



Standardization of Recipe of Barbados Cherry Pickle

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Authors' contributions

This work was carried out in collaboration among all authors. Author AM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors VSK, SM, AKB, IC, FKB and SD helped in statistical analysis of the data and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Barbados cherry is a fruit with magical amount of Vitamin C in it. But the main problem with the fruit is a very low ambient storage life of just 1-2 days. After which the fruit start decaying. Even the loss in nutrients and phytochemicals commence 4-5 hours after harvest. Hence there is a need to preserve the fruit for availing long term benefits of the fruit. Among all processed product, pickling is a very important and stable method of preservation.

Design: Completely Randomized Block Design.

Methodology: Till now recipe standardization of Barbados cherry pickle is not yet documented. In our products prepared with 4 recipee, 2 each with pickling in oil and pickling in water.

Results: The oil picked fruits were having highest amount of vitamin C was retained in Recipe 2 (T₂) and Recipe 1 (T₁) even after 6 months of storage. Total plate count after 6th month of storage

was also low in Recipe 2 (T₂) and Recipe 1 (T₁). In terms of organoleptic property the best pickle with good flavour, remarkable taste, outstanding texture, brilliant consistency and high overall acceptability was in Recipe 2 (T₂) and Recipe 1 (T₁).

Conclusion: Hence Recipe 2 (T₂) can be successfully used for commercial preparation of Barbados cherry pickle.

Keywords: Tropical cherry; barbados cherry; malpighia; pickle; recipe standardization.

ABBREVIATIONS

TSS : Total Soluble Solids
 °B : degree brix
 CFU : Colony Forming Units
 TPC : Total plate count
 LAB : Lactic acid bacteria
 CD : Cumulative difference
 SEM : Standard Error Mean

1. INTRODUCTION

Barbados cherry or tropical cherry (*Malpighia glabra* L.) is a member of the family Malpighiaceae. It is also known as west Indian cherry or tropical cherry as its primary center of origin is tropical America. The fruit is fairly juicy (73%) and with ascorbic acid ranging from 800 to 5,000mg/100g of juice, which is around 80 times than lemons and oranges [1]. In addition to vitamin C, it contains vitamin A, Vitamins B complex such as thiamine (B1), riboflavin (B2) and niacin (B3) and minerals such as iron, calcium and phosphorus [2]. In India, Barbados cherry can be fairly cultivated in tropical humid region of Kerala, Tamil Nadu, Andaman and Nicobar Island and Karnataka. Beside that it can also be grown in southern part of West Bengal, Orissa, Andhra Pradesh and Maharashtra [3]. Plants are shrub type and are resistant to pests and diseases. The plant can flower and fruit properly in tropical region. In sub-tropical region flowering and fruiting is sparse and fruit also contains higher moisture percentage and lesser amount of Vitamin C [4]. Fruits of Barbados cherry are known to have very fast metabolic process and ripening is usually very prompt and speedy [5,6]. The rate of respiration and ripening is very high as well [7]. Depending on purpose of harvesting, the fruits can be harvested either in mature green stage or deep red ripe stage. Shelf life of Barbadoscherry is a matter of concern and the fruits start losing its original composition even after 4-5 hours of ambient storage [4]. Hence there is a need to preserve it into

processed product. Many products like murabba, preserve, candy, syrup, juice, wine has been standardized but there is still a need to standardize the procedure and recipe of pickle preparation. Pickle made from Barbados cherry can be a potential processed product and can conserve the nutrient up to a considerably longer duration [8].

2. MATERIALS AND METHODS

Just ripened fresh tropical cherry/ barbados cherry was harvested from AICRP, Minor Fruit Block, Mandouri. Spices, oil, salt were procured from local market. The design of experiment was Completely Randomized Block Design (CRD) with 4 treatments and 5 replications. Pickle was prepared according to procedure illustrated below [9].

2.1 Spice Preparation

1st set of spice: Mustard is washed and pressed in separate container.

2nd set of spice: Fenugreek is grinded and kept in a separate container.

3rd set of spice: Ginger paste is kept in another container.

4th set of spice: Rest other spices are pasted and kept separately in each container.

2.2 Treatment Details

Treatment is actually the recipe for pickle preparation is tabulated in Table 1. The main difference among the recipe is the amount of spice content and whether the pickling is done in oil or in water. The number of replications were five (5) and sample pickle jar per replications were three (3).

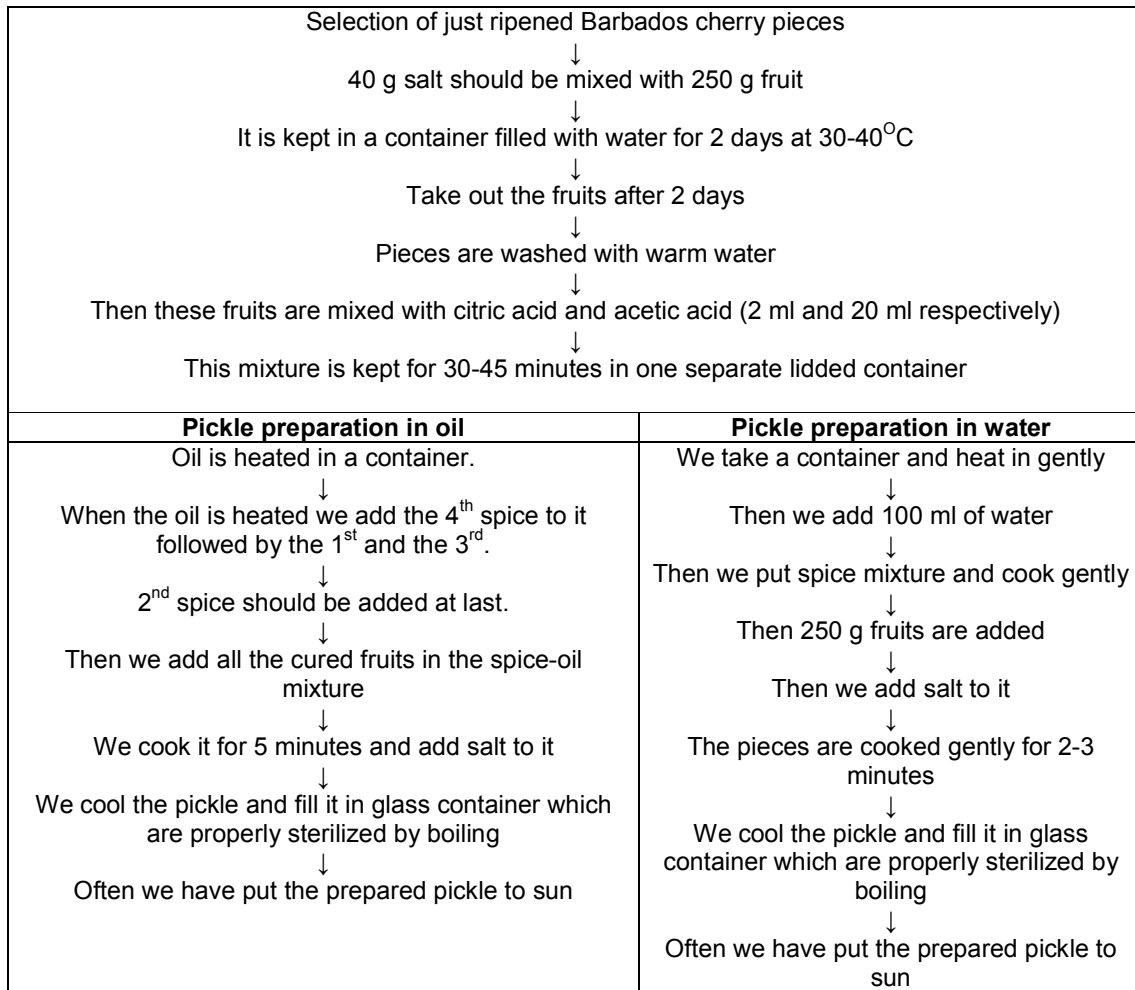


Chart 1. Flowchart for pickle preparation

Table 1. Recipe charts for preparation of Barbados/West Indian/tropical cherry [8]

Ingredients	Recipes			
	Pickle preparation in oil		Pickle preparation in water	
	Recipe 1 (T ₁)	Recipe 2 (T ₂)	Recipe 3 (T ₃)	Recipe 4 (T ₄)
Barbados cherry	250 g	250 g	250 g	250 g
Turmeric	7 g	5 g	7 g	5 g
Mustard seed (paste)	12 g	6 g	12 g	6 g
Aniseed	2 g	4 g	2 g	4 g
Black pepper	3 g	2 g	3 g	2 g
Asafoetida	1.5 g	2 g	1.5 g	2 g
Methi	15 g	10 g	15 g	10 g
Red chilli powder	5 g	8 g	5-6 g	8 g
Fennel	3 g	5 g	3 g	5 g
Cardamom	4 g	5 g	4 g	5 g
Black Cumin seed	2 g	1 g	2 g	1 g
Fenugreek powder	3 g	4 g	3 g	4 g
Salt	40 g	40 g	40 g	40 g
Mustard Oil	70 ml	50 ml	Not added	Not added
Sugar	Not added	Not added	Not added	Not added

3. RESULTS AND DISCUSSION

Table 2 highlights the Physico-chemical composition of fresh harvested Barbados/West Indian/tropical cherry. Vitamin C content of freshly harvested fruit was 913mg/100 g. This value is quite low as compared to fruits grown in extreme tropics. Titratable acidity is 1.72%. Moisture percent is 86.3% and total sugar content at ripe stage was 4.34%.

Table 3 highlights the variation in TSS ($^{\circ}$ B) of Barbados cherry pickle prepared from different recipes. At 0 days of storage, the TSS was more or less same in pickle prepared by different recipes. But at 3 month of storage, pickle prepared by Recipe 3 (T_3) had maximum TSS of 41.64 $^{\circ}$ B followed by 41.54 $^{\circ}$ B in Recipe 4 (T_4), 41.34 $^{\circ}$ B in Recipe 2 (T_2) and 41.14 $^{\circ}$ B in Recipe 1 (T_1). Similar trend has been observed in pickle prepared by different recipe at 6th month of storage. The highest TSS was observed in Recipe 3 (T_3) followed by Recipe 4 (T_4), Recipe 2 (T_2) and Recipe 1 (T_1) which are 42.34 $^{\circ}$ B, 42.14 $^{\circ}$ B, 42.06 $^{\circ}$ B and 41.78 $^{\circ}$ B respectively. The main reason behind this might be best removal of water from fruit pieces in absence of oil could have led to increase in TSS.

Table 4 highlights the variation in titratable acidity (%) of Barbados cherry pickle prepared from different recipes. At 0 days of storage, the titratable acidity was more or less same in pickle prepared by different recipes. But at 3 month of storage, pickle prepared by Recipe 4 (T_4) had maximum titratable acidity of 1.13% followed by 1.09% in Recipe 3 (T_3), 1.06% in Recipe 2 (T_2) and 1.02% in Recipe 1 (T_1). At the 6th month of storage highest titratable acidity was observed in Recipe 3 (T_3) followed by Recipe 4 (T_4), Recipe 2 (T_2) and Recipe 1 (T_1) which are 1.22%, 1.21%, 1.18% and 1.16% respectively. Recipe 3 (T_3) and Recipe 4 (T_4) is at par with each other.

Table 5 highlights the variation in total sugar (%) of Barbados cherry pickle prepared from different recipes. At 0 days of storage, the total sugar was more or less same in pickle prepared by different recipes. But at 3 month of storage, pickle prepared by Recipe 1 (T_1) had maximum total sugar of 2.32% followed by 2.31% in Recipe 2 (T_2), 2.29% in Recipe 4 (T_4) and 2.28% in Recipe 3 (T_3). At the 6th month of storage highest total sugar was observed in Recipe 1 (T_1) followed by

Recipe 2 (T_2), Recipe 4 (T_4) and Recipe 3 (T_3) which are 2.30%, 2.29%, 2.26% and 2.24% respectively. Lesser decline in total sugar in case of pickling in oil as compared to pickling in water is because of better ability of oil to preserve the fruit piece as compared to that of pickling in water.

Table 6 illustrates the variation in ascorbic acid content (mg/100 g) of Barbados cherry pickle prepared from different recipes. At 0 days of storage, the ascorbic acid content (mg/100g) was more or less same in pickle prepared by different recipes. But at 3 month of storage, pickle prepared by Recipe 2 (T_2) had maximum ascorbic acid content (mg/100 g) of 469.4 mg/100 g followed by 463.6 mg/100 g in Recipe 4 (T_4), 457.2mg/100 g in Recipe 1 (T_1) and 452.4 mg/100 g in Recipe 3 (T_3). Similar trend was observed after 6th month of storage as well. At the 6th month of storage highest ascorbic acid content (mg/100g) was observed in Recipe 2 (T_2) followed by Recipe 1 (T_1), Recipe 4 (T_4) and Recipe 3 (T_3) which are 437 mg/100 g, 432.6 mg/100g, 419.4 mg/100g and 406.6mg/100 g respectively. Lesser decline in ascorbic acid content (mg/100g) in case of pickling in oil as compared to pickling in water is because of better ability of oil to preserve the quality of fruit more as compared to that of pickling in water.

Table 7 illustrates the variation in total plate count (10^{-5} log CFU) of Barbados cherry pickle prepared from different recipes. At 0 days of storage, the total plate count (10^{-5} log CFU) was more or less same in pickle prepared by different recipes. But at 3 month of storage, pickle prepared by Recipe 3 (T_3) had highest total plate count (10^{-5} log CFU) was observed in Recipe 3 (T_3) followed by Recipe 4 (T_4), Recipe 1 (T_1) and Recipe 2 (T_2) which was 24, 21, 18.6 and 17 respectively. Similar trend was observed after 6th month of storage as well. At the 6th month of storage highest total plate count (10^{-5} log CFU) was observed in Recipe 3 (T_3) followed by Recipe 4 (T_4), Recipe 1 (T_1) and Recipe 2 (T_2) which are 50, 43.4, 40.6 and 34.4 respectively. Higher bacterial count was evident in case of Recipe 3 (T_3) and Recipe 4 (T_4). The overall lesser population of bacteria in pickling with oil is due to the fact that oil has its own potential to kill bacterial population. Oil also creates an impermeable barrier to bacteria and air [10].

Table 2. Physico-chemical composition of Barbados/West Indian/tropical cherry

Attributes	Value/100g
Vitamin C	913 mg/100g
Titrateable acidity	1.72%
Moisture percent	86.3%
Total sugar	4.34%

Table 3. Effect of different recipe on TSS (°B) of Barbados cherry pickle

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T ₁)	40.6	41.14	41.78
Recipe 2 (T ₂)	40.58	41.34	42.06
Recipe 3 (T ₃)	40.58	41.64	42.34
Recipe 4 (T ₄)	40.6	41.54	42.14
S.Em. (±)	0.03	0.02	0.03
CD (0.05)	N/A	0.07	0.10

Table 4. Effect of different recipe on titrateable acidity (%) of Barbados cherry pickle

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T ₁)	0.96	1.02	1.16
Recipe 2 (T ₂)	0.96	1.06	1.18
Recipe 3 (T ₃)	0.96	1.09	1.22
Recipe 4 (T ₄)	0.95	1.13	1.21
S.Em. (±)	0.00	0.01	0.01
CD (0.05)	N/A	0.01	0.01

Table 5. Effect of different recipe on total sugar (%) of Barbados cherry pickle

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T ₁)	2.35	2.32	2.30
Recipe 2 (T ₂)	2.35	2.31	2.29
Recipe 3 (T ₃)	2.35	2.28	2.24
Recipe 4 (T ₄)	2.36	2.29	2.26
S.Em. (±)	0.00	0.00	0.01
CD (0.05)	N/A	0.01	0.02

Table 6. Effect of different recipe on ascorbic acid (mg/100 g) of Barbados cherry pickle

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T ₁)	514.2	457.2	432.6
Recipe 2 (T ₂)	515.6	469.4	437
Recipe 3 (T ₃)	515.6	452.4	406.6
Recipe 4 (T ₄)	515.6	463.6	419.4
S.Em. (±)	0.64	1.64	2.13
CD (0.05)	N/A	4.95	6.45

Table 8 illustrates the variation in Lactic acid bacteria (10^5 log CFU) of Barbados cherry pickle prepared from different recipes. At 0 days of storage, the Lactic acid bacteria (10^5 log CFU)

were maximum 67.6 in Recipe 3 (T₃), 65 in Recipe 4 (T₄), 59.6 in Recipe 1 (T₁) and 56.2 in Recipe 2 (T₂). At 3rd month of storage, pickle prepared by Recipe 2 (T₂) exhibit a lower

increase in Lactic acid bacteria (69.3) followed by Recipe 1 (T₁) which was 72.4, Recipe 3 (T₃) which was 76.8 and Recipe 4 (T₄) which was 82.6. At the 6th month of storage there was a decline in Lactic acid bacteria (10⁻⁵ log CFU) population as compared to 3rd month of storage. Highest population of LAB was observed in Recipe 3 (T₃) followed by Recipe 4 (T₄), Recipe 1

(T₁) and Recipe 2 (T₂) which were 61.4, 58.2, 56.6 and 52.2 respectively. Higher LAB population was evident in case of Recipe 3 (T₃) and Recipe 4 (T₄). This is mainly because of the fact that mustard oil has its own antibacterial property which regulates a lower population of both LAB and total bacterial population [11].

Table 7. Effect of different recipe on total plate count (10⁻⁵ log CFU) of Barbados cherry pickle

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T ₁)	1.2	18.6	40.6
Recipe 2 (T ₂)	1.6	17	34.4
Recipe 3 (T ₃)	1.2	24	50
Recipe 4 (T ₄)	1.4	21	43.4
S.Em. (±)	2.33	0.26	0.53
CD (0.05)	N/A	0.80	1.60

Table 8. Effect of different recipe on Lactic acid bacteria (10⁻⁵ log CFU) of Barbados cherry pickle

Treatment details	Months of storage		
	0	3	6
Recipe 1 (T ₁)	59.6	72.4	56.6
Recipe 2 (T ₂)	56.2	69.6	52.2
Recipe 3 (T ₃)	67.6	76.8	61.4
Recipe 4 (T ₄)	65	82.6	58.2
S.Em. (±)	0.56	0.66	0.47
CD (0.05)	1.70	1.98	1.43

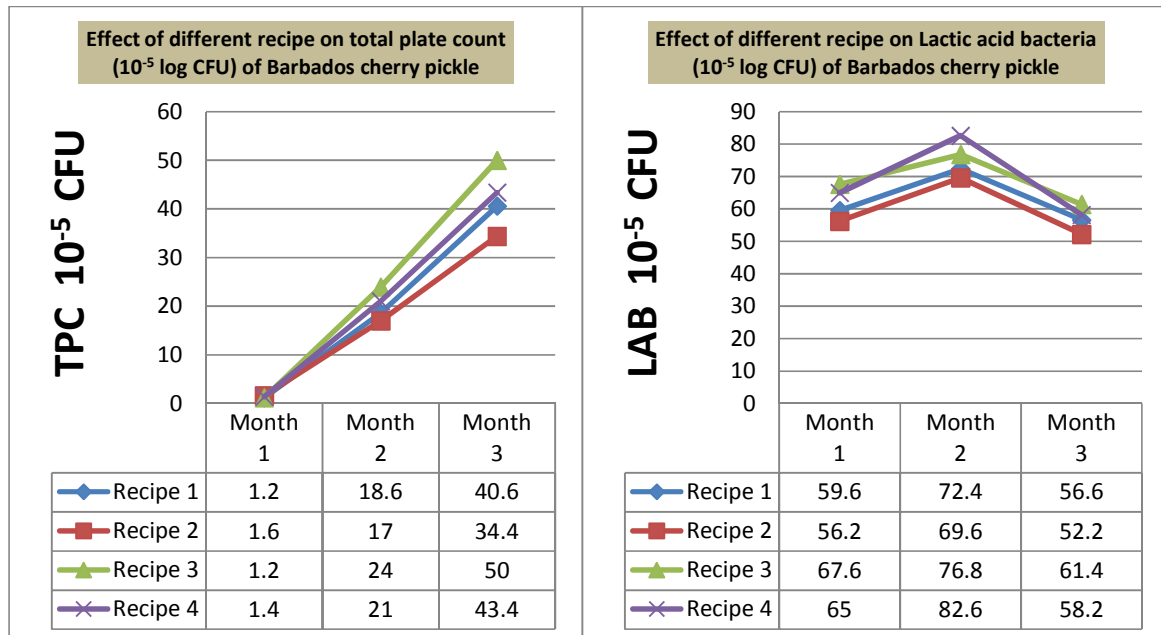


Fig. 1. Effect of different recipe on total plate count and Lactic acid bacteria (10⁻⁵ log CFU) of Barbados cherry pickle

Table 9. Effect of different recipe on organoleptic property (9 point hedonic scale) of Barbados cherry pickle at 6th month of storage

Treatment details	Months of storage				
	Flavour	Colour	Texture	Consistency	Overall acceptability
Recipe 1 (T ₁)	7.6	8.2	8.6	8	8
Recipe 2 (T ₂)	8.6	8.6	8.2	8.4	8.6
Recipe 3 (T ₃)	6.8	5.6	6.4	5.2	5.8
Recipe 4 (T ₄)	7.2	5.2	5	4.6	6.6
S.Em. (±)	0.32	0.32	0.34	0.30	0.25
CD (0.05)	0.96	0.96	1.02	0.91	0.77

Table 9 highlights the variation in flavour, colour, texture, consistency and overall acceptability of Barbados cherry pickle prepared from different recipes at 6th month of storage. In terms of flavour, highest score was given to Recipe 2 (T₂) which was 8.6 followed by 7.6 in Recipe 1 (T₁), 7.2 in Recipe 4 (T₄) and 6.8 in Recipe 3 (T₃). The reason for good flavour of Recipe 2 (T₂) is its abundant spice and excellent blend with mustard oil. In terms of colour, highest score was given to Recipe 2 (T₂) which was 8.6 followed by 8.2 in Recipe 1 (T₁), 5.6 in Recipe 3 (T₃) and 5.2 in Recipe 4 (T₄). The reason for good colour of Recipe 2 (T₂) and Recipe 1 (T₁) is because of mustard oil and spice mixture. In terms of texture (mouth feel), highest score was given to Recipe 1 (T₁) which was 8.6 followed by 8.2 in Recipe 2 (T₂), 6.4 in Recipe 3 (T₃) and 5 in Recipe 4 (T₄). The reason for good colour of Recipe 2 (T₂) and Recipe 1 (T₁) is because of perfect blend between mustard oil and spice mixture. The rough surface of the fruits get enough softened by action of salt and mustard oil. In terms of consistency, highest score was given to Recipe 2 (T₂) which was 8.4 followed by 8 in Recipe 1 (T₁), 5.2 in Recipe 3 (T₃) and 4.6 in Recipe 4 (T₄). The reason for good consistency of Recipe 2 (T₂) and Recipe 1 (T₁) is because the mustard oil mixture was able to hold the fruit pieces and spice mixture in proper uniformity. The overall acceptability of the pickle also followed a similar trend the highest acceptability was observed in Recipe 2 (T₂) followed by Recipe 1 (T₁), Recipe 4 (T₄) and Recipe 3 (T₃) which was 8.6, 8, 6.6 and 5.8 respectively.

4. CONCLUSION

From the above results it can be concluded that highest amount of vitamin C was retained in Recipe 2 (T₂) and Recipe 1 (T₁). Total plate count after 6th month of storage was also low in Recipe 2 (T₂) and Recipe 1 (T₁). In terms of organoleptic property the best pickle with good flavour, remarkable taste, outstanding texture,

brilliant consistency and high overall acceptability was in Recipe 2 (T₂) and Recipe 1 (T₁). Hence Recipe 2 (T₂) can be successfully used for commercial preparation of Barbados cherry pickle.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Teixeira AHC, Azevedo PV. Potential in the state of Pernambuco for the cultivation of acerola. *Brazilian Journal of Agrometeorology*. 1994;2:105-113.
2. Ritzinger R, Ritzinger CHSP. Acerola: aspects of culture. *Cross of the Souls: Embrapa Cassava and Tropical Fruits*. 2004;2.
3. Singh DB, Attri BL, Suryanarayana MA, Sharma TVRS. West Indian Cherry – A rich source of Vitamin C. *Agro India*; 1999.
4. Dey K, Ghosh A, Bauri FK, Bhowmick N, Dey AN, Mishra DK, Das BC. Barbados cherry: Agriculture, breeding, utilization and role in nutritional and economical security: A review. *Agricultural Reviews*. 2018;39(2):144-150.
5. Barwal VS, Garg, V, Sharma R. Development and quality evaluation of aonla mouth fresher. *Journal of food science and technology*. 2010;47(6):697-699.
6. Harna B, Patidar J, Tripathy S, Pachauri DR. Scope of income enhancement of rural youth through home scale processing

- of Indian gooseberry (aonla)-An overview. Current Advances in Agricultural Sciences (An International Journal). 2019;11(1):19-27.
7. Netto AG, Ardito EFG, Garcia EEC, Bleinroth EW, Freire FCO, Menezes JB. Acerolaparaexportação: Procedimentos de colheita e pós-colheita. Brazil; 1996.
 8. Singh DR, Medhi RP. West Indian Cherry cultivation in Andamans. Bulletin no. 15. Published by Director, CARI, Port Blair; 1996.
 9. Mani A, Roy S, Mitra S. Recipe for Barbados cherry pickle. Agriculture & Food: e-Newsletter. 2020;2(4): 845.
Available: https://www.researchgate.net/publication/340789331_Recipe_for_Barbados_cherry_pickle
 10. Mani A, Patil P, Tiwary AK, Bukya K. The science and art of pickling. Trends & Prospects in Processing of Horticultural Crops. Today & Tomorrow's Printers and Publishers. 2018;1:59-80. [ISBN: 9788170196389]
Available: https://www.researchgate.net/publication/328073558_The_science_and_art_of_pickling
 11. Turgis M Han J, Caillet S, Lacroix M. Antimicrobial activity of mustard essential oil against Escherichiacoli O157:H7 and Salmonella typhi. 2009;20:1073-1079. DOI:10.1016/j.foodcont.2009.02.001

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