

Studies on the Utilization of Immature Cashew Nuts

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ABSTRACT: Cashew, a major commercial horticultural crop of India, is primarily cultivated for its nut. India ranks first in its cultivation, processing and export since its commercial cultivation and utilization has been started. Substantial quantities of cashew nuts are produced during rainy season in Kerala, particularly in the late flowering varieties, which are inferior in quality and are being wasted. If the immature nuts can be economically utilized, the wastage /loss during rainy season can be reduced to a great extent. Immature cashew kernels have been used traditionally for various culinary purposes in Kerala. In this context a study was conducted at Cashew Research Station, Kerala Agricultural University Madakkathara, Thrissur, for finding out some utilization of immature nuts. The trial consisted of standardization of stage of harvest of immature nuts, varietal influence on the recovery of immature kernels, storage studies and preparation of value added products. Maximum recovery of kernels was obtained from the variety Madakkathara-1(32.7%) which had the minimum tannin content of 0.22%. Kernel recovery was highest when the nuts were harvested at 55 days after flowering. Dried kernels from immature nuts could be stored for three months in ambient conditions and immature nut with shell could be stored for 6 months in refrigerated condition. The kernels could be used for the preparation of highly relished curries and products like spiced and salted kernels.

INTRODUCTION

Cashew, an important horticultural crop of India, has great socioeconomic significance in our country. India is the largest producer, processor and consumer of cashew occupying an area of 9.8 lakh ha. (Hubbali, 2013). Even though cashew is considered as an export oriented crop, data on trade indicate that domestic consumption of cashew kernels is almost equal to its exports. The demand for raw and processed cashew nut is bright in internal and export markets. Cashew nuts are one of the most nutritious nuts in the world, high in protein and with a large amount of important vitamins and minerals. Cashew nuts are excellent source of protein and fibre and considered to be "low-fat" nut (Ponnuswami *et al.*, 2011). Cashews can be enjoyed as a snack when they are salted or sweetened.

Kerala has an approximate area of 70,000 ha under cashew cultivation. Substantial quantities of cashew nuts are produced during rainy season in Kerala, particularly in the late flowering varieties, which are inferior in quality and are being wasted. The rain starts in the month of April as summer showers and heavy rainy season falls during June-July, ie SW monsoon. Cashew varieties in the high ranges of Kerala

(Wayanad and Idukki districts) starts flowering very late, usually coinciding with the rainy season. The rain causes lot of damage to the nuts, thereby yielding very less quantity and leading to high amount of economic loss to the farmers. This is aggravated by the pest and disease infestation. Under this situation it is better to harvest the nuts in the early stages i.e. in the immature stage before the heavy rain fall occurs. If these immature nuts can be economically utilized, the wastage /loss during rainy season can be reduced to a great extent. Small scale exploitation of immature cashew nuts is being practiced in certain areas of Kerala for culinary purposes. In this context, study was conducted at Cashew Research Station, Kerala Agricultural University Madakkathara, Thrissur, to standardize techniques for the utilization of immature cashew nuts for product development including storage studies.

MATERIALS AND METHOD

Varietal Evaluation

Six cashew varieties were selected from the fields of Cashew Research Station, Madakkathara, for finding the suitable variety for maximum recovery of

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kernels. They were Madakkathara-1, Dhana, Damodhar, Poornima, Priyanka and Vridhachalam-3. All these varieties were marked at flowering stage and the nuts were harvested at 40, 45, 50 and 55 days after flowering. Observations on recovery of kernels and tannin content were recorded and tabulated.

Storage Studies

Storage studies were conducted in the variety Madakkathara-1. For the storage studies, 55 days old immature nuts were harvested and the kernels were stored. Fresh kernels and kernels after blanching and drying were stored at different conditions viz, room temperature, refrigerated condition (4 °C) and freezer. The drying was effected in two ways- sun drying for

3 days and cabinet drying for 10 hours. Immature cashew nut packed in polythene cover was also stored. The microbial growth was assessed for all these samples at definite intervals and data recorded.

Preparation of Value Added Products

Culinary Preparations

Culinary preparations were made from the immature kernels of 55 days old, using potato, cauliflower, mushroom, egg etc. Two different sets of preparations were tried, the details of which are given below in Tables 1 and 2. The immature kernels of the variety Madakkathara-1 were used for the product development.

Table 1
Ingredients for Curry Preparation using Immature Cashew Kernels and Potato

Sl. No.	Ingredients	Sample 1	Sample 2	Sample 3	Sample 4
1	Immature kernel	150g	150g	150g	150g
2	Coconut oil	20ml	20ml	20ml	20ml
3	Onion & Tomato	1no. each	1no. each	1no. each	1no. each
4	Garlic	5no.s	5no.s	5no.s	5no.s
5	Ginger	1table spoon	1table spoon	1table spoon	1table spoon
6	Green chilly	3no.s	3no.s	3no.s	3no.s
7	Potato	1no	1no	-	-
8	Coconut (chopped)	-	-	50g	-
9	Coconut milk	-	-	-	75ml
10	Red chilly powder	1/2teaspoon	1/2teaspoon	1/2teaspoon	1/2teaspoon
11	Turmeric powder	1pinch	1pinch	1pinch	1pinch
12	Coriander powder	1/2teaspoon	1/2teaspoon	1/2teaspoon	1/2teaspoon
13	Garam masala powder	1/4 teaspoon	-	1/4 teaspoon	1/4 teaspoon
14	Salt & Curry leaves	as required	as required	as required	as required

Table 2
Ingredients Used for Curry Preparation using Immature Cashew Kernels, Mushroom, Cauliflower and Egg

Sl no.	Ingredients	Sample 1	Sample 2	Sample 3
1	Immature kernel	150g	150g	150g
2	Mushroom	150g	-	-
3	Cauliflower	-	150g	-
4	Egg	-	-	2no.s
5	Coconut oil	20ml	20ml	20ml
6	Onion&Tomato	1no. each	1no. each	1no. each
7	Garlic	5no.s	5no.s	5no.s
8	Ginger	1table spoon	1table spoon	1table spoon
9	Green chilly	3no.s	3no.s	3no.s
10	Coconut milk	75ml	75ml	75ml
11	Red chilly powder	1/2teaspoon	1/2teaspoon	1/2teaspoon
12	Turmeric powder	1pinch	1pinch	1pinch
13	Coriander powder	1/2teaspoon	1/2teaspoon	1/2teaspoon
14	Garam masala powder	1/4 teaspoon	-	1/4 teaspoon
15	Salt & Curry leaves	as required	as required	as required

In each sample, the cashew kernel was fried in coconut oil. All the spices and the tomato were added as per the treatments and fried until the colour changed to brown. Added the potato, cauliflower or mushroom in different samples as specified in the treatments. Cooked for 10 minutes. Then added boiled egg in the treatment with egg. Finally added the coconut/coconut milk as per the treatments, cooked

for one minute. Garnished with curry leaves. Transferred to clean bowls and served for organoleptic scoring.

Confectionery Preparation

Confectionery preparation was tried from immature cashew kernel using honey and sugar. The ingredients are listed in Table 3.

Table 3
Ingredients used for the Preparation of Sugar/honey Coated Kernels

Sl no.	Ingredients	Cabinet drying (8hr)		Sun drying (two days)		Sun drying (two days)
		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	Immature kernel	100g	100g	100g	100g	100g
2	Sugar	50g	100g	50g	100g	-
3	Honey	-	-	-	-	100g

Sugar was made into syrup. The kernel was kept in the sugar syrup/honey for four hours and then dried.

Sensory Evaluation

The products were subjected to sensory scoring with five point hedonic scale (Lindaposte *et al*, 1999). The organoleptic evaluation of the products was carried out among selected 10 members who were asked to give score for various parameters like appearance, colour, flavour, taste, texture, saltiness, and overall acceptability and data tabulated. Data collected from organoleptic studies were subjected to statistical analysis. Kendall's coefficient of concordance was used to assess the degree of agreement among the 10 judges.

RESULTS AND DISCUSSION

Even though cashew is considered as an export oriented crop, data on trade indicate that domestic consumption of cashew kernels is as much as its exports. At present cashew kernels are consumed directly or for various food preparations. Cashew kernel, derived by processing of cashew nut, is highly nutritious and is an ingredient of dietary item in most of the developed countries (Hubbali, 2011). Cashew nut is a popular snack, often eaten on its own, roasted, salted or sugar coated or covered in chocolate. The research efforts bestowed till now are concentrated mostly on mature kernels and immature kernels gained little attention.

In Kerala, sprouted cashew nuts are eaten raw and as cooked. Substantial quantities of cashew nuts are produced during rainy season in Kerala, especially

in the late season flowering types, which are inferior in quality and are being wasted. The quality of nut is affected mainly by the infestation of pests and diseases. It is estimated that more than 50% of the crop is lost annually due to pests and diseases in cashew (Haribabu *et al*, 1983). If the immature nuts can be economically utilized, the loss during rainy season can be reduced to a great extent. The immature nuts are harvested in tender form, when the shells have not hardened and are green in colour. The shell is soft and can be cut with a knife and kernel can be extracted. Small scale utilization of immature cashew nuts is being practiced in certain areas of Kerala for culinary purposes. The immature kernel is mostly found in Kerala cuisines, typically, *avial* and also for pickle making and in non vegetarian curries.

Varietal Evaluation

The data on the recovery of kernels from immature nuts and tannin content of the selected varieties are given in Tables 4 & 5. Maximum recovery of kernels was obtained from the variety Madakathara-1 (32.7%). Recovery was highest when the nuts were harvested at 55 days after flowering. The variety Madakathara-1 released from Cashew Research Station, Madakkathara, Kerala Agricultural University, has small sized nuts weighing about 6.2g (Jayaprakash Naik, 2009), because of which there will be more number of nuts in one kilogram weight compared to other varieties. This might be the reason for the highest percentage of kernel recovery. Tannin content in the immature stage of the nut is more than that of the mature nuts which ranged between 0.22% and 0.28% among the selected six varieties. Madakathara-

1 and Dhana had the minimum tannin content of 0.22%. There exists varietal difference with respect to all the characters including tannin content. Nut development pattern in cashew including kernel formation and change in colour of nuts have been extensively studied (Narayanankutty, 2000).

Table 4
Recovery of Kernels from 1Kg of Immature Nut among Selected Varieties

Sl no.	Name of variety	Recovery of kernels from 1Kg immature nuts(g)			
		40 days old	45 days old	50 days old	55 days old
1	Madakathara-1	125	175	200	327
2	Dhana	54	60	87	183
3	Damodar	67	100	125	170
4	Poornima	60	113	140	180
5	Priyanka	50	84	118	207
6	Vridhachalam-3	50	100	175	220

Table 5
Tannin Content of Immature Kernels (55days) in Different Varieties

Sl No.	Variety	Tannin (%)
1	Madakathara1	0.22
2	Dhana	0.22
3	Damodar	0.28
4	Poornima	0.26
5	Priyanka	0.24
6	Vridhachalam	0.28

Storage Studies

Storage is one of the important aspects of post harvest management system. The objective of storage is to increase the period of consumption. Cashew is a seasonal flowering tree, with the main crop season during January-May. Hence storage of nuts becomes essential to make it available throughout the year for product preparation.

The data on the microbial count in the immature kernels of all the six varieties stored under different conditions are presented in tables 6, 7, 8 and 9. Fresh kernels did not last for even two weeks under room temperature as indicated by the presence of too many bacteria (Table 6). It is evident that all the six varieties had almost similar microbial growth after 2 weeks of storage (Table 8). Dried immature kernels could be best stored for 3 months without any spoilage at room temperature (Tables 8). Sun drying and cabinet drying with or without blanching are equally good for getting 3 months shelf life. Cabinet dried kernels were found better in appearance than sun dried ones. The nut with shell also had a shelf life of 3 months at room temperature. Moisture content in any product gives

a congenial atmosphere for the growth and multiplication of many microbes leading to perishability. In the drying process, sufficient moisture is removed so that the kernel is free from spoilage by microorganisms. Thus dried kernels could be stored for more period and had more shelf life. Dried immature cashew nut packed in polythene cover could be stored in the freezer for 6 months (Table 9). Packing protects from the entry of foreign particles and retains quality and thus increased shelf life.

Table 6
Microbial Analysis of Immature Fresh Kernels Stored under Different Conditions, after Two Weeks of Storage

Storage condition	Microbial count in 1gm of sample (cfu/g)					
	Immature fresh kernels			Immature fresh kernels after blanching		
	Bacteria $\times 10^6$	Fungus $\times 10^4$	Yeast $\times 10^3$	Bacteria $\times 10^6$	Fungus $\times 10^4$	Yeast $\times 10^3$
Room temperature	TNTC	12	Nil	TNTC	9	Nil
Refrigerator (4 °C)	16	7	Nil	13	5	Nil
Freezer (0 °C)	3	0	Nil	3	0	Nil

TNTC-too numerous to count

Table 7
Microbial Analysis of Dry Immature Kernels of Different Cashew Varieties after Storage of 2 Weeks

Sl No.	Variety	Microbial count in 1ml of sample (cfu/ml)		
		Bacteria $\times 10^6$	Fungus $\times 10^4$	Yeast $\times 10^3$
1	Madakathara1	6	5	Nil
2	Dhana	11	4	Nil
3	Damodar	5	3	Nil
4	Poornima	8	3	Nil
5	Priyanka	10	2	Nil
6	Vridhachalam	12	5	Nil

Table 8
Microbial Analysis of Dried Immature Kernels/nuts after Blanching and Kept in Room Temperature, after 3 Months of Storage

Drying method	Microbial count in 1g of sample (cfu/g)		
	Bacteria $\times 10^6$	Fungus $\times 10^4$	Yeast $\times 10^3$
Sun dried kernels	14	6	Nil
Sun dried after blanching of kernels	10	6	
Cabinet dried kernels	6	4	Nil
Cabinet dried after blanching of kernels	7	4	Nil
Sun dried nut with shell	2	Nil	Nil

Table 9
Microbial Analysis of Dried Immature Nuts with Shell Packed in Polythene Cover and Stored in the Freezer

Period of storage	Microbial count in 1gm of sample (cfu/g)		
	Bacteria $\times 10^6$	Fungus $\times 10^4$	Yeast $\times 10^3$
3 months	3	Nil	Nil
6 months	8	5	Nil

Preparation of Value Added Products

Culinary Preparations

Cashew kernel is generally used for garnishing sweets or curries or ground into paste that forms a base of sauces for curries or some sweets. Split or crushed cashew kernels along with other dry fruits can be sprinkled over desserts/confectioneries including chocolates to enhance their flavour. Kurien and Peter (2007) reported that lower grade cashew kernels are processed into cashew flour, which has a high protein content and is easily digested. The immature kernel is mostly found in Kerala cuisines, typically, *avial* and also for pickle making and non vegetarian curries. In this study two types of curries were made from

immature cashew kernels and results on the sensory scoring are briefed hereunder.

Culinary preparation-I

The sensory evaluation of the two culinary preparations made from the immature kernels is presented in Tables-10 &11. From Table 10, wherein, the preparation was with potato along with the immature kernels, it is clear that sample 4 prepared with coconut milk had maximum acceptability followed by sample 3 prepared with coconut pieces. The coconut is an inevitable ingredient in almost all curries of Keralites, either as gratings or coconut milk. Coconut milk when added to curries gives a better taste liked by all people. In this trial also maximum acceptance was got for the curry with coconut milk. Usually the mature cashew kernel is used for garnishing curries or ground into paste that forms a base of sauces for curries. New recepies using cashew nut are being developed at different places which can easily blend with the traditional cuisine of the various cultures, which will persuade people to consume more cashew nuts without compromising on their cultural habits.

Table 10
Organoleptic Scoring of Immature Cashew Kernel Curry with Potato

Samples	Colour	Flavour	Taste	Texture	Saltiness	consistency	Overall Acceptability
1	2.30	2.10	1.85	2.00	2.10	2.05	1.95
2	2.05	1.95	2.45	2.40	2.10	2.20	2.25
3	2.65	3.05	2.85	2.65	3.10	2.85	2.85
4	3.00	2.90	2.85	2.95	2.70	2.90	2.95
Kendall's w(a)	0.181	0.220	0.174	0.137	0.288	0.192	0.166
Asymp. sig	0.143	0.086	0.156	0.251	0.034	0.124	0.173

(a) - Kendall's coefficient of concordance

Culinary preparation-II

Another preparation tried was with immature cashew kernels along with mushroom, cauliflower and egg. The results of organoleptic scoring (Table 11) reveals that sample 3 prepared with egg had maximum acceptability followed by sample 3 prepared with cauliflower. The addition of egg has an added advantage of increasing taste and flavour of any

preparation, liked by the non vegetarians. This was further improved by the addition of cashew kernels. Cauliflower has a unique taste liked by the consumers when prepared with spices. Here also the curry with cauliflower and cashew kernel got good acceptance. The combination of mushroom and cashew kernel could not score as with egg or cauliflower. This might be due to the combination effect of the ingredients.

Table 11
Organoleptic Scoring of Immature Cashew Kernel Curry with Mushroom,Cauliflower and Egg

Samples	Appearance	Colour	Flavor	Taste	Consistency	Saltiness	Overall Acceptability
1	2.00	2.10	2.00	1.90	1.90	2.20	1.65
2	2.10	1.80	1.90	2.10	1.95	1.80	1.90
3	1.90	2.10	2.10	2.00	2.15	2.00	2.45*
Kendall's w(a)	0.029	0.080	0.017	0.014	0.044	0.123	0.248
Asymp. sig	0.751	0.449	0.840	0.871	0.646	0.292	0.084

(a) - Kendall's coefficient of concordance.

Confectionery Preparation

The sensory evaluation of the sugar/honey coated kernels is presented in Table 12. Among the five samples, sample-1 coated with sugar and dried in the cabinet drier had maximum acceptability. This was followed by the honey coated sundried kernels. Cashew nut is a popular snack, often eaten on its own, roasted, salted or sugar coated or covered in chocolate. They are widely used in confectionery, as additions to biscuits, sweets and cakes. The study shows that sugar coated immature kernels are also liked by the consumers. The same can also be used for garnishing sweets and cakes. Sweet preparations are always liked by majority of the people, and coating

doesn't increase the sugar as in the case of sweets or chocolates. Hence considering the nutritive value of cashew kernels, the sugar coated immature kernels have immense scope for future. The sugar/honey coated kernels can be used for direct consumption or for garnishing cakes and sweets.

The sugar/honey coated kernels were kept for two months at room temperature and analyzed for microbial growth the results of which are presented in Table 13. It is clear that the products do not have microbial growth above the permissible limit. Thus it is concluded that the immature cashew kernels coated with sugar/honey could be stored for 2months at room temperature without any spoilage.

Table 12
Organoleptic Scoring of Immature Cashew Kernels Coated with Sugar/honey

Samples	Appearance	Colour	Flavor	Taste	Crispness	Sweetness	Overall Acceptability
1	3.30	3.45	4.00	4.15	3.70	4.40	4.10
2	2.60	2.70	2.75	2.50	2.70	2.85	2.40
3	2.30	2.45	2.70	2.20	2.70	2.10	2.35
4	3.70	3.20	2.65	3.15	2.75	2.80	2.90
5	3.10	3.20	2.90	3.00	3.15	2.85	3.25
Kendall's w(a)	0.182	0.102	0.206	0.324	0.132	0.388	0.297
Asymp. sig	0.121	0.394	0.084	0.011	0.258	0.004	0.018
significance	1.21	3.94	0.84	0.11	2.58	0.04	0.18

(a) - Kendall's coefficient of concordance.

Table 13
Microbial Analysis of Immature Cashew Kernels Coated with Sugar/honey after two Months of Storage under Room Temperature

Samples	Microbial count in 1gm of sample (cfu/g)		
	Bacteria $\times 10^6$	Fungus $\times 10^4$	Yeast $\times 10^3$
1	4	1	Nil
2	3	0	Nil
3	5	2	Nil
4	4	1	Nil
5	6	2	Nil

CONCLUSION

The study revealed that kernels from immature nuts can be stored for three months after drying and immature nut with shell could be stored for 6 months in refrigerated condition and can be used for the preparation of highly relished curries/products which is particularly relevant in rainy season during which period the mature nuts become damaged and cannot be used further. Cashew till recently was considered as a poor man's crop and the rich man's food and as such the consumption of cashew kernels was mostly oriented around rich and developed nations (Bhodes, 2014). By increasing the awareness

about the health advantages of cashew nuts, the benefits can be enjoyed by new segments such as school going children, old people requiring nutritional supplements, pregnant women, etc, (Varma and Venkiteswaran, 2009). The product development from the otherwise wasted rainy season nuts offers immense scope for its utilization on a large scale thus leading to enhanced income for the farmers.

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