Challenges and opportunities towards sustainable consumption and value addition of cashew apple in Tanzania

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Introduction

- Cashew apple (CA) is an important health fruit; contain five-times more vitamin C compared to that of citrus fruit
- CA is highly underutilized in Tanzania due to high perishability and inadequate postharvest value addition technologies
- This study explored factors affecting CA utilization and develop value added product from CA

Methodology

- Survey: semi-structured questionnaire
- CA value added product: pre-treated by blanching and osmotic dehydration, then dried on oven or solar drier
- Analysis of total phenolic and tannin content: folin ciocalteau method and spectrophotometric determination
- Analysis of ascorbic acid and beta-carotene: spectrophotometric method
- Sensory evaluation: 5-point hedonic scale

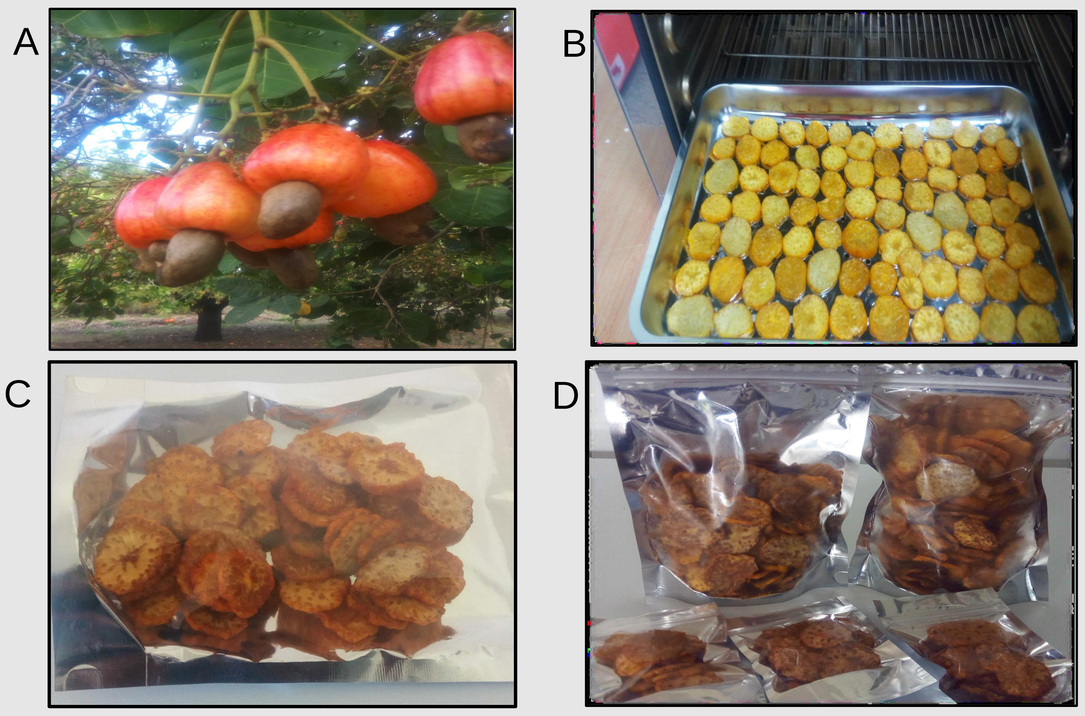

Figure 1. A: CA on the cashew tree; B: Pre-treated CA slices before drying; C: Dried CA slices; D: Packed dried CA slices

Results

Table 1. Farmers' consumption habits of raw CA across the surveyed districts

Variables		Districts					
		Tandahimba	Masasi Rular	Lindi Rular	Nachingwea	Mean(SD)	Chi Square
Raw consumption(%)	Yes	95.7	99.4	97.6	98.0	**97.7**(1.5)	χ2=4.29; p=0.23
	No	4.3	0.6	2.4	2.0	2.3(1.5)	
Place(%)	Home	0.0	0.6	0.8	0.0	0.4(0.4)	χ2=126.56; p=0.001
	Farm	61.9	42.4	87.7	26.5	**54.6(26.4)**	
	Both	38.1	57.0	11.5	73.5	45.0(26.6)	
Number of fruits per day (%)	1-5	60.2	37.3	21.3	33.7	38.1(16.2)	χ2=81.62; p=0.001
	6-10	26.5	23.4	52.5	41.3	**35.9(13.5)**	
	11-15	6.2	19.0	14.8	3.6	**10.9(7.2)**	
	>15	7.1	20.3	11.5	21.4	**15.1(6.9)**	
Frequency per week	1 day	15.0	6.3	0.0	6.6	7.0(6.2)	χ2=215.81; p=0.001
	2 days	11.5	3.2	0.0	11.7	6.6(5.9)	
	3 days	11.5	8.9	4.1	14.8	9.8(4.5)	
	3 to 5 days	37.2	41.1	1.6	2.6	20.6(21.5)	
	6 to 7 days	24.8	40.5	94.3	64.3	**56.0(30.3)**	

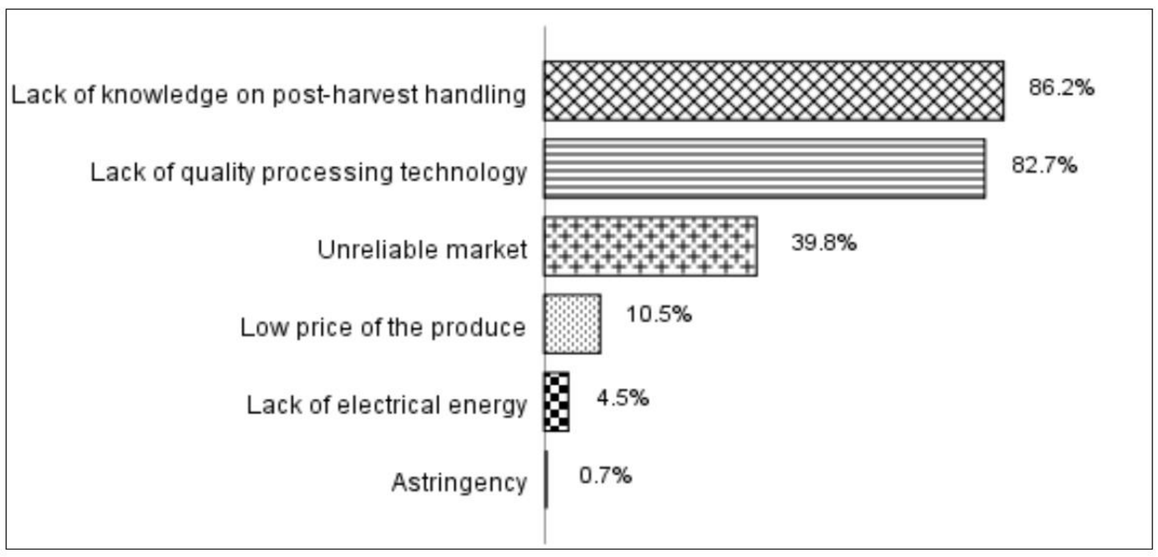

Figure 2. Post-harvest constraints encountered by Cashew Farmers (N = 600)

Table 2. Proportion of farmers involved in processing of CA

Variables		Processing of cashew apples		
		Process	Do not process	Chi square
Districts(%)	Tandahimba	15.4	84.6	
	Masasi Rular	22.0	78.0	
	Lindi Rular	77.4	22.6	
	Nachingwea	60.0	40.0	
	Mean(SD)	**43.7(29.9)**	56.3(29.9)	χ2=146.34; p=001
Gender(%)	Male	41.5	58.5	
	Female	48.9	51.1	
	Mean(SD)	45.2(5.2)	54.8(5.2)	χ2=3.32;p=0.07
Age(%)	18-29	39.6	60.4	
	30-39	38.4	61.6	
	40-49	52.0	48.0	
	50-59	48.0	52.0	
	>59	41.1	58.9	
	Mean(SD)	43.8(5.9)	56.2(5.9)	χ2=7.90;p=0.10
Household size (%)	1	35.7	64.3	
	2-5	48.2	51.8	
	>5	26.2	73.8	
	Mean (SD)	36.7(11.0)	63.3(11.0)	χ2=14.59;p=0.001
Years in cashew farming (%)	1-5	41.2	58.8	
	6-10	43.9	56.1	
	>5	45.9	54.1	
	Mean(SD)	43.7(2.4)	56.3(2.4)	χ2=0.69;0.71

Table 3. Physicochemical parameters of fresh and dried CA slices

Parameters	Fresh fruit	Hot air oven dried slices	Solar dried slices
Carotenoids (g/100g dry basis)	1.33±0.02^{b}	0.33 ±0.03^{a}	0.28 ±0.01^{a}
Tannins (mg/100GAE dry basis)	388.96 ±7.37^{b}	267.95 ±18.06^{a}	266.59 ±1.89^{a}
Ascorbic acid(g/100g dry basis	1.96 ±0.09^{b}	0.85 ±0.01^{a}	0.73 ±0.01^{a}

Means with similar letter in the same row are not significantly different from each other(p>0.05). GAE: Gallic acid equivalent.

Table 4. Quality parameters of dried CA slices during storage at room temperature

	Hot air oven dried products			Solar dried products		
	0 days	30 days	60 days	0 days	30 days	60 days
CC	0.33±0.03^{a}	0.31±0.01^{a}	0.30±0.01^{a}	0.28±0.09^{b}	0.24±0.01^{a}	0.23±0.01^{a}
TC	267.95±18.06^{b}	241.41±1.36^{b}	158.19±1.31^{a}	266.59±1.89^{c}	223±14±3.17^{b}	160.12±5.48^{a}
TAA	0.85±0.01^{b}	0.84±0.01^{ab}	0.83±0.01^{a}	0.74±0.0^{c}	0.70±0.01^{b}	0.60±0.01^{a}

Means with similar letter in the same row and within the same column i.e. column for hot air oven dried products, and column for solar dried products are statistically different from each other(p>0.05).CC: carotenoid content(g/100g dry basis) ;TC: Tannin content(mg/100g GAE dry basis);GAE: Gallic acid equivalent; TAA: Total ascorbic acid(g/100g dry basis).

Table 5. Sensory evaluation scores of dried CA products

Sample	Color ^{A}	Texture ^{A}	Taste ^{A}	Aroma ^{A}	Astringent ^{B}	Overall acceptability ^{A}
A	4.91^{a}	4.86^{b}	4.92^{a}	4.94^{a}	4.90^{a}	4.87^{a}
B	4.96^{a}	4.93^{a}	4.95^{a}	4.95^{a}	4.96^{a}	4.93^{a}
C	3.54^{b}	3.18^{c}	2.81^{b}	3.25^{b}	2.77^{b}	3.07^{b}

Means with same letters in the same column are not significantly different (p > 0.05). A: Solar dried sample; B: Hot air oven dried sample; C: Hot air dried sample without osmotic treatment. A Mean values based on 5-point Hedonic scale (5 = like very much; 1 = dislike very much); B Mean values on 5-point scale (5 = no astringent; 1 =extremely astringent)

Discussion

- 61.9% consume more than five fruit a day and 56.0% has almost every day frequency per week (Table 1).
- Lack of post-harvest handling and processing technology, 86.2% and 82.7% respectively(Figure 2)
- Traditional technology employed 43.7% (Table 2).
- No significance different p>0.05 on carotenoids, tannin and ascorbic acid for both dried products (Table 3).
- Storage at ambient temperature for 60 days, significantly (p<0.05) reduced carotenoid, tannin and ascorbic acid (Table 4)
- Both dried products showed similar (p > 0.05) overall sensory acceptability(Table 5).

Conclusion

- The combination of blanching, osmotic dehydration and solar or oven drying provide economically feasible value added products that can be reproduced in both urban and rural settings
- The technology can enhance reduction of postharvest losses of the fruit and leverage social economy of smallholder farmers

Reference

- AOAC. **(**1980): Official methods of analyses. Washington, DC 20044: The Association of Analytical Chemists (AOAC), 738-739.
- Dimoso N., Aluko A., Makule E., Kassim N. (2020): Challenges and opportunities toward sustainable consumption and value addition of cashew apple in Tanzania. Outlook on Agriculture: 1-9.
- Kapur A, Hasković A, Čopra-Janićijević A, Klepo L, Topčagić A, Tahirović I, Sofić E. **(**2012): Spectrophotometric analysis of total ascorbic acid content in various fruits and vegetables. Bulletin of the Chemists and Technologists of Bosnia and Herzegovina **38,** 39-42.
- Ojha P, Sigdel A, Karki R, Mishra A, Subedi U, Karki TB.(2017): Physiochemical and bioactive characteristics of osmo-air dried mulberry fruit. Nepalese Horticulture **12,** 27-32.

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