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**SL Pal**  
Department of Horticulture,  
R.S.M. (P.G.) College Dhampur,  
Bijnor, U.P., India

**Devi Singh**  
Department of Horticulture,  
SHUATS, Naini, Allahabad,  
Uttar Pradesh, India

**PK Attri**  
Department of Horticulture,  
SHUATS, Naini, Allahabad,  
Uttar Pradesh, India

## Evaluation of physico-chemical properties of different types of pickles of wood apple (*Limonia acidissima*)

**SL Pal, Devi Singh and PK Attri**

### Abstract

The present research "Evaluation of physico-chemical properties of different types of pickles of wood apple (*Limonia acidissima*)." was conducted 20<sup>th</sup> December 2013. to 20<sup>th</sup> April 2014 for 90 Days processing lab, Department of Horticulture; SHUATS Allahabad. The experiment was laid out in Complete Randomized Design (C.R.D) method with nine treatments and three replications in preparation of Wood apple pickles for quality evaluation and improvement. They are namely Wood apple pickles treatment Wood apple plain, Wood apple with Carrot + turnip, Wood apple with Aghar + green chili, Wood apple with Jamun vinegar, Wood apple with Green chili + methi, Wood apple with Lemon, Wood apple with Sugar, Wood apple with Ginger, Wood apple with Acetic acid + methi and on the basis of evaluation treatment with Wood apple with Sugar, was found superior for Wood apple preparation in term of (T. S. S. 43.977<sup>0</sup> Brix), pH n(4.526), Acidity (0.4375), Moisture (16.426), color and appearance (8.625) texture (8.79) flavor and taste (8.575), and over all acceptability (8.225) for preparation of Wood apple pickles in processing laboratory.

**Keywords:** Wood apple pickles, Physico – chemical and Organoleptic test

### Introduction

The wood apple (*Limonia acidissima*) is the only species of its genus, in the family 'Rutaceae' has 2n=18 chromosomes. It is native to the dry plains of India, Pakistan and Sri Lanka, where it grows in the wild and is also cultivated along roads, the edges of fields and occasionally in orchards. Wood-apple is also known as elephant apple in English and kavitha or kutbel in Hindi, and kaithbel in Bengali, Oriya and Asamese. The plant is seen to be distributed throughout the subtropical and tropical regions of the world, particularly in India, Bangladesh, Sri Lanka, Malaysia, Myanmar, Thailand, Indonesia, Laos, Cambodia, Vietnam, small islands of Indian ocean, Northern Australia, Central African Countries, Pakistan and Nepal. The exact area and annual fruit production of Wood apple is not known, nor there is any report of organized cultivation of the plant, and it is mostly grown as stray plant and that too on waste lands. But, recently it has gained importance as a suitable horticulture plant for soil reclamation and most hardy plant for cultivating it in arid and semi-arid zones. The fruits obtained from the plants are edible and the pulp of fruit is acid-sweet with coarse texture, seediness and fibrous. Different processed foods like pickles sour and sweet, refreshing drinks, chutney, paste etc. could be prepared from the pulp. Seeds and fibre are good animal feed. Gums obtained from stem or branches and fruits are used as substitute for gum-Arabic. Wood is used as timber, fuel and making agricultural implements, oil crusher and walking sticks (Singh *et al.*, 1990) <sup>[1]</sup>. Fruit pulp is considered tonic, refreshing, cardiacal and astringent which is used to treat diarrhoeas and dysentery when unripe. Pulp from the ripe fruits which has pleasant smell is used to treat gum and throat infections. Edible full ripe pulp contains, on an average, 69.5% moisture, 7.3% protein, 0.6% fat and 1.9% mineral matter. Total soluble solids content of pulp varies around 7.0; total acidity ranges between 3.0-2.3% and pectin content between 3-5%. Bhat (1994) <sup>[2]</sup> prepared wood-apple jelly with agreeable flavor. The pulp is a rich source of riboflavin (170mg/100 g). The importance of wood-apple fruit lies in its curative properties, which make the tree one of the useful medicinal plants of India (Kirtikar *et al.*, 1935) <sup>[3]</sup>. This fruit can be exploited for regular cultivation in dry areas, provided supported by processing industry as it makes excellent chutney, can be used as adjunct in jelly and made into squash, Being rich in pectin, it makes good jelly. Pulp contains 2.66% pectin on fruit juice basis (Roy and Mazumdar, 1988) <sup>[4]</sup>. As such wood apple pickle prepared with oil is stored for long period of time loses texture and become soft which is not acceptable by the consumer. Further, it is difficult to carry pickle which is oily. Modernization has led to lack of time and there is a need for convenience food for working people. Drying is the most widely used primary method of food processing and preservation.

**Correspondence**  
**SL Pal**  
Department of Horticulture,  
R.S.M. (P.G.) College Dhampur,  
Bijnor, U.P., India

So there is a need to develop dehydrated pickle mix which can be reconstituted and used as and when required. The present study was conducted to develop a suitable dehydrated wood apple mix which is more convenient to store and handle.

### Materials and methods

The Experimental work of "Evaluation of physico-chemical properties of different types of pickles of wood apple (*Limonia acidissima*).'' was conducted in the Post harvest laboratory of Department of Horticulture, SHUATS Allahabad during the year 2013-2014. The value added Wood apple pickles prepared has 9 treatments with 3 replications and stored for 90 days under ambient temperature. The experiment was laid out in Complete Randomized Design (C.R.D) method. Details of treatment combination with treatment Numbers are as follows:

### Treatment Treatment Details

**T0** Wood apple control (Ingredients were Wood apple 3 kg+ mustard oil 100g,+jeera 50g,+ hing 5g,+Sauf 50g,+ clove 25g,+ kashmiri mirch 15g,+mangrael 25g,+cardamom 25g,+turmeric 50g,+rai 10g,+salt 400g, +sodium benzoate 3g.)

**T1** Wood Apple with Carrot + Turnip (Ingredients were Wood apple 1.5 kg, +carrot 1kg+ mustard oil 100g.+jeera 50g,+ hing 5g,+Sauf 150g,+ clove 25g,+ Yellow mustard 50g,+red chilli 75g,+turnip 500g,+mangrael 25g,+cardamom 25g,+turmeric 70g,+rai 100g,+salt 400g, +sodium benzoate 3g.)

**T2** Wood Apple with Aghar + Green Chilies(Ingredients were Wood apple 3 kg, +mustard oil 100g.+jeera 50g,+ hing 5g,+Sauf 150g,+ clove 25g,+ Yellow mustard 50g,+red chilli 75g,+mangrael 25g,+aghar 1 kg, +turmeric 70g,+rai 100g,+salt 400g, +sodium benzoate 3g.)

**T3** Wood Apple with Jamun Vinegar (Ingredients were Wood apple 3 kg +carrot 0.5kg+ mustard oil 50g.+jeera 50g,+ hing 5g,+Sauf 150g,+ Yellow mustard 50g,+red chilli 75g,+ mangrael 25g,+Jamun Vinegar 150 ml,+ turmeric 70g,+rai 100g,+salt 450g, +sodium benzoate 3g, +Acetic Acid 30 ml.)

**T4** Wood Apple with Green Chili + Methi (Ingredients were Wood apple 2 kg +Green Chilies 1 kg,+ mustard oil 100g.+jeera 50g,+ Hing 50g,+Sauf 5g,+clove 50g, Yellow mustard 50g,+ methi 100g,+cardamom 25g,+ mangrael 25g,+turmeric 100g,+rai 100g,+salt 400g, +sodium benzoate 3g.)

**T5** Wood apple with Lemon (Ingredients were Wood apple 2 kg + lemon 1kg,+Green Chilies 1 kg,+ mustard oil 100g.+jeera 50g,+ Hing 5g,+Sauf 150g,+clove 30g, Yellow mustard 25g,+ cardamom 25g,+ mangrael 25g,+turmeric 50g,+rai 100g,+salt 400g, +sodium benzoate 3g.)

**T6** Wood Apple with Sugar (Ingredients were Wood apple 2 kg,+sugar 1kg,+ mustard oil 100g.+jeera 50g,+ hing 5g,+Sauf 150g,+ Yellow mustard 50g,+ methi 100g,+ mangrael 25g,+turmeric 75g,+rai 100g,+salt 400g, +sodium benzoate 3g.)

**T7** Wood Apple with Ginger (Ingredients were Wood apple 3 kg + ginger 400g,+mustard oil 100g.+jeera 50g,+ hing 5g,+Sauf 150g,+clove 30g, Yellow mustard 50g,+cardamom 25g,+ mangrael 25g,+turmeric 50g,+rai 100g,+salt 400g, +sodium benzoate 3g.)

**T8** Wood Apple with Acetic Acid+ methi ( Ingredients were Wood apple 3 kg,+ mustard oil 100g.+jeera 50g,+ hing 5g,+Sauf 150g,+ Yellow mustard 50g,+ methi 200g,+ mangrael 25g,+turmeric 75g,+rai 100g,+salt 400g, +sodium benzoate 3g,+ acetic acid 30ml.

### Results and Discussion

The data with respect to total soluble solid is presented in table 1 reveal that there was subsequent increase in total soluble solids and significant difference among all treatments. The highest score for TSS were observed in treatment T<sub>6</sub> mean value of replication (R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub>) i.e. 43.17, 44.00, 44.14 and 44.60<sup>0</sup> Brix at 1<sup>st</sup>, 30<sup>th</sup> days, 60<sup>th</sup> days, 90<sup>th</sup> days followed by treatment T<sub>2</sub>, which attained 21.07, 21.10, 21.30 and 21.12<sup>0</sup>Brix of total soluble solids respectively during storage. While the minimum score of TSS, were observed in treatment T<sub>0</sub> i.e. 15.00, 16.23, 16.15 and 16.17<sup>0</sup> Brix at 1<sup>st</sup>, 30<sup>th</sup> days, 60<sup>th</sup> days, 90<sup>th</sup> days during storage. Increasing in TSS% is due to hydrolysis of polysaccharides (Starch) in monosaccharide's (sucrose, fructose, glucose) and decrease in the percentage of moisture as a result of dehydration. The finding agreed with the findings of Kumar (1990) <sup>[5]</sup> in wood apple pickles. The data with respect to pH is presented in table 1 indicates that there was a gradual decrease in pH among all the treatment at ambient storage. The data also indicates that there was significant effect in all the treatment during storage. The maximum pH, mean value of replication (R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>) were observed in T<sub>6</sub> i.e. 4.53, 4.55, 4.50 and 4.50 followed by T<sub>4</sub> i.e. 4.57, 4.47, 4.47 and 4.50 during the at 31<sup>st</sup> days, 30<sup>th</sup> days, 60<sup>th</sup> days and 90<sup>th</sup> days, respectively, whereas the optimum pH, were observed in treatment T<sub>5</sub>, i.e. 4.13, 4.20, 4.20 and 4.18. It is also due to increase in the hydrogen ion concentration of the pickle. The findings agree with the observation of Aradhita *et al.* (1996) <sup>[6]</sup> in jackfruit pickles. The data with respect to moisture content reveals that there was significant difference among all treatments during storage. There was gradual decrease in moisture content at different periods of storage. The percentage of maximum moisture decrease 19.53, 16.34, 16.30 and 16.22 % was observed in treatment T<sub>3</sub>, followed by treatment T<sub>2</sub>, 16.53, 16.38, 16.35 and 16.347 at 1<sup>st</sup>, 30<sup>th</sup>, 60, and 90<sup>th</sup> days, where the minimum moisture decrease i.e. 16.52, 16.5, 16.48 and 16.38% were observe in treatment T<sub>10</sub>. It is may be due to absorption of moisture by sugar present in it, which lower down the concentration of moisture throughout the storage. The findings also agrees with the finding of Aradhita *et al.* (1996) <sup>[6]</sup> in wood apple and other pickles. The perusal of table 1 reveals that there was significant effect in all the treatments during the periods, of storage. The maximum retention of acidity 0.48, 0.52, 0.48 and 0.51 were observed in treatment T<sub>3</sub> mean value of replication (R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub>), followed by treatment T<sub>2</sub> mean value of the replication (R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub>), i.e. 0.47, 0.50, 0.48 and 0.49 at 1<sup>st</sup> days, 30<sup>th</sup> days, 60<sup>th</sup> days and 90<sup>th</sup> days, while the minimum acidity was observed in treatment T<sub>7</sub> i.e. 0.42, 0.42, 0.40 and 0.29. Among all the treatments T<sub>1</sub>, tended to have the highest acidity percentage during storage, showing a significant increase. The finding agreed with the finding of Sethi (1980) <sup>[7]</sup> observed that acidity values gradually increased with storage time in intermediate aonla preserve.

The statistically analyzed data presented in table 2 that there was a slightly increasing trend score card for color and appearance among the treatment. The treatment T<sub>6</sub> have the maximum score of 8.625 followed by T<sub>7</sub> 7.5 and T<sub>0</sub>, 7.29, respectively and whereas minimum score for color and appearance were observed on treatment T<sub>3</sub>(4.5) of storage. Because the slight heat treatment applied as a blanching step to inactivate enzyme, inactivated or injured microorganisms, reducing the initial microbial load (Barbosa-Canoves, *et al.*, 1998) <sup>[8]</sup>. The sensory evaluation of all products was significantly color and appearance during 4 months storage,

but panelists gave higher score on product in vacuum bag without pasteurization than pasteurized ones. The data with respect to texture is presented in table 2 reveal that, there was a considerable increasing trend in texture among all treatments during storage. The treatment T<sub>6</sub> have the highest score 8.79 followed by T<sub>7</sub> 7.40 and T<sub>2</sub> 6.27, respectively and while minimum score were observed on treatment T<sub>0</sub> 4.8. However, the studies conducted by several authors have reported different ratios. Roy (1969) [9] has reported 1:4 ratio of dehydrated ready to use lime pickle: water for optimum texture and taste. Similarly, Tomar *et al.* (1989) [10] have noted 1:2 ratio of dehydrated mixed vegetable pickle water as the best for rehydration of pickle. The data with respect to Flavor and taste is presented in table 2 reveals that there was subsequent increase in Flavor and taste and significant difference among all treatments. The highest score for Flavor and taste were observed in treatment T<sub>6</sub> mean value of replication (R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub>) i.e. 8.00, 8.50, 8.80 and 9.00 at 1<sup>st</sup>, 30<sup>th</sup> days, 60<sup>th</sup> days, 90<sup>th</sup> days followed by treatment T<sub>1</sub> which attained 7.00, 7.20, 7.50 and 8.00 Flavor and taste respectively during storage. While the minimum score of

Flavor and taste were observed in treatment T<sub>0</sub> i.e. 3.67, 3.00 and 4.00 at 1<sup>st</sup>, 30<sup>th</sup> days, 60<sup>th</sup> days, 90<sup>th</sup> days during storage. The developed ready to use pickle mixes were packed in 33 jars. Similar packaging material was used in several studies for the storage of wood apple pickles reported by Chakrabarty *et al.* (1970) [11], Tomar *et al.* (1989) [10] and Mehta and Tomar (1982) [12]. The data with respect to texture is presented in table 2 express that, there was a considerable increasing trend in Overall acceptability among all treatments during storage. The treatment T<sub>6</sub> have the highest score 8.22 followed by T<sub>7</sub> 7.40 and T<sub>7</sub> 7.05 respectively and while minimum score were observed on treatment T<sub>0</sub> 2.83. Because the slight heat treatment applied as a blanching step to inactivate enzyme, inactivated or injured microorganisms, reducing the initial microbial load (Barbosa-Canoves, *et al.*, 1998) [8]. The sensory evaluations of all products were significantly Overall acceptability during 4 months storage, but panelists gave higher score on product in vacuum bag without pasteurization than pasteurized ones. This is concluded from investigation that treatment T<sub>6</sub> (wood apple with sugar) was found most suitable in terms of quality.

**Table 1:** Effect of different treatment on TSS (<sup>o</sup>Brix), pH, total moisture (%) and Acidity

Treatments	Color and appearance				texture				Flavor & taste				Over all acceptability			
	Total soluble solids ( <sup>o</sup> Brix)				pH				Total Moisture (%)				Acidity			
	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day
T <sub>0</sub> (Wood Apple plain (Control))	15.00	16.23	16.15	16.17	4.37	4.27	4.37	4.23	16.3	16.41	16.38	16.35	0.48	0.44	0.49	0.47
T <sub>1</sub> (Wood Apple with Carrot + turnip)	16.00	18.23	18.10	18.50	4.27	4.17	4.18	4.18	16.54	16.52	16.51	16.51	0.43	0.48	0.52	0.47
T <sub>2</sub> (Wood Apple with Aghar + green chili)	21.07	21.10	21.30	21.12	4.32	4.35	4.33	4.20	16.67	16.52	16.53	16.52	0.47	0.50	0.48	0.48
T <sub>3</sub> (Wood Apple with Jamun vinegar)	19.03	16.20	19.10	19.13	4.25	4.35	4.30	4.33	19.53	16.34	16.30	16.22	0.48	0.50	0.48	0.49
T <sub>4</sub> (Wood Apple with Green chili + methi)	18.27	18.47	18.50	18.13	4.57	4.47	4.44	4.50	16.53	16.41	16.33	16.31	0.43	0.42	0.42	0.42
T <sub>5</sub> (Wood Apple with Lemon)	20.03	20.40	20.20	20.15	4.23	4.27	4.27	4.23	16.38	16.33	16.32	16.32	0.44	0.41	0.43	0.45
T <sub>6</sub> (Wood Apple with Sugar)	43.17	44.00	44.14	44.60	4.53	4.55	4.50	4.50	16.52	16.34	16.32	16.42	0.47	0.45	0.41	0.43
T <sub>7</sub> (Wood Apple with Ginger)	19.03	19.13	19.13	19.13	4.42	4.33	4.37	4.33	16.22	16.22	16.21	16.29	0.42	0.42	0.40	0.38
T <sub>8</sub> (Wood Apple with Acetic acid + methi)	20.12	20.10	19.73	20.05	4.13	4.20	4.20	4.18	16.58	16.39	16.40	16.32	0.43	0.50	0.47	0.46
F-test	NS	S	S	S	NS	S	S	S	NS	S	S	S	NS	S	S	S
S. Ed.(±)	0.06	1.42	0.14	0.09	0.82	0.05	0.06	0.06	1.57	0.03	0.02	0.02	0.08	0.02	0.01	0.01
C.D. (at 5%)	0.12	2.97	0.30	0.18	1.72	0.11	0.12	0.12	3.31	0.06	0.04	0.03	0.16	0.04	0.03	0.02

**Table 2:** Effect of different treatments on color and appearance, texture, flavor & taste and over all acceptability

Treatments	Color and appearance				texture				Flavor & taste				Over all acceptability			
	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day	1 <sup>st</sup> Day	30 <sup>th</sup> Day	60 <sup>th</sup> Day	90 <sup>th</sup> Day
T <sub>0</sub> (Wood Apple plain (Control))	6.67	7.33	7.33	7.83	5.00	4.50	4.80	5.20	3.67	3.00	3.50	4.00	2.40	2.80	3.00	3.00
T <sub>1</sub> (Wood Apple with Carrot + turnip)	6.00	7.00	6.50	7.00	5.80	6.20	6.50	6.80	7.00	7.20	7.50	8.00	7.00	6.83	7.40	8.00
T <sub>2</sub> (Wood Apple with Aghar + green chili)	5.00	5.50	5.80	6.00	6.77	7.20	7.40	7.73	5.00	5.20	5.40	5.60	5.80	6.00	6.20	6.50
T <sub>3</sub> (Wood Apple with Jamun vinegar)	4.00	4.50	4.80	5.00	3.80	4.00	4.20	4.50	4.00	4.23	4.50	4.80	3.00	3.20	3.50	4.93
T <sub>4</sub> (Wood Apple with Green chili + methi)	6.00	6.20	6.50	6.80	6.30	6.63	6.93	7.07	6.17	6.40	6.80	7.00	5.20	5.83	6.00	6.67
T <sub>5</sub> (Wood Apple with Lemon)	6.20	6.50	7.00	7.00	5.37	5.77	5.90	5.97	6.50	6.13	6.80	6.93	5.50	4.00	6.27	6.60
T <sub>6</sub> (Wood Apple with Sugar)	8.00	8.50	9.00	9.00	8.50	8.60	8.93	9.13	8.00	8.50	8.80	9.00	7.50	8.00	8.40	9.00
T <sub>7</sub> (Wood Apple with Ginger)	7.20	7.50	7.80	7.50	6.93	7.20	7.50	8.00	6.00	6.50	6.53	6.73	6.50	7.00	7.20	7.50
T <sub>8</sub> (Wood Apple with Acetic acid + methi)	6.50	6.80	7.00	7.20	6.00	6.20	6.50	6.80	5.00	5.60	6.00	3.90	4.00	4.37	4.63	4.80
F-test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed.(±)	0.16	0.08	0.08	0.08	0.08	0.04	0.02	0.12	0.32	0.08	0.11	0.73	0.05	0.05	0.08	0.07
C.D. (at 5%)	0.33	0.17	0.17	0.17	0.17	0.07	0.05	0.25	0.68	0.16	0.22	1.54	0.10	0.10	0.18	0.18

## References

1. Singh U, Wadhvani AM, Johri BM. Dictionary of Economic Plants of India. ICAR, New Delhi. 1990, 123.
2. Bhat SS. Indian farming, 1994; 5:17-18.
3. Kirtikar KR, Basu BD. Indian Medicinal Plants, (2<sup>nd</sup> edition), 1935; 1:496-497.
4. Roy P, Mazumdar BC. Sci and cult, 1988; 55:110-111.
5. Kumar S. Studies on post-harvest technology of Papaya (*Carica papaya* L.) Fruits Ph.D. Thesis, N. D. Univ. of Ahri. And Tech. Kumargunj, Faizabad, 1990.
6. Aradhita Basmanray, Gupta OP, Dhawan SS. Comparison of guava hybrids with commercial cultivators for making Jelly. Haryana Journal of Horticulture Science. 1996; 25(24):196-204.
7. Sethi V. Studies on preparation and storage of some dry preserve (Murrabba) Ph.D. Thesis I. A. R. I. New Delhi, 1980.
8. Barbosa-Canovas GV. Nonthermal Preservation of Foods. New York: Marcel Dekker. 1998, 276.
9. Roy SK. Preliminary studies on preparation of ready-to-use dehydrated pickle from waste lime peel. Indian Food Packer, 1969; (9):9-10
10. Tomar MC, Singh UB, Bisht NS. Dehydrated mixed vegetable pickle – A study on its preparation and storage. Indian Food Packer, 1989; (5):53-60.
11. Chakrabarty TK, Dwarakanath KR, Bhatia BS. Studies on dehydration of Pickles. Indian Food Packer, 1970; 2(1):5-8.
12. Mehta GL, Tomar MC. Dehydration and utilization of raw mangoes, Indian Food Packer, 1982; 36(11):75-79.