The Pharma Innovation Journal 2021; 10(11): 393-396

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 393-396

www.thepharmajournal.com
Received: 16-09-2021
Accepted: 29-10-2021

Md. Shamsher Ahmad
Department of Pomology and Postharvest Technology, Faculty of Horticulture, UBKV, Pundibari, Cooch Behar, West Bengal, India

Mutum Preema Devi
Department of Pomology and Postharvest Technology, Faculty of Horticulture, UBKV, Pundibari, Cooch Behar, West Bengal, India

Prodyut Kumar Paul
Department of Pomology and Postharvest Technology, Faculty of Horticulture, UBKV, Pundibari, Cooch Behar, West Bengal, India

Nilesh Bhowmick
Department of Pomology and Postharvest Technology, Faculty of Horticulture, UBKV, Pundibari, Cooch Behar, West Bengal, India

Corresponding Author:
Md. Shamsher Ahmad
Department of Pomology and Postharvest Technology, Faculty of Horticulture, UBKV, Pundibari, Cooch Behar, West Bengal, India

Study on juice extraction methods for enhancing juice yield and reducing bitterness in pummelo

Md. Shamsher Ahmad, Mutum Preema Devi, Prodyut Kumar Paul and Nilesh Bhowmick

Abstract
Pummelo (*Citrus grandis* (L.) Osbeck, is the largest fruits among fruits of citrus family and mainly grown in home gardens of many Indian states. Fresh pummelo juice is an excellent source of antioxidant, nutrition and Posses medicinal values but people don't like to consume it either as fresh or processed. This is because the taste of pummelo juice turns highly bitter within few hours of extraction. This bitterness is mainly due to flavonoids and limonoids found in the fruit itself and get mixed during extraction process. This is a major problem and limiting factor of popularization and commercialization of pummelo fruit juice. The juices of other citrus fruits are also bitter but acceptable due to less quantity of bittering compounds. The present investigation was therefore, aimed at reducing bitterness of juice by different methods of juice extraction as well as enhances the yield. Two methods were applied for extraction of juice. In the first method of juice extraction, fruits were halved with stainless steel knife and pressed using a hand press citrus Juicer. In the second method, Screw type juice extractor was used for juice extraction with and without pre-treatment. Out of different methods tried, dipping of fruit in hot water at 80^0C for 5 and 10 minutes, peeling and juice extraction by Screw type juice extractor was found most effective and economical with respect to low bitter compounds (limonin @ 86.62 ± 79.81 and 34.15 ± 11.58 ppm and naringin @ 961.89 ± 299.41and 132.84 ± 97.87 ppm respectively). High Percentage of juice yield (42.44±3.27 and 44.10 ± 1.76%) and low percent of wastage (49.49 ± 2.37 and 44.73 ± 1.30%) also recorded in the same treatments.

Keywords: Pummelo, juice extraction, bitter compounds, debittering

1. Introduction

Citrus fruits are popular throughout the world and extensively processed into juices due to its health and nutritional benefits. A wide range of flavonoid glycosides, such as naringin, narirutin, neohesperidin, and hesperidin are present in citrus fruits (Ramful *et al*. 2011) [18]. Citrus fruits belong to the family Rutaceae and are the most produced fruit crop of the world (Davies and Albrigo 1994; Khan 2007**)** [5, 9]. Citrus fruits are a rich source of vitamin C. It also contains vitamin P, which keeps the small blood vessels in our bodies in a healthy condition and helps in the assimilation of vitamin C (Singh and Saxena, 2008) [21]. In India, citrus fruits are grown on large scale and occupy third position among fruits grown with an annual production of 13.40 million MT (National Horticulture Board (NHB), 2018-19). It accounts about 13.68% of total fruit production and occupies about 15.58% of total area under fruits in the country (NHB, 2018-19).

Pummelo [*Citrus grandis* (L.) Osbeck] is one of the most important fruits of genus citrus, grown in many states of India. It is also known as pomelo, shaddock (Uzun and Yesiloglu, 2012) [24], or Chinese grapefruit and commonly classified on the basis of segment color such as white, pink and red (Morton, J.F., 1987; Sawamura *et al*. 1990) [12, 19]. The world production of pummelo is about 9.3 million metric tons (FAOSTAT, 2019) [6]. The pummelo fruit has been gaining popularity all over the world and is now one of the five most widely cultivated and consumed citrus fruit of the world (Tocmo *et al*. 2020) [22].

Pummelo juice has been reported to have many health benefits. Its juice is an excellent source of antioxidant compounds and exhibited great efficiency in scavenging different forms of free radicals including DPPH, superoxide anion, and hydrogen peroxide radicals (Tsai *et al.*, 2007). Despite its health and nutritional benefits, it has neither become popular among consumers nor attained the commercial importance in any state of the country. It is because the juice of pummelo is bitter in taste and bitterness increases after extraction. This bitterness is mainly due to flavonoids and limonoids found in the fruit itself and get mixed during extraction process. Bitterness in fresh juice is due to flavonoids and during storage is due to limonoids (Premi *et al*. 1996) [16]. This is a major problem and limiting factor of popularization and commercialization of pummelo fruit juice. The juices of other citrus fruits are also bitter but acceptable due to less quantity of bittering compounds

The optimization of juice extraction methods and debittering process in grapefruit will not only enhance production and productivity of pummelo but also ensure premium price to growers. Keeping the above facts in considerations, the present study was under taken to develop suitable technology for debittering of pummelo juice and to evaluate its quality.

2. Materials and Methods

2.1 Pummelo fruits

Fully mature and ripened pummelo fruits were procured from people's backyard and farmer's field locally available at Pundibari, Cooch Behar and transported to the department of Pomology and Postharvest Technology, UBKV, Pundibari Cooch Behar. After sorting fruits were washed in clean water to remove dirt and dust particles.

2.2 Pretreatments of fruits

The fruits were subjected to pre-treatment before juice extraction (table 1) except control (T_1) and peeling and screw type juice extraction (T_2). The best method was identified on the basis of juice yield, waste generated and quantity of bittering compounds (limonin and naringin).

2.3 Extraction of juice

Two methods were applied for extraction of juice. In the first method of juice extraction, fruits were halved with stainless steel knife prior to juice extraction. Each halve was pressed and rotated against the projected knob of a stainless steel hand press citrus juicer. In the second method, Screw type juice extractor was used. The extracted juice was then strained through a muslin cloth.

Table 1: Methods of Juice extraction

Treatment symbol	Descriptions of treatments
T_1	Halving (without peeling) and manual juice extraction by a fruit/citrus juicer + filter (Control).
T_2	Peeling and juice extraction by Screw type juice extractor + filter
T_3	Peeling, lye treatment (in boiling 1% NaOH solution for 1 minute) + dipping in 1% Citric Acid + Screw type juice extractor + filter.
T_4	Peeling, lye treatment (in boiling 2% NaOH solution for 1 minute) + dipping in 2% Citric Acid + Screw type juice extractor + filter.
T_5	Dipping fruit in hot water at 80^0C for 5 minutes, peeling juice extraction by Screw type juice extractor + filter.
T_6	Dipping fruit in hot water at 80^0C for 10 minutes, peeling juice extraction by Screw type juice extractor + filter.

3. Physico-chemical analysis

The physico chemical analysis of pummelo fruits were conducted for different parameters like percent juice content, percent wastage, limonin, naringin, total soluble solids (TSS), acidity, ascorbic acid, reducing and total sugar.

3.1 Percent juice content and percent wastage

Percent juice content was calculated by dividing amount of extracted juice in gram with the weight of pummelo fruits taken for juice extraction and multiplying by one hundred. Similarly percent wastage was calculated by dividing amount of waste generated (weight of peel + rag + seed) in gram with the weight of pummelo fruits taken for juice extraction and multiplying by one hundred.

3.2 Estimation of limonin and naringin

Limonin content was estimated by the colorimetric method of Vaks and Lifshitz (1981) [25] and naringin by the method of Davis (1947) [4].

3.3 Statistical analysis

The data with three replications were collected for each parameter and analysed statistically by using completely randomized block design (CRD). The data were analyzed by analysis of variance (ANOVA) and means were compared by Duncan's Multiple Range Test (DMRT) by using SPSS Version 26. Differences between the means at the 5% level were considered significant.

4. Results and Discussion

The physico chemical characteristics pertaining to optimization of juice extraction is presented in table 2.

4.1 Influence of juice extraction methods on yield and waste generated

Juice extraction methods always play an important role in determining the bitterness of juice extracted from fruits (Lotha *et al*., 1994) [11] and therefore, optimization is required in every fruit. The results of optimization of extraction methods on juice yield and waste generated presented in table 2 and fig 1. It is evident from the table that out of different methods of juice extraction studied, maximum recovery of juice was obtained by screw type juice extractor. The findings are in line with the findings of Bala *et al*. (2017) [2] where they obtained maximum juice in kagzi lime by using screw type juice extractor. Pareek *et al*. (2011) [15] also reported higher juice yield in Nagpur mandarin by manual and power operated screw type commercial juice extractor.

4.2 Influence of pretreatments on juice yield and waste generated

Dipping fruits in hot water at 80^0C for 10 minutes, followed by peeling and juice extraction by screw type juice extractor (T_6) registered maximum yield and lowest waste generation. However, other pretreatments of juice extraction by screw type juice extractor were found non-significant. The higher juice yield in hot water treated fruits (T_6 and T_5) might be due to more squeezing of juice from warm juice sacs. Tomato processors usually boil tomatoes after crushing or cutting prior to pulping to obtain higher juice yields (Kaur *et al.* 2007) [10]. The minimum waste generated during extraction was found significantly lowest in hot water treated fruits (T_6). Other treatments of screw type juice extractor were found non-significant in waste generation as expected with higher juice yield but significantly superior than control (T_1).

Table 2: Optimization of juice extraction methods for pummelo fruits

Treatment (T)	Juice (%)	Wastage (%)	Limonin	Naringin
T_1	16.79 ± 2.10^{c}	78.20 ± 11.75^{a}	138.68 ± 75.19^{ab}	1759.84 ± 410.92^{bc}
T_2	32.80 ± 2.13^{b}	58.05 ± 2.84^{b}	265.91 ± 127.45^{a}	3596.03 ± 1031.06^{a}
T_3	42.70 ± 6.17^{a}	52.07 ± 8.48^{bc}	101.80 ± 32.87^{b}	2012.23 ± 623.23^{b}
T_4	39.46 ± 6.50^{ab}	52.96 ± 4.27^{bc}	65.69 ± 40.71^{b}	1258.89 ± 169.87^{bc}
T_5	42.44 ± 3.27^{a}	49.49 ± 2.37^{bc}	86.62 ± 79.81^{b}	961.89 ± 299.41^{cd}
T_6	44.10 ± 1.76^{a}	44.73 ± 1.30^{c}	34.15 ± 11.58^{b}	132.84 ± 97.87^{d}
S.Em (±)	2.392	3.678	41.592	311.664
CD (P=0.05)	7.37049	11.333	128.158	960.332

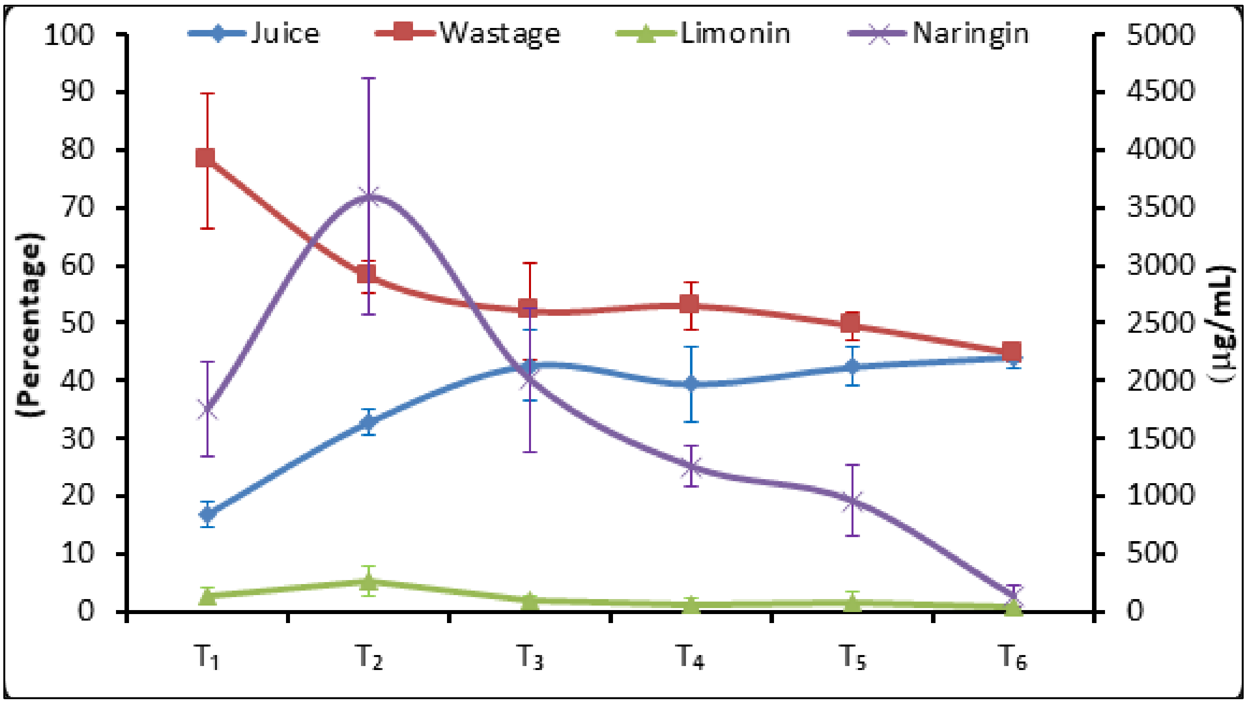

Fig 1: Graphical presentation of percent wastage, Juice yield and bittering compounds

4.3 Influence of juice extraction methods on bittering compounds (limonin and naringin)

Distribution pattern of limonin and naringin in pummelo is found different in different parts like albedo, flavedo, seeds, segment membrane and juice. It has been proved by many workers that the concentration of limonin in pummelo fruit is more in seeds, segment wall and albedo as compared to juice and flavedo (McIntoch *et al*. 1982; Jungsakulruijirek, 1997; Pichaiyongvongdee and Haruenkit, 2009) [13, 8, 17]. However, albedo was found the major source of naringin followed by albedo and segment membrane (Barthe *et al.*, 1988; Pichaiyongvongdee and Haruenkit, 2009) [3, 17].

In the present study, the bittering compound (limonin and naringin) were found significantly higher in the juice where fruits were not subjected to any pre treatment prior to screw type juice extraction (T_2) than all other treatments including control (T1) and lowest in the fruits of hot water treatments (T_5 & T_6). The probable reason behind this finding might be due to the fact that pretreatments facilitated removal of more albedo and less crushing of seeds during juice extraction. Sandhu and Singh (2001) [20] also reported reduction of bitter compounds in kinnow juice extracted after pre-treatment (lye peeling) of segments. Multiple blanching steps in hot water were found very effective in reducing bitter compound naringin by 40 - 50% for fresh orange slices, peel, and pulp (Jagarnath and Kumar, 2016) [7]. Many citrus processors tend to give a warm water wash to remove naringin, in citrus fruits. Hot water blanching also facilitates water inflow in the fruit and leaching of solutes including bitter flavanone glycosides, as reported by Zid *et al.* (2015) [26] while working for *Citrus aurantium* peels. The loss of naringin has been reported to increase by the same author from 14% at 5 minutes to 52% at 60 minutes of treatment at 85 °C. The higher blanching temperature for longer period results more outflow of flavanones (Zid *et al*., 2015) [26] and resulted less bitterness.

5. Concluding remark

The results of the present study indicate that hot water treatment prior to juice extraction by screw type juice extractor enhanced juice yield, minimized waste generation and reduced bittering compounds (limonin and naringin) from pummelo fruits. More or less similar results were also obtained in lye treatment of fruits after peeling but not as economical and feasible as hot water treatment.

6. References

1. Association of Official Analytical Chemist (AOAC). Official methods of analysis of Association of Official Analytical Chemists, 16th edition, Washington, DC, USA 1984.
2. Bala A, Kaushal BBL, Joshi VK, Kaushal M. Comprison of juice extraction methods, determination of bittering principles and standardization of debittering of lime juice. Indian Journal of Natural Products and Resources 2017;8(3):263-268.
3. Barthe GA, Jourdan PS, McIntosh CA, Mansell RL.

Radioimmuno-assay for the quantitative determination of hesperidin and analysis of its distribution in Citrus sinensis. Phytochemistry 1988;27:249-254.
4. Davis WB. Determination of flavanones in citrus fruits Analyst Chernistry 1947;19:476.
5. Davies FS, Albrigo LG. Citrus. Wallingford: CAB International 1994, 254.
6. Food and Agricultural Organization of the United Nations (FAO STATICS) 2019; (http://www.fao.org/economic/est/est-commodities/citrus-fruit/en/)
7. Jagannath A, Kumar M. Monitoring Blanching Induced Debittering and Storage Losses of Naringin in Orange Subjected to Osmotic Dehydration, International Journal of Fruit Science 2016;16(4):410-422.
8. Jungsakulruijirek S. Limonin in Thai Tangerine (*Citrus reticulata*, Blanco) in relation to reduction of juices bitterness Ph. D. thesis, Asian Institute of Tecnology, Bangkok 1997.
9. Khan IA. Citrus genetics, breeding and biotechnology. 1st ed. Cambridge: CABI Publishing, 2007, 1-370.
10. Kaur C, George B, Deepa N, Jaggi S, Kapoor HC. Viscosity and quality of tomato juice as affected by processing methods Journal of Food Quality 2007;30**:**864-877.
11. Lotha RE, Khurdiya DS, Mahashwari ML. Effect of storage on the quality of kinnow mandarin for juice processing Indian Food Packers 1994;48:25-3.8
12. Morton JF. Fruits of Warm Climates. J. F. Morton Publisher; Miami, Florida, USA 1987.
13. McIntosh CA, Mansell RL, Rouseff RL. Distribution of limonin in the fruit tissue of nine grapefruit cultivar Journal of Agricultural Food Chemistry 1982;30:689-692.
14. National Horticulture Board National Horticulture Board Data base 2018-19, (http://nhb.gov.in)
15. Pareek S, Paliwal R, Mukherjee S. Effect of juice extraction methods and processing temperature-time on juice quality of Nagpur mandarin (*Citrus reticulata* Blanco) during storage. Journal of Food Science and Technology 2011;48(2):197-203.
16. Premi BR, Joshi VK, Lal BB, Maine SB. Bitterness and its possible control in citrus juices Indian Food Packer 1996;50(5):29-37.
17. Pichaiyongvongdee, Haruenkit. Comparative Studies of Limonin and Naringin Distribution in Different Parts of Pummelo [*Citrus grandis* (L.) Osbeck] Cultivars Grown in Thailand Kasetsart Journal (Natural Sciences) 2009;43:28 -36.
18. Ramful D, Tarnus E, Aruoma OI, Bourdon E, Bahorun T. Polyphenol composition, vitamin C content and antioxidant capacity of Mauritian citrus fruit pulps 2011; Food Research International 2011;44:2088-2099.
19. Sawamura M, Kuwahara S, Shichiri K, Aoki T. Volatile Constituents of Several Varieties of pummelos and a Comparison of the nootkatone levels in pummelos and other citrus fruits. Agriculture Biological Chemistry 1990;54:803-805.
20. Sandhu KS, Singh N. Studies on factors affecting the physicochemical and organoleptic properties of Kinnow juice. Journal of Food Science and Technology 2001;38:266-269.
21. Singh R, Saxena SK. Fruits. New Delhi, India National Book Trust 2008, 85-116.
22. Tocmo R, Pena-Fronteras J, Calumba KF, Mendoza M, Johnson JJ. Valorization of pomelo (*Citrus grandis* Osbeck) peel: A review of current utilization, phytochemistry, bioactivities, and mechanisms of action. Comprative Review Food Science and Food Safety 2020;19:1969-2012.
23. Tsai HL, Chang SKC, Chang SJ. Antioxidant content and free radical scavenging ability of fresh red pummelo (*Citrus grandis* (L.) Osbeck) juice and freeze-dried products Journal of Agricultural Food Chemistry 2007;55:2867-72.
24. Uzun A, Yesiloglu T. Genetic Diversity in Citrus, In: Genetic Diversity in Plants (Ed. M. Caliskan) 2012, 213-31.
25. Vaks B, Lifshitz A. Debittering of orange juice by bacteria which degrade limonin Journal of Agricultural Food Chemistry 1980;29:1258-1261.
26. Zid MB, Dhuique-Mayer C, Bellagha S, Sanier C, Collignan A, Servent A *et al.* Effects of blanching on flavanones and microstructure of *Citrus aurantium* peels 2015; Food Bioprocess Technology 2015;8:2246-2255.