Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(6): 222-225
Received: 15-09-2018
Accepted: 02-11-2018

Dagadkhair RA
ICAR- Directorate of Cashew Research, Puttur, Karnataka, India

Janani P
ICAR- Directorate of Cashew Research, Puttur, Karnataka, India

Preethi P
ICAR- Directorate of Cashew Research, Puttur, Karnataka, India

Raichurkar SJ
MIT College of Food Technology, Pune, Maharashtra, India

Athawale GH
MIT College of Food Technology, Pune, Maharashtra, India

Correspondence
Dagadkhair RA
ICAR- Directorate of Cashew Research, Puttur, Karnataka, India

Removal of tannins from cashew apple juice by using low cost food grade materials

Dagadkhair RA, Janani P, Preethi P, Raichurkar SJ and Athawale GH

Abstract
Cashew nut kernel is endowed with its indisputably exclusive fine taste and has got a commercial attractiveness of its own. On the other hand, despite its high nutritive value the cashew apple is virtually an unknown product in the consumer market. The major culprit of cashew apple utilization is its high astringency. The tannins present in apple are mostly responsible for astringency of the juice. Tannins interfere with the assimilation of proteins in the body. Therefore to make cashew apple juice acceptable like other fruits, tannin reduction becomes a major step. Tannins form soluble, insoluble and sometimes irreversible complexes with protein, starch and iron. The time required for detanning by using earlier methods (gelatin, polyvinyl pyrolidone, starch, sago, and rice gruel) was 8-10hrs during which the juice was very prone to fermentation and juice recovery was low. Three low cost food grade materials namely, defatted soymeal, dried potato powder and bajara (pearl millet) flour are identified and the method of its treatment with juice is so modified and standardized that it increased the efficiency of tannin reduction and improved juice recovery with no fermentation in fruit juice. Defatted soybean meal at the rate of 2% at 4ºC for 4hrs found to be more effective (34.3%) over dried potato powder (28.6%) and bajara flour (24.0%) in tannin reduction and juice recovery was registered as 89.5%, 84.50% and 80.50% with the respective treatments. With these interventions most of obstacles of earlier methods in the process of tannin reduction were overcome.

Keywords: Cashew apple, tannin removal, cashew apple processing, astringency

Introduction
Cashew was introduced into India from Brazil by Portuguese travelers during 16th Century. India is one of the leading countries in cashew cultivation and production. With 9.8 lakh ha land under cashew cultivation India is producing 7.28 lakh tonnes of raw cashew nuts every year. Cashew nut kernel is gifted with its unarguably exclusive fine taste and has got a commercial attractiveness of its own. The pseudo fruit which is also called cashew apple is a juicy fibrous fruit which is quite nutritious. For every ton of cashew nut produced, nearly 8 to 10 ton of cashew apples are produced. Cashew apple contains sugars, amino acids, tannins, ascorbic acid (Vitamin C) and crude fibre [1]. Cashew apples are very rich in ascorbic acid (240 mg/100 g) which is almost six times that of citrus fruits (40 mg/100 g) and many other customary tropical fruits which are known to be very rich sources of Vitamin C. Besides vitamin C, cashew apple contains free soluble sugars most of which are reducing sugars. Cashew apple is very rich in crude fibre and on a dry weight basis the crude fibre content varies from 15 to 18%. Phenols and flavonols present in cashew apple could serve as natural antioxidants which play a major role in destroying free radicals [2]. Cashew apples are good source of Vitamin C and fibre. Consumption of cashew apple could help in overcoming the Vitamin C deficiency and also constipation [3].

The lion share of total cashew apple produced is left to rot in to the field principally due to its astringency and unawareness about post-harvest handling and processing. Tannin, the astringent compound present in cashew apple obstruct with the assimilation of proteins in the body, ensuing nutritional deficiency [4]. Therefore to make cashew apple juice acceptable like other fruits, tannin reduction becomes a major step during cashew apple processing.

Tannins establish soluble, insoluble and sometimes permanent complexes with proteins, digestive enzymes, iron and possibly starch in the digestive tract. Sorghum tannins can bind and precipitate at least 12 times their own weight of protein [5, 6, 7, 8]. This principles can be used for selecting the appropriate agent for tannin reduction from the astringent fruit juices. Earlier workers established methods of tannin reduction includes use of gelatin, polyvinyl pyrolidone (PVP), starch [9], sago, and rice gruel. Tannin from cashew apple could be minimized by soaking cashew apples in 2% sodium chloride containing 500 mg potassium metabisulphite in a litre of water. Cashew apple juice can be clarified by using polyvinyl pyrolidone (PVP) [10] and sago [11].

Uma Talasila and Rama Rao Vechalapu [12] revealed that sago at a concentration of 2 g/L was efficient in decreasing tannins by 42.85 and 41.75%.

The efficiency of tannin reduction varied as per the change in the agent/ method used. The aforementioned methods of tannin reduction were reviewed at the food technology laboratory of ICAR Directorate of Cashew Research, Puttur, Karnataka, brought out certain conclusions. Use of PVP was limited despite its efficiency because of its inaccessibility and higher cost. Gelatin powder is also efficient but regarding amount required there is no consensus (India- 5%, Brazil-10% Benin- a 10% solution) and also to some extent use of animal originated gelatin is not preferred because of some ethical beliefs. Enzymes like tannase are difficult to use because its sourcing is a challenge and also not affordable [13]. Microfiltration is also in practice but requires tedious pre-treatments like use of clarifying agents prior to filtration and is expensive as well**.** Cassava starch is readily available, cheap but requires refrigeration of the juice and takes more time (8 hr) lead to fermentation of juice. Rice gruel is also effective clarifying agent and takes less time (20 to 40 min) to process but the quantity of gruel to be added is always more than 100 ml which leads to dilution of fruit juice and also alter the taste.

Taking in to account the above story, a research break through was required in the direction of tannin reduction of cashew apple juice without disturbing its nutritional and organoleptic characteristics. The new detannying agents were identified based on the chemical nature of the tannins. Tannins form soluble and insoluble and sometimes irreversible complexes with protein, starch and iron [14] accordingly three new low cost, readily available food grade materials were identified namely, defatted soya meal (DSM) source of proteins, dried potato flour (DPF) source of starch and bajara (pearl millet) flour (BF) source of iron and starch etc. were identified and the method of its treatment with juice is so modified and standardized so that the draw backs of earlier methods mentioned are addressed to a greater extent. Added to that a cohesive and an integrated detanninification strategy is developed for alleviating the astringency and antinutritional effects of tannins of cashew apple juice.

Materials and methods

Reagents and standards: All chemicals used in this experiment were of analytical grade. Sodium tungstate, phosphomolybdic acid, phosphoric acid, sodium carbonate, standard tannic acid, potassium metabisulphite, Whatman filter paper No. 1are all from Himedia (Mumbai, India).

Extraction of juice

Fully ripe cashew apples collected from the plantations at National Research Centre for Cashew, Puttur, after washing thoroughly with water were squeezed through a juice extractor to remove the juice.

Detannification Treatments

For the review of the methods of tannin reduction established by earlier workers the protocol given by Uma Talasila and Rama Rao Vechalapu (2012) was followed. The extracted cashew apple juice was filtered through sterile muslin cloth and pasteurized at 62˚C for four minutes. The filtered juice was distributed into sterile bottles of one litre capacity each. Amounts of starch, gelatin, and sago were dissolved as per the instructions in sterile lukewarm water and PVP being highly soluble was directly added to juice samples in duplicate and kept overnight undisturbed after thorough stirring at 4^0C followed by filtering through Whatman filter paper. One control sample of juice was maintained without any addition of clarifying agents.

For testing the efficiency of newly identified low cost food grade materials the cashew apple juice prepared as above was distributed in one litre capacity bottles in the numbers to have each sample duplicate. The DSM was prepared by course grinding of defatted soybean chunks followed by passing it through 300 mesh screens. The good quality potatoes were sliced and semi-cooked in boiling water containing 2% salt [15], followed by drying in hot air oven at 55^0C for 8 hours with intermittent surface shift. Dried potato slices are then powdered in to 300 mesh size. Bajara was also floured in to 300 mesh particle size. Obtained three different meals were then exposed to U.V. light for 15 minutes in a laminar flow cabinet for initial disinfection [16]. The disinfected DSM, DPF and BF is added to the pre-pasteurized and lukewarm cashew apple juice at different concentrations with 20 ppm potassium metabisulphite as a preservative and stirred thoroughly. Prepared samples were allowed to settle at 4^0C for four hours. Out of total quantity of treated; half is filtered through Whatman filter paper No. 1 and half is just decanted leaving the sediments at the bottom of sample bottles and then tested for tannin content.

Determination Detannying Efficiency: The tannin removing capacity of each material is determined by estimating tannin content of fresh and treated cashew apple juice. The tannin content of all treated juice samples was determined in terms of gallic acid equivalents (GAE) using Folin Ciocalteu method [17]. An aliquot (0.1 ml) of treated and controlled cashew apple juice was mixed with 1 ml of distilled water and 0.5 ml of Folin Ciocalteu to 2 N. The mixture was allowed to stand for 3 minutes. Then 3 ml of 2% Na_2CO_3 are added. The solution was centrifuged for 15 min. Finally, the absorbance is measured at 750 nm using a UV spectrophotometer and tannin content is calculated in terms of Gallic acid equivalents.

Results and Discussion

Review and Verification of Earlier Methods of Tannin Reduction

The cassava starch at the rate of 2% (Sago) was found more effective (Table No.1) (39.8% tannin reduction) over PVP at the rate of 4% (34.3% tannin reduction), gelatin at the rate of 3% (33.5% tannin reduction) and activated charcoal at the rate of 2.5% (15.0 % tannin reduction). In contrary to this the use of 2.5% charcoal brought out the highest clarity (96.3% juice clarity) in juice after treatment compared to PVP at the rate of 4% (91.6 % juice clarity), gelatin at the rate of 3% (82.9% juice clarity) and sago at the rate of 2% (91.2 % juice clarity). The above findings are similar to the findings of Uma Talasila, Rama Rao Vechalapu (2012).

Table 1: Review of earlier methods of tannin reduction

Treatment	Juice Recovery (%)	Absorbance (%)	Transmittance (%)	Tannin Removal (%)
Control	70.5	0.146	88.04	7.25
Sago 1%	88.5	0.189	92.945	23.325
Sago 2%	86.5	0.120	91.275	39.8
Sago 3%	80	0.164	87.8	28.91
Sago 4%	78	0.208	81.15	24.385
PVP 1%	91	0.156	88.5	31.6
PVP 2%	87	0.204	83.5	27.28
PVP 3%	82.5	0.189	87.72	30.17
PVP 4%	80	0.135	91.68	34.355
Gelatin 1%	87.5	0.500	58.78	26.385
Gelatin 2%	81.5	0.853	42.625	24.695
Gelatin 3%	82.5	0.194	82.9	33.535
Gelatin 4%	80.5	0.126	53.645	25.58
Charcoal 2.5%	87.5	0.042	96.325	15.075
Charcoal 5.0%	79.5	0.114	87.655	13.24
Charcoal 7.5%	80.5	0.209	77.475	7.875
Charcoal 10.0%	79.5	0.186	80.465	9.47
Mean	82.53	0.22	80.73	23.70
Sem	0.59	0.23	0.83	0.27
Sed	0.83	0.33	1.18	0.37
CD 0.05	1.78	0.70	2.54	0.80

Tannin reduction efficiency of newly identified low cost food grade materials:

The treatment given was similar to earlier methods except the treatment time was just four hours instead of 8-10 followed in case of sago, PVP, gelatin and charcoal. This in turn prevented the early spoilage of detanned juice during subsequent storage. Bajara flour imparted dull colour to the juice was the only drawback but addition of 0.5% activated charcoal along with bajara flour and other detannying agents helped to get rid of this colour problem. DSM at the rate of 2% at 4^0C for four hours found to be more effective (34.3% tannin reduction) over DPF (28.6% tannin reduction) and BF (24.0 % tannin reduction) and the trend of juice recovery was also recorded to be same as in case of tannin removal i.e. 89.5, 84.5 and 80.5% respectively (Table No. 2). The fact that the complex forming ability of tannins with proteins is higher than starch and iron as mentioned by Jansman (1993) [14] was hence re-established. Considering the most efficient concentrations of DSM, DPF and BF, the amount of tannins removed after ten hours treatment at 4^0C differed only by 2.27, 2.88 and 2.24% respectively over four hours treatment at same temperature (Table No. 2).

Table 2: Tannin reduction efficiency of newly identified low cost food grade materials

Treatment	Juice Recovery (%)	Absorbance (%)	Transmittance (%)	Tannin Removal (%)	
				4 hours	10 hours
Control	70.50	0.146	88.04	7.25	8.02
DSM 1%	84.50	0.074	88.82	28.67	30.40
DSM 2%	89.50	0.110	92.13	34.33	36.60
DSM 3%	79.50	0.161	78.94	24.03	26.20
DSM 4%	77.75	0.206	75.93	22.31	23.84
DPF 1%	82.50	0.096	86.19	26.03	28.02
DPF 2%	84.50	0.132	89.51	28.62	31.50
DPF 3%	75.50	0.159	79.58	23.92	25.32
DPF 4%	72.50	0.207	82.43	22.30	24.06
BF 1%	82.00	0.098	81.91	21.14	22.80
BF 2%	80.50	0.234	78.12	24.06	26.30
BF 3%	75.50	0.361	74.43	19.17	21.84
BF 4%	72.50	0.412	70.03	17.39	19.17
Mean	79.02	0.184	82.00	23.02	24.93
Sem	0.45	0.001	0.11	0.08	0.07
Sed	0.64	0.001	0.16	0.11	0.12
CD 0.05	1.38	0.003	0.34	0.24	0.25

Synergistic effect of detannying agent and filtration on tannin reduction of cashew apple juice

During experiments it was found that fresh cashew apple juice tend to clarify its own through sedimentation when kept undisturbed for 4-6 hours at room temperature and the process of sedimentation was further made two fold faster through low temperature (2-3hr at 4^0C) application thereby minimizing the probable chance of fermentation of juice during subsequent storage. The tannins either free (untreated juice) or in precipitate form (treated juice) still remains in the clear juice to major extent in the form of suspended particles or light weight precipitates. Keeping treatment time constant i.e. 4 hours, the untreated juice and treated juice are strained through Whatman filter paper No. 1 resulted in to two fold less tannins in the filtrate compared to unfiltered sample (Table No. 3).

Table 3: Synergistic effects of detannying agent and filtration on tannin reduction of cashew apple juice

Treatment	% Tannin Removal
Without Treatment/ filtered @ 4^0C	13.65
Without Treatment/ unfiltered /@ 4^0C	7.3
Sago 2%/filtered/@ 4^0C	28.8
Sago 2%/unfiltered /@ 4^0C	15.25
PVP 2%/filtered/@ 4^0C	26.65
PVP2%/unfiltered /@ 4^0C	12.5
DSM 2%/filtered/@ 4^0C	29.05
DSM 2%/unfiltered /@ C	14.35
Mean	18.44
Sem	0.17
Sed	0.24
CD 0.05	0.58

Conclusion

The time required for detanning by using earlier methods (gelatin, polyvinyl pyrolidone, starch, sago, and rice gruel) was 8-10hrs during which the juice was very prone to fermentation and juice recovery was low. Three low cost food grade materials namely, defatted soymeal, dried potato powder and bajara (pearl millet) flour are identified and the method of its treatment with juice is so modified and standardized that it increased the efficiency of tannin reduction and improved juice recovery with no fermentation in fruit juice. Defatted soybean meal at the rate of 2% at 4ºC for 4hrs found to be more effective (34.3%) over dried potato powder (28.6%) and bajara flour (24.0%) in tannin reduction and juice recovery was registered as 89.5%, 84.50% and 80.50% with the respective treatments. With these interventions most of obstacles of earlier methods in the process of tannin reduction were overcome.

Acknowledgement

We express our sincere thanks to Dr. P.L. Saroj, Director, ICAR Directorate of Cashew Research, Puttur, and Karnataka for his timely advices and support during this research activity.

References

1. Muniz CR, Borges MDF, Freire FDCO. Tropical and subtropical fruit fermented beverages. In Microbial Biotechnology in Horticulture. 2006; 2:123-128.
2. Adou M, Kouassi DA, Tetchi FA, Amani NGG. Phenolic profile of cashew apple juice (*Anacardium occidentale* L.) from Yamoussoukro and Korhogo (Côte d'Ivoire). J Appl. Biosci. 2012; 49:3331-3338.
3. Nagaraja KV. Nutritive value of cashew. National Research Centre for Cashew, Puttur, 2008, 12.
4. Morton JF, Dowling CF. Fruits of Warm Climates. Miami FL (eds). Creative Resources Systems, Orlando, FL, USA. 1987, 239-240.
5. Jansman AJM, Huisman J, van der Poel AFB. Ileal and faecal digestibility in piglets of field beans (*Viciafaba* L.) varying in tannin content. Animal Feed Science and Technology. 1993; 42:83-96.
6. Viriwutthikorn W. The importance of tanninfor food industries. J of Food. 1996; 26(3):157-167.
7. Nagaraja KV. Antioxidants in cashew (*Anacarium occidentale*). Director National Research Centre for Cashew Puttur. 2006; XXI(4):6-20.
8. Delimont NM, Haub MD, Lindshield BL. The Impact of Tannin Consumption on Iron Bioavailability and Status: A Narrative Review. Curr Dev Nutr. 2017; 1(2):1-12.
9. Costa MCO, Maia GA, Figueiredo RW, Souza Filho MM, Brasil IM. Storage stability of cashew apple juice preserved by hot fill andaseptic processes. Cienc. Tecnol. Aliment. 2003; 23:106-109.
10. Augustin A. Studies on the clarification of cashewapple for the preparation of cashew syrup. Indian J Nutr. Diet. 1982; 19:169-172.
11. Jayalekshmy VG, John PS. 'Sago' -A natural product for cashewapple juice clarification. J Trop. Agr. 2004; 42: 67-68.
12. Uma T, Rama RV, Khasim BS. Storage Stability of Cashew Apple Juice-Use of Chemical Preservatives. J of Food Technology. 2012; 10(4):117-123.
13. Campos DCP, Santos AS, Wolkoff DB, Matta VM, Cabral LMC, Couri S. Cashew apple juice stabilization by microfiltration. Desalination. 2002; 148:61-65.
14. Jansman AJM, Huisman J, van der Poel AFB. Ileal and faecal digestibility in piglets of field beans (*Viciafaba* L.) varying in tannin content. Animal Feed Science and Technology. 1993; 42:83-96.
15. Nagaraja KV. Composition of cashew processing by-products. J Food Sci Technol. 2006; 43:267-271.
16. Rajesh T, Anil S, Ahuja PS. Portable laminar flow cabinet (STARIFLOW^{TM}). J Scientific & Industrial Research. 2003; 62:1158-1163.
17. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagents. Am. J Vtic. 1965; 16:144-158.