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Studies on Preparation of Wood Apple Ready to use RTS Powder Mix

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ABSTRACT: Wood apple is an underutilized fruit crop known for its excellent flavour, nutritional value and medicinal characteristics with great potentiality for processing into valuable products. This fruit is not popular as a desert fruit because, fruit has hard shell containing mucilaginous pulp with numerous seeds. Therefore, it is not easily marketable in fresh form should be processed into acceptable products. This experiment was conducted at Department of Postharvest Technology, KRC College of Horticulture, Arabhavi, to standardize the recipe for preparation of wood apple ready to use RTS powder mix. The experiment was laid out in CRD with six treatments consist of three levels (50, 60 and 70 g) of fruit powder, three levels (50, 40 and 30g) of maltodextrin, two levels (500 and 1000 mg) of spice mixture and constant level (100 mg) of CMC (carboxymethyl cellulose). Treatment T_6 (70 g wood apple powder, 30 g maltodextrin, 1000 mg spice mixture and 100 mg CMC) was found superior in organoleptic as well as physicochemical characteristics and this powder mixture can be safely stored upto three months under ambient conditions.

Keywords: Wood apple, ready to use, CMC, powder mix.

INTRODUCTION

Wood apple (*Feronia limonia* Swingle) is an under exploited fruit, which is known for its delightful pulp characters having exceptional medicinal values. It is one of the most nutritious fruit of Indian subcontinent. It contains many vitamins such as, vitamin A, Vitamin C, thiamine, riboflavin and niacin and minerals such as, calcium and phosphorus. The fruit is used in India as a liver and cardiac tonic, when unripe, as an astringent means of halting diarrhoea and dysentery (Singh, 2001), effective treatment for hiccups, sore throat and diseases of the gums. The pulp is poultice onto bites and stings of venomous insects (Kirtikar and Basu 1935). Wood apple has hypoglycemic activity, antitumour, larvicidal, antimicrobial activity and hepatoprotective activity (Vidhya and Narayin 2011). It also has anti-diabetic and antioxidant potential by reducing the level of blood glucose and malondialdehyde (Patel, *et al*., 2012). The 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).

People consume the raw fruit pulp as such with or without sugar or jaggery, or as a beverage after blending it with other ingredients (cardamom, salt, ginger etc.). Some people prepare a popular drink known as Simhalese or dimbulkiri (wood apple milk) by mixing ripened wood apple pulp with coconut milk and palm sugar (Morton, 1987). The pulp is also suitable for making food products such as juice, nectar, jam, jelly, fruit bar, wine, chutneys, sherbet, pulp powder *etc*. Because of its excellent flavour and nutritive value this fruit has a great potential for value addition especially in beverage industry. Due to a lack of knowledge about fruit processing technologies and processing facilities, approximately 25 to 30 per cent of harvested wood apple fruits are lost before consumption (Namdev and Singh 2015). One of the best ways to prevent losses is to convert them into various products. Dried foods/ dehydrated fruits, particularly in tropical and temperate countries, have traditionally been recognized as alimentary reserves among processed foods.

India represents a huge growth potential in the global fruit powder market. This can be attributed to changing consumer preference for nutritious and healthy food and increasing acceptance of packaged foods with high nutritional content. Increasing prevalence of lifestyle problems is propelling the trend of healthy and nutritious food, which is another factor that is contributing toward increased growth of the fruit powder industry in the country (Anon., 2021). Fruit

powder used in development of value-added products contribute significantly to the therapeutic as well as nutritive value. Development of value-added products based on fruit powders have excellent flavour and very attractive colour along with helping in overcoming the post-harvest losses as well as contribute in improving the health status of people (Johari and Kawatra, 2016). Keeping above points in view and possibly meeting out the recent trend of the consumers, efforts have been made to develop the nutritionally rich and delightful flavoured wood apple ready to use RTS powder mix.

MATERIAL AND METHODS

The fully ripe, edible stage wood apple fruits were selected and opened by breaking against the hard surface. The pulp along with the seed and fiber was separated with the help of stainless-steel spoon from the hard shell. The extracted pulp was homogenized by hand squeezing and then it was passed through the strainer to separate seeds and fibre. Thus, obtained pulp (without seeds and fiber) was further homogenised manually to make fine pulp.

The homogenised pulp was pre-treated with potassium metabisulphite (KMS) at the rate of 250 ppm and was spread evenly on the drying trays to a thickness of 5 mm. These trays were loaded into an EZY cabinet tray drier and dried at 60±2°C for 24 hours. The dried pulp was pulverized in a mixer. Pulverized pulp powder was sieved under 52 mesh size and was mixed with maltodextrin, spice mixture (powder form of pepper, ginger, cardamom and salt) and carboxy methyl cellulose (CMC) according to the treatment mentioned in Table 1. While organoleptic evaluation RTS was prepared by dissolving 10 g of ready to use RTS powder mix in 200 ml of cold water and then powdered sugar was added to adjust the TSS of RTS between 14 to 15°Brix.

Table 1: Wood apple ready to use RTS powder mix prepared by different level of wood apple powder, maltodextrin, spice mixture and CMC.

T_1	50 g wood apple powder + 50 g maltodextrin + 500 mg spice mixture + 100 mg CMC
T_2	60 g wood apple powder + 40 g maltodextrin + 500 mg spice mixture + 100 mg CMC
T_3	70 g wood apple powder + 30 g maltodextrin + 500 mg spice mixture + 100 mg CMC
T_4	50 g wood apple powder + 50 g maltodextrin + 1000 mg spice mixture + 100 mg CMC
T_5	60 g wood apple powder + 40 g maltodextrin + 1000 mg spice mixture + 100 mg CMC
T_6	70 g wood apple powder + 30 g maltodextrin + 1000 mg spice mixture + 100 mg CMC

The products were analyzed for moisture content using a moisture analyser (Model: P1019319, A & D Company Limited, Japan). A digital water activity meter (Model: Novasia AG, Switzerland) was used to determine the water activity. Titratable acidity (%) and ascorbic acid (mg/100 g) content was estimated as per the modified procedure of AOAC (Anon., 1984). The pH was determined by using a digital pH meter (Model: Analog research, USA). The total carbohydrate content was estimated by using the anthrone method (Hodge and Hofreiter, 1962). A Lovibond colour meter (Lovibond RT300, Portable spectrophotometer, The Tintometer Limited, Salisbury, UK) with an 8mm aperture was used to determine the colour values (*L**. *a**, *b**). The minerals such as calcium, phosphorus and iron present in the ready to use RTS powder mix was estimated as per the procedure given in AOAC (Anon., 1990). The organoleptic characters were evaluated by a panel of semi-trained judges consisting of teachers and post-graduate students of KRC College of Horticulture, Arabhavi, using a nine point hedonic scale as per the method of Ranganna (2003).

RESULTS AND DISCUSSION

Effect of different treatments on the nutritional quality of wood apple ready to use RTS powder mix. The mean moisture content was increased from 6.95 to 7.37 per cent during three months of storage (Table 2). The marginal increase in the moisture content in ready to use RTS instant powder mix may be due to absorption of moisture by powder as well as other ingredients added (hygroscopic nature) to the powder mix. Similar observations were made by Manya (2014) in sapota RTU mix, Shishir *et al.* (2017) in guava and Sornsomboonsuk *et al.* (2019) in bael. The mean water activity found increased gradually from 0.308 to 0.331 (Table 2). The slight variations in the moisture content of the powder mixture was also reflected in the water activity of the powder. The data was in agreement with Du *et al.* (2014) in persimmon powder and Pattar (2020) in jamun seed powder. The mean titratable acidity exhibited a decreasing trend 5.11 to 4.77 per cent (Table 2) with the increase in the storage period. Shinde *et al.* (2021) opinioned that, the decrease in acidity may be due to the formation of polysaccharides and oxidation of reducing sugar by degradation of acids. Similar results were noticed by Dak *et al.* (2014) in dried pomegranate arils; Swami *et al.* (2014) in kokum sarbat mix; Shinde *et al.* (2021) in jack fruit RTU mix. The mean pH increased from 3.65 to 3.67 (Table 2) as the storage period progressed. An increase in pH during storage may be attributed due to a decrease in acidity during storage and can also be due to the formation of sugars by the degradation of acidic compounds. Similar results were obtained by Swami *et al.* (2016) in ripe jackfruit bulb powder; Sneha and Deb (2018) in wood apple powder and Moazzem *et al.* (2019) in wood apple powder beverages. The mean ascorbic acid content was decreased from 2.82 to 2.22 mg/100 g (Table 2) during 3 months of storage. A reduction in ascorbic acid content might be due to the degradation of ascorbic acid molecules forming dehydro ascorbic acid by oxidation (Lal *et al.*, 2009).

Table 2: Changes in moisture content, water activity, titratable acidity and pH of wood apple ready to use RTS powder mix as influenced by treatments and storage period.

Treatments	Moisture content (%)		Water activity (a_w)		Titratable acidity (%)		pH		Ascorbic acid (mg/100 g)		Total carbohydrates (g/100 g)	
	Months after storage											
	Initial	3	Initial	3	Initial	3	Initial	3	Initial	3	Initial	3
T_1	7.09	7.55	0.314	0.334	4.05	3.71	3.71	3.65	2.25	1.64	26.27	26.26
T_2	6.92	7.31	0.308	0.330	4.97	4.69	3.67	3.69	2.61	1.97	31.26	31.27
T_3	7.06	7.44	0.311	0.336	5.83	5.43	3.60	3.64	3.01	2.42	35.32	35.34
T_4	6.87	7.35	0.304	0.327	4.45	4.12	3.71	3.74	2.63	2.10	27.48	27.50
T_5	6.95	7.33	0.309	0.331	5.23	4.87	3.65	3.68	3.04	2.44	31.98	31.99
T_6	6.83	7.24	0.303	0.330	6.14	5.80	3.59	3.63	3.35	2.76	36.54	36.56
Mean	**6.95**	**7.37**	**0.308**	**0.331**	**5.11**	**4.77**	**3.65**	**3.67**	**2.82**	**2.22**	**31.48**	**31.49**
S.Em±	0.013	0.019	0.001	0.001	0.033	0.023	0.013	0.014	0.025	0.023	0.005	0.008
C.D. @ 1%	0.052	0.079	0.002	0.003	0.133	0.094	0.052	0.056	0.100	0.095	0.020	0.032

T_1- 50 g WA powder + 50 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_2- 60 g WA powder + 40 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_3- 70 g WA powder + 30 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_4- 50 g WA powder + 50 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_5- 60 g WA powder + 40 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_6- 70 g WA powder + 30 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC

Table 3: Changes in *L, *a**, *b**, calcium, phosphorous and iron content of wood apple ready to use RTS powder mix as influenced by treatments and storage period.**

Treatments	*L**		*a**		*b**		Calcium (mg/100 g)		Phosphorus (mg/100 g)		Iron (mg/100 g)	
	Months after storage											
	Initial	3	Initial	3	Initial	3	Initial	3	Initial	3	Initial	3
T_1	71.55	69.08	9.25	9.81	18.23	18.02	36.11	36.08	21.32	21.26	3.91	3.88
T_2	70.34	67.26	9.54	9.96	18.09	17.81	36.32	36.28	21.68	21.61	4.52	4.48
T_3	68.12	64.98	9.87	10.25	17.89	17.60	49.54	49.51	30.28	30.25	5.23	5.19
T_4	69.96	65.73	9.39	10.02	18.12	17.78	36.83	36.80	22.03	21.98	4.08	4.05
T_5	69.03	66.12	9.63	10.13	17.93	17.52	44.03	43.97	26.11	26.06	4.63	4.61
T_6	66.37	62.83	9.98	10.35	17.73	17.54	50.59	50.51	30.87	30.81	5.31	5.29
Mean	**69.23**	**66.00**	**9.61**	**10.09**	**18.00**	**17.71**	**43.40**	**42.19**	**25.38**	**25.33**	**4.61**	**4.58**
S.Em±	0.017	0.016	0.018	0.016	0.017	0.013	0.007	0.010	0.014	0.013	0.006	0.009
C.D. @ 1%	0.068	0.064	0.074	0.064	0.070	0.055	0.030	0.039	0.055	0.054	0.025	0.038

T_1- 50 g WA powder + 50 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_2- 60 g WA powder + 40 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_3- 70 g WA powder + 30 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_4- 50 g WA powder + 50 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_5- 60 g WA powder + 40 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_6- 70 g WA powder + 30 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC

Table 4: Changes in organoleptic evaluation of wood apple ready to use RTS powder mix as influenced by treatments and storage period.

Treatments	Colour and appearance		Flavour		Mouthfeel		Taste		Overall acceptability	
	Months after storage									
	Initial	3	Initial	3	Initial	3	Initial	3	Initial	3
T_1	8.13	7.63	7.50	7.25	8.19	7.63	8.13	7.63	7.98	7.53
T_2	8.13	7.81	7.81	7.31	8.31	8.00	8.31	7.94	8.14	7.77
T_3	8.00	7.56	8.00	7.31	8.31	8.25	8.31	7.81	8.16	7.73
T_4	7.50	7.00	7.00	6.50	7.50	7.19	7.00	6.50	7.25	6.80
T_5	7.50	6.81	6.56	6.13	7.31	7.06	6.88	6.38	7.06	6.59
T_6	6.50	6.19	6.50	6.06	7.31	7.00	6.81	6.31	6.78	6.39
Mean	**7.63**	**7.17**	**7.23**	**6.76**	**7.82**	**7.52**	**7.57**	**7.09**	**7.56**	**7.14**
S.Em±	0.110	0.132	0.091	0.107	0.109	0.086	0.111	0.119	0.066	0.066
C.D. @ 1%	0.449	0.536	0.370	0.437	0.445	0.350	0.453	0.483	0.271	0.270

T_1- 50 g WA powder + 50 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_2- 60 g WA powder + 40 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_3- 70 g WA powder + 30 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_4- 50 g WA powder + 50 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_5- 60 g WA powder + 40 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_6- 70 g WA powder + 30 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC

Table 5: Cost of economics of wood apple ready to use RTS powder mix (in Rs.).

	T_1	T_2	T_3	T_4	T_5	T_6
Variable cost						
1. Wood apple pulp powder	354.00	424.80	495.60	354.00	424.80	495.60
2. Maltodextrin	212.00	169.60	127.20	212.00	169.60	127.20
3. Spice mixture	83.87	83.87	83.87	167.75	167.75	167.75
4. CMC	10.00	10.00	10.00	10.00	10.00	10.00
5. PET	120.00	120.00	120.00	120.00	120.00	120.00
6. Electricity cost	12.00	12.00	12.00	12.00	12.00	12.00
7. Labour cost	50.00	50.00	50.00	50.00	50.00	50.00
Sub Total	841.87	870.27	898.67	925.75	954.15	982.55
Fixed cost						
1. Depreciation of equipments	8.00	8.00	8.00	8.00	8.00	8.00
TOTAL COST	849.87	878.27	906.67	933.75	962.15	990.55
Return						
Out put (g)	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Gross returns	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00
Net returns	650.13	621.73	593.33	566.25	537.85	509.45
Returns per rupees of expenditure	1.76	1.71	1.65	1.61	1.56	1.51

T_1- 50 g WA powder + 50 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_2- 60 g WA powder + 40 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_3- 70 g WA powder + 30 g Maltodextrin + 500 mg Spice mixture + 100 mg CMC
T_4- 50 g WA powder + 50 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_5- 60 g WA powder + 40 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC
T_6- 70 g WA powder + 30 g Maltodextrin + 1000 mg Spice mixture + 100 mg CMC

Similar data was noticed by Swami *et al.* (2014) in kokoum sarbath mix and kokum solkhadi mix and Shinde *et al.*, (2021) in jackfruit RTU mix. The total carbohydrate content was increased from 31.48 to 31.49 g/100 g (Table 2) during the storage period of 3 months. The variations in the carbohydrate content of powder mixture made with different recipes may be due to variations in the concentration of different ingredients used. A similar increase in carbohydrate content during storage was reported by Sahni and Shere (2017) in apple pomace powder, carrot pomace powder and also in beetroot pomace powder.

The mean colour values (Table 3) *L** (lightness) value of RTS powder mix was decreased from 69.23 to 66.00 during storage period. The *a** (redness) value was increased from 9.61 to 10.09 during storage period. The *b** (yellowness) value decreased from 18.00 to 17.71 during storage period of 3 months. The decrease in *L** value and increase in *a** values indicate the product mixture turning towards dark colouration. The darkening of the product during storage particularly under ambient conditions is most common in many the fruit powders as well as products. Similar findings were observed in banana powder by Mary *et al.* (2007), lemon by Darvishi *et al.* (2014), mango powder by Nasiru *et al.* (2019) and in wood apple fruit powder by Singhania and Ray, (2019).

A negligible reduction in the mean calcium, phosphorus and iron content (43.40 to 42.19, 25.38 to 25.33 and 4.61 to 4.58 mg/100 g, respectively) in RTS powder mix was observed (Table 3). This reduction was due to the light, oxygen and water content will affect the mineral content of the product during storage, which will result in oxidation and reduction of these minerals. The results are confirmative with Attri *et al.*, (1998; Vidhya and Narain (2011), Bafna and Manimethalai; (2014) and Manya (2014).

Effect of different treatments on the organoleptic quality and safety of wood apple ready to use RTS powder mix. The RTS powder mix exhibited significant variations with respect to all the sensory quality parameters. The mean organoleptic scores decreased from an initial value of 7.63 to 7.17 for color and appearance, 7.23 to 6.76 for flavor, 7.82 to 7.52 for mouthfeel, 7.57 to 7.09 for taste and 7.56 to 7.14 for overall acceptability during the storage period of 3 months (Table 4). The overall decline in the sensory score during the storage may be due to some undesirable changes taking place in the product during storage. Similar results were observed in Kumar *et al.* (2012) in jack fruit powder; Manya (2014) in sapota RTU powder mixture and Shinde *et al.* (2021) in RTU jackfruit mixture powder. No microbial growth was observed during the storage period, ensuring that, the product was safe even after 90 days of storage, because of the less moisture, low water activity of RTS powder mix and high acidic nature of pulp.

Economics of wood apple ready to use RTS powder mix. Among different treatments the highest (Rs. 1.76) returns/rupee of investment (RPRI) was noticed in T_1 and lowest (Rs 1.51) RPRI was noticed in T_6 (Table 5). The prepared wood apple powder's return per rupees of expenditure was varying slightly among the treatments, this is because of the variation in the treatment recipes. The treatment T_1 recorded the highest returns per rupees of expenditure compared to other treatments, this may be because of maximum levels off ingredients powder used. Similar cost benefit ratio was observed in Shinde *et al*. (2021) in jackfruit RTU mix.

CONCLUSION

Wood apple instant RTU mix powder prepared with 70 g wood apple powder, 30 g maltodextrin, 1000 mg spice mixture and 100 mg CMC was found superior in organoleptic as well as physico-chemical characters and it can be stored safely up to 3 months under ambient conditions.

FUTURE SCOPE

Wood apple pulp powder highly acidic in nature, free flowing with good keeping quality, can be well utilized for preparation of rasam powder, puliyogare mix, sambar mix preparation in replacement to tamarind powder.

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Conflict of Interest. None.

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