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PROTOCOL FOR PREPARATION AND PRESERVATION OF WOOD APPLE PICKLE

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Abstract– The wood apple pickle was prepared by using eight recipes which includes, two levels of sugar (50 and 100g), salt (100 and 200g) and spice mixture (10 and 15g). Significant differences were observed with respect to physico-chemical and organoleptic quality parameters between the recipes. During the storage of three months, the chemical constituents *viz.*, total soluble solids (TSS) and titratable acidity were found to increase marginally from 18.59 to 18.71°B and 2.28 to 2.67 per cent, respectively whereas, moisture, pH, ascorbic acid, crude fibre and overall acceptability scores were decreased from 56.09 to 49.44 per cent, 3.41 to 3.35, 6.99 to 3.19 mg/100g and 3.26 to 3.21 per cent, 7.37 to 7.46, respectively. The results of the organoleptic evaluation indicated that the wood apple pickle prepared with recipe containing, wood apple pickle prepared from recipe containing 1000 g pulp + 100/200 g salt + 100 g sugar + 15 g spice mixture was found superior in their acceptability than other recipes throughout the study.

INTRODUCTION

India is home to many of the fruit crops and some of them are limited to its growing regions and neglected or underutilized. Most of underutilized fruits are cheap, highly nutritious, known for medicinal and therapeutic properties and are used by the local tribes to cure various diseases. Among underutilized indigenous fruit species, wood apple (*Feronia limonia* Swingle) is one, known by several names like elephant apple, curd apple, monkey fruit, kavat, kathbel, Kotha, Vilanga, Kapith and Vela marum (Mazumder *et al.*, 2006). In northern parts of Karnataka, it is called as balolakai whereas, bellada hannu in southern parts (Gorabal *et al.*, 2020). It is one of the very hardy trees, tolerant to drought, salinity and thrives better in deep, well drained soils. It grows in the wild and is also planted along roads, the edges of fields and occasionally in orchards (Jayakumar and Geetha, 2012).

The flesh of the wood apple fruit is sweet, somewhat acidic and aromatic and it is commonly eaten as a raw along with or without jaggery and has high nutritional value particularly rich in minerals. Gorabal (2020) studied the nutrient composition of 108 wood apple genotypes and noticed that fruit comprises 40.47 to 66.46 per cent of pulp. The moisture content ranges between 65.32 to 74.04 per cent, TSS 12.08 to 18.44°B, acidity 2.44 to 6.12 per cent, brix:acid ratio 2.46 to 6.48, pH 2.80 to 3.54, total sugars 2.23 to 6.83 per cent, pectin 1.02 to 2.13 per cent, vitamin C 2.88 to 6.24 mg/100 g, vitamin B_{12} 0.05 to 0.27 mg/100 g, calcium 80.1 to 111.35 mg/100 g, iron 0.05 to 16.29 mg/100 g and phosphorus 37.10 to 69.17 mg/100 g.

Importance of wood apple fruit lies in its curative properties, which makes the tree as one of the useful medicinal plants of India. The fruit is used in India as a liver and cardiac tonic, when unripe, as an astringent means of halting diarrhea and dysentery, effective treatment for hiccups, sore throat and diseases of the gums (Singh, 2001). The pulp is poultice onto bites and stings of venomous insects (Kirtikar and Basu, 1935) also it has hypoglycemic, antitumor, larvicidal, antimicrobial and

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hepatoprotective activity (Vidhya and Narain, 2011). This fruit is considered to be one of the natural sources of anti-oxidants due to its potential radical scavenging activity of various phytochemicals (Nithya and Saraswathi, 2010).

The fruit is not popular as a desert fruit as it has hard shell containing mucilaginous pulp with numerous seeds. Therefore, it is not easily marketed in the fresh form therefore it has to be processed into acceptable products. Because of its excellent flavour and nutritive value, this fruit has a great potential for value addition. Many of wood apple products are new to consumers, sincere efforts need to be made to introduce them in the market and to evaluate the consumer acceptance and economic viability for commercialization of such products. Therefore, the present study was undertaken to exploit the excellent and delightful pulp characters having exceptional medicinal value of this fruits in pickle industry.

Pickling is one of the oldest method of preserving fruits or vegetables in common salt, oil, vinegar and citrus juices. They are good appetizer and add to the palatability of a meal, stimulate the flow of gastric juice and thus help in digestion. Various kinds of pickles are made in Indian homes and now a day's pickling is also done on commercial scale and has became one of the major food industries of the country.

MATERIALS AND METHODS

Mature unripe fruits were harvested and broken by hitting to a hard surface. A stainless steel spoon was used to aid the pulp escape the hard shell and steel knife was used to slice the pulp into uniformly sized pieces. Salt, sugar and spice mixtures (coriander, cumin, mustard and black pepper) were added in various amounts as specified in the treatment details (Table 1) and other ingredients *Viz.*, turmeric powder (10 g), chilli powder (50 g), asafetida (1.5 g), clove (1 g) and vegetable oil (250 ml) were added commonly to all the treatments. The finished product was placed in pet jars and kept in an ambient condition for further study.

The Products were analyzed for moisture content using a moisture analyzer (Model: P1019319, A & D Company Limited, Japan). TSS (°B) was measured by using an 'Erma' make hand refractometer after necessary corrections whereas, pH was by using PH meter (Model: Analogue research, USA). Titratable acidity (%) and ascorbic acid (mg/100 g) content was estimated as per the modified procedure of AOAC (Anon., 1984). Crude fibre content (%) was estimated as per the modified procedure of (Ranganna, 2003). The organoleptic characters were evaluated by a panel of semi-trained judges consisting of teachers and post-graduate students by using a nine- point hedonic scale as per the method of Ranganna (2003). Economics of pickle was estimated by using formulas *i.e.* net returns = total revenue – total expenditure and returns per rupee of investment = total revenue/total expenditure. The data recorded on the Physico-chemical and organoleptic parameters were subjected to statistical analysis in CRD. The interpretation of data was carried out in accordance with Panse and Sukhatme (1985). The level of significance used in the 'F' test was p=0.01.

RESULTS AND DISCUSSION

The nutritional quality of wood apple pickle was affected by the advancement of the storage period. The mean moisture content and crude fibre of wood apple pickle decreased from 56.09 to 49.44 per cent and 3.26 to 3.21 per cent whereas, TSS increased from 18.59 to 18.71°B during storage period (Table 2). This decrease in moisture could be due to the natural dehydration of the product during storage. Similar observations were made by Sastry *et al.* (1975) in mango pickle and Rathore *et al.*, 2021 in wood apple pickle. The increase in TSS due to the conversion of polysaccharides like starch and gum

Table 1. Different recipes involved in preparation of wood apple pickle

T_1 - 1000 g pulp + 100 g salt + 50 g sugar + 10 g spice mixture
T_2 -1000 g pulp + 100 g salt + 50 g sugar + 15 g spice mixture
T_3 - 1000 g pulp + 100 g salt + 100 g sugar + 10 g spice mixture
T_4 - 1000 g pulp + 100 g salt + 100 g sugar + 15 g spice mixture
T_5 - 1000 g pulp + 200 g salt + 50 g sugar + 10 g spice mixture
T_6 - 1000 g pulp +200 g salt + 50 g sugar + 15 g spice mixture
T_7 - 1000 g pulp + 200 g salt + 100 g sugar + 10 g spice mixture
T_8 - 1000 g pulp + 200 g salt + 100 g sugar + 15 g spice mixture

into soluble sugars. Similar results were reported by Rashmi (2010) in peach sweet pickle and Pal *et al.* (2018) in wood apple pickle. Whereas, decrease in crude fibre might be due to decrease in moisture content (Bom and Malgi, 2017). Similar observations were noticed in Karadiguddi (2022) in shatavari pickles. The mean ascorbic acid content and pH were decreased from 6.99 to 3.19 mg/100 g and 3.41 to 3.35 whereas, titratable acidity increased from 2.28 to 2.67 per cent during storage (Table 3). The decrease in ascorbic acid due to osmotic action of added salt and sugar, as well as its conversion into di-hydroxy ascorbic acid through oxidation. Similar findings were reported by Haware and Rao (1979) in Karonda pickle and Rathore *et al.* (2021) in wood apple pickle. The increase in acidity might be due to the formation of acids through the degradation of polysaccharides and the oxidation of reducing sugars. Similar results were observed by Haware and Rao (1979) in karonda pickle and Verma *et al.* (1986) in mango pickle. Whereas, decrease in pH due to increase in acidity corresponded with the decrease in pH. Similar findings were reported by Sharma (2002) in lime pickle and Rekha (2004) in kachri pickle. The mean sensory quality parameters *viz.*, colour and appearance score (8.10 to 7.46), and aroma (7.99 to 7.64) were decreased (Table 4) whereas, texture (6.34 to 7.30), taste (7.05 to 7.44) and overall acceptability (7.37 to 7.66) were increased (Table 5) during storage period of three months. The decreasing trend in colour and appearance could be attributed to an increase in browning. The increase in the scores for texture, taste, and overall acceptability of pickle may be due to the improved blending of all the ingredients during the pickling process and conversion of insoluble fraction of pectin into soluble form. Similar observation were observed by Verma *et al.* (1986) in mango pickle, Shantha *et al*. (2014) in stem amaranths pickle and Rathore *et al.* (2021) in wood apple pickle. The highest total cost of preparation of wood apple pickle recorded in T_8 (258.1 Rs) and least total cost recorded for T_1 (247.3 Rs). Highest net returns observed in T_5 (556.2 Rs) least net returns

Table 2. Effect of storage period on moisture content, TSS and crude fibre of wood apple pickle

Treatments	Moisture content (%)				TSS (°B)				Crude fibre (%)			
	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1MAS	2 MAS	3 MAS
T_1	57.42	55.87	52.32	50.08	17.82	17.87	17.91	17.93	3.19	3.18	3.16	3.14
T_2	57.33	55.68	52.21	50.38	18.07	18.13	18.17	18.19	3.31	3.31	3.29	3.28
T_3	56.28	54.73	51.62	49.67	19.11	19.18	19.21	19.24	3.22	3.20	3.17	3.16
T_4	56.20	54.70	51.57	49.51	19.23	19.30	19.33	19.35	3.35	3.34	3.32	3.30
T_5	55.63	54.07	50.97	49.07	17.90	17.67	18.02	18.06	3.21	3.21	3.20	3.17
T_6	55.59	54.01	50.89	49.03	18.10	18.16	18.20	18.23	3.28	3.26	3.24	3.23
T_7	55.18	53.27	50.05	48.92	19.19	19.25	19.28	19.31	3.16	3.15	3.13	3.10
T_8	55.09	53.19	50.01	48.88	19.31	19.35	19.37	19.40	3.32	3.30	3.27	3.26
Mean	56.09	54.44	51.21	49.44	18.59	18.61	18.69	18.71	3.26	3.24	3.22	3.21
S.Em±	0.052	0.037	0.035	0.040	0.010	0.110	0.009	0.009	0.008	0.008	0.008	0.010
C.D. @ 1%	0.215	0.153	0.145	0.165	0.040	0.454	0.037	0.038	0.032	0.035	0.035	0.042

Table 3. Effect of storage period on ascorbic acid, titratable acidity and pH of wood apple pickle

Treatments	Ascorbic acid (mg/100 g)				Titratable acidity (%)				pH			
	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1MAS	2 MAS	3 MAS
T_1	6.89	4.93	3.67	2.48	2.23	2.35	2.48	2.62	3.47	3.43	3.41	3.37
T_2	7.02	5.17	4.08	3.22	2.37	2.45	2.57	2.73	3.33	3.35	3.35	3.33
T_3	6.96	5.18	4.23	3.43	2.19	2.27	2.41	2.59	3.45	3.43	3.40	3.37
T_4	7.11	5.39	4.44	3.51	2.34	2.45	2.58	2.71	3.40	3.38	3.37	3.35
T_5	6.83	4.88	3.76	2.68	2.17	2.25	2.36	2.55	3.43	3.42	3.40	3.38
T_6	7.09	5.21	4.34	3.47	2.38	2.46	2.59	2.74	3.33	3.35	3.33	3.32
T_7	6.93	5.01	4.08	3.31	2.21	2.33	2.45	2.70	3.47	3.45	3.40	3.35
T_8	7.07	5.23	4.35	3.42	2.35	2.44	2.56	2.69	3.40	3.33	3.35	3.33
Mean	6.99	5.13	4.12	3.19	2.28	2.38	2.50	2.67	3.41	3.39	3.38	3.35
S.Em±	0.044	0.042	0.036	0.027	0.017	0.016	0.016	0.016	0.028	0.025	0.021	0.027
C.D. @ 1%	0.182	0.172	0.147	0.112	0.070	0.064	0.066	0.068	NS	NS	NS	NS

Table 4. Effect of storage period on colour and appearance, texture and aroma of wood apple pickle

Treatments	Colour and appearance				Texture				Aroma			
	Initial	1 MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Initial	1MAS	2 MAS	3 MAS
T_1	14.28	15.11	16.38	17.26	10.62	11.62	13.05	14.61	3.47	3.31	3.16	2.51
T_2	14.43	15.23	16.18	17.08	10.75	11.75	13.60	14.74	3.49	2.54	2.45	2.22
T_3	15.37	16.19	17.30	18.11	10.99	11.99	13.72	14.67	4.16	3.99	3.40	3.26
T_4	15.54	16.38	17.43	18.24	11.19	12.19	13.65	14.53	4.13	3.98	3.59	3.53
T_5	14.19	15.07	16.13	17.08	10.54	11.55	13.28	14.26	3.43	3.35	2.70	2.67
T_6	14.35	15.21	16.41	17.38	10.68	11.68	13.11	14.10	3.48	3.35	3.13	3.11
T_7	15.51	16.38	17.42	18.63	11.15	12.13	13.26	14.82	4.25	4.03	3.95	3.61
T_8	15.42	16.29	17.33	18.41	11.02	12.02	13.18	14.89	4.18	4.05	3.94	3.34
Mean	14.89	15.73	16.82	17.77	10.87	11.87	13.36	14.58	3.82	3.58	3.29	3.03
S.Em±	0.023	0.025	0.017	0.017	0.008	0.009	0.011	0.012	0.012	0.016	0.012	0.012
C.D. @ 1%	0.094	0.102	0.072	0.072	0.033	0.038	0.046	0.048	0.048	0.064	0.048	0.048

Table 5. Effect of storage period on taste, overall acceptability and economics of wood apple pickle

Treatments	Taste				Overall acceptability				Economics			
	Initial	1MAS	2 MAS	3 MAS	Initial	1 MAS	2 MAS	3 MAS	Total cost	Gross returns	Net returns	Returns per rupees expenditure
T_1	7.17	8.00	7.67	7.50	7.52	8.02	7.71	7.60	247.3	720	472.7	2.91
T_2	7.33	8.17	8.17	8.08	7.50	8.08	8.00	7.90	249.1	720	470.9	2.89
T_3	7.08	7.83	6.67	7.67	7.52	7.94	7.56	7.69	249.8	720	470.2	2.88
T_4	7.33	8.42	8.25	8.17	7.52	8.21	8.06	7.96	251.6	720	468.4	2.86
T_5	7.00	7.83	7.50	7.08	7.29	7.83	7.54	7.25	253.8	810	556.2	3.19
T_6	6.83	7.67	7.33	7.00	7.19	7.65	7.35	6.98	255.6	810	554.4	3.17
T_7	7.00	8.00	7.67	7.17	7.29	7.85	7.58	7.27	256.3	810	553.7	3.16
T_8	6.67	7.08	7.17	6.83	7.15	7.46	7.29	7.02	256.3	810	551.9	3.13
Mean	7.05	7.88	7.55	7.44	7.37	7.88	7.64	7.46				
S.Em±	0.072	0.072	0.072	0.072	0.036	0.035	0.045	0.036				
C.D. @ 1%	0.298	0.298	0.298	0.298	0.149	0.143	0.188	0.149				

was observed in T_4 (468.4 Rs) whereas, highest returns per rupee expenditure (3.19) was noticed in T_5 and least (2.86) was noticed in T_4 (Table 5).

CONCLUSION

Superior quality wood apple pickle with respect to physic-hemial and organoleptic qualities can be obtained by adding 100/200 g salt + 100 g sugar + 15 g spice mixture (T_8) and 1000 g pulp + 100 g salt + 100 g sugar + 15 g spice mixture to the 1000g of fruit pieces.

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