chitosan as a novel clarifying agent on clear apple juice production: optimization of process conditions and changes on quality characteristics. Food Chemistry. 2017;237:818-824.