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***Original Research Paper***

# Qualitative and organoleptic evaluation of immature cashew kernels under storage

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## ABSTRACT

**Cashew cultivars, based on flowering behaviour, are categorized into three types, *viz*., early season, mid-season and late season. In late season type, the harvesting of cashew nuts coincides with the rainy season during which the quality of matured nuts are affected by increased pest and disease attack. This loss can be reduced if the nuts are harvested before it reaches its complete maturity. In this context, present study was conducted in immature cashew kernel to find out suitable storage treatments to enhance the shelf life. Immature cashew kernels were stored in different concentrations of brine solution (5%, 10% and 15%), sugar syrup (50°B, 60°B and 70°B) and by drying in hot air oven until the moisture content of kernel reaches 2-3 per cent. Storage period was for four months and the observations like tannin content, microbial content and organoleptic qualities of kernels stored in each treatment were analysed at the beginning and at the end of the storage. The treatment with 10% brine and 70°B sugar syrup for four months were found as best for storing immature cashew kernels.**

**Keywords**: Cashew, immature kernels, organoleptic qualities and storage

## INTRODUCTION

Cashew, an important horticultural crop of India, has a great socio-economic significance in this country. It is native of Brazil and the Lower Amazons. The demand for raw and processed cashew nut is high in both internal and export markets. According to the annual report of CEPCI (2019), India continued to be the largest producer of cashew nut in the year 2017-2018 and the state that contributed maximum towards production is Maharashtra (33%), followed by Andhra Pradesh (14%), Kerala (11%) and Karnataka (11%). At present cashew kernels are consumed directly or used for various food preparations. Raw cashews contain 5% water, 30% carbohydrates, 44% fat and 18% protein. In a 100 gram reference quantity, raw cashews provide 553 Calories, 67% of the Daily Value (DV) in total fats, 36% DV of protein, 13% DV of dietary fiber and 11% DV of carbohydrates (USDA, 2015). The research efforts are concentrated mostly on mature kernels, and immature kernels gained little attention. In Kerala, sprouted cashew nuts are eaten as raw and also after cooking. Considerable quantities of cashew nuts are produced during rainy season in Kerala, especially in the late season flowering varieties like Madakkathara-2 and Sulabha, which are inferior in quality and are being wasted. The occurrence of late season flowering is mostly observed in hilly regions of Kerala like Wayanad and Idukki districts. The quality of nut is affected mainly by the infestation of pests and diseases during this season. 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 nuts are harvested before it reaches complete maturity and if those can be economically utilized, the loss during rainy season can be reduced to a great extent. Therefore, in this experiment, the immature nuts were harvested in tender form, when the shells were not hardened and were green in colour. The shell is soft and can be cut with a knife and kernel can be extracted. The kernels can be put to use in a variety of ways like serving as a snack or it could be relished as salads by combining with mango and sweets like *tikka* and cashew cake can be prepared

(Anandkumar *et al.,* 2011). If we can store these immature kernels, it can be used round the year. In this context, the storage studies of immature cashew kernels were studied in College of Agriculture, Kerala Agricultural University, Thrissur, India.

## MATERIALS AND METHODS

The immature cashew nuts were collected from Cashew Research Station, Madakkathara, Thrissur, India. Inflorescences of cashew tree were tagged at the time of anthesis and the nuts were harvested after 55 days. This is the stage before the nuts turn from green to grey colour. The harvested tender nuts were cut into halves using sharp knife and the kernels were scooped out. The outer covering of kernel (i.e.,) testa, was removed and these kernels were washed thoroughly in water followed by steam blanching for two to three minutes.

Brine solutions of 5%, 10% and 15% concentrations were prepared and poured in sterilized glass bottles, to which the pre-treated kernels were added. Three replications were kept for each treatment. Similarly immature kernels were stored in sugar syrups of 50°B, 60°B and 70°B concentrations. Permissible quantity of preservative was added to every treatments. Another treatment under storage studies was by drying. The pre-treated kernels were dried in hot air oven for two days, until the moisture content of the kernels were reduced to 2-3% and then stored in glass containers after complete cooling. Observations taken were tannin content, microbial content and organoleptic evaluation of kernels at first and fourth months of storage.

**Tannin content**

Tannin content of the kernels were estimated using Folin-Denis method at first and fourth months of storage.

**Microbial Count**

In microbial analysis, total bacterial, fungal and yeast counts were evaluated for both stored kernels and keeping solution.

**Organoleptic Evaluation**

Organoleptic evaluation was carried out by a panel of judges consisting of 15 members. The evaluation was carried out at beginning and ending of the storage period. Different organoleptic parameters like appearance, colour, texture, flavour, taste, mouth feel and overall acceptability were evaluated.

## RESULT AND DISCUSSION

**Tannin content**

Tannin content could not be detected in any of the treated kernels at both first and fourth months of storage. It might be because of the primary processing steps like washing and steam blanching employed before storage treatments. Anand (1970) reported loss of tannins during pre-treatments like soaking, blanching and brining of fruits during preparation of aonla preserve. According to Afoakwa *et al*. (2007), blanching of Bambara groundnuts before canning reduced the tannin content. Thus, these pre-treatments and storage treatments were found to be very effective in removing tannin content of immature cashew kernels.

**Table 1. Microbial count of the keeping solution in different storage treatments**

| Treatments | Bacteria ($10^7$ cfu/ml) | | Fungi ($10^3$ cfu/ml) | | Yeast ($10^4$cfu/ml) | |
|---|---|---|---|---|---|---|
| | 1 MAS | 4 MAS | 1 MAS | 4 MAS | 1 MAS | 4 MAS |
| 5% brine | 7.67 (0.93) | 6.33 (0.86) | 1.67 (0.42) | 4.67 (0.75) | 1.33 (0.36) | 1.67 (0.42) |
| 10% brine | 0.00 | 0.00 | 0.00 | 0.33 (0.10) | 0.00 | 0.00 |
| 15% brine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50°B syrup | 5.00 (0.77) | 1.67 (0.26) | 1.33 (0.36) | 2.00 (0.48) | 0.00 | 1.67 (0.42) |
| 60°B syrup | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 70°B syrup | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CD (5%) | 0.11 | 0.32 | 0.20 | 0.14 | 0.07 | 0.10 |

MAS - Months after storage (Values in the parenthesis are logarithmically transformed) Cfu/ml - Colony forming unit per ml

**Table 2. Microbial count of the kernels preserved in different storage treatments**

| Treatments | Bacteria ($10^7$ cfu/ml) | | Fungi ($10^3$ cfu/ml) | | Yeast ($10^4$cfu/ml) | |
|---|---|---|---|---|---|---|
| | 1 MAS | 4 MAS | 1 MAS | 4 MAS | 1 MAS | 4 MAS |
| 5% brine | 5.67 (0.82) | 4.33 (0.73) | 0.67 (0.20) | 1.67 (0.42) | 0.33 (0.10) | 1.00 (0.30) |
| 10% brine | 0.00 | 0.00 | 0.00 | 0.33 (0.10) | 0.00 | 0.00 |
| 15% brine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50°B syrup | 3.33 (0.63) | 1.00 (0.30) | 3.33 (0.63) | 3.00 (0.60) | 0.33 (0.10) | 1.67 (0.42) |
| 60°B syrup | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 70°B syrup | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| drying | 0.00 | 0.00 | 0.00 | 0.33 (0.10) | 0.00 | 0.00 |
| CD (5%) | 0.04 | 0.03 | 0.12 | 0.17 | NS | 0.06 |

MAS - Months after storage (Values in the parenthesis are logarithmically transformed) Cfu/ml - Colony forming unit per ml
NS - Non-significant

**Microbial count**

The microbial count of both kernels and keeping solution is presented in table 1 and table 2. Among the seven treatments of storage, the bacterial count was beyond permissible limit both in the solution and kernels stored in 5% brine as well as in 50°B sugar syrup.

The fungal population was within the acceptable limit for all the treatments. The yeast population was also found above the permissible limit for 5% brine and 50°B sugar syrup. This might be due to the less concentration of salt and sugar content in both these treatments which might not be sufficient to control the microbes. Ranken *et al*. (1997) reported that placing vegetables in 8-11% of salt content inhibited the microorganisms that may cause spoilage of vegetables. Thus, the immature cashew kernels can be stored for four months without microbial attack in 10% brine, 15% brine, 60°B sugar syrup and 70°B sugar syrup. Storage after drying was also found to contain permissible limit of microbial population.

**Organoleptic evaluation**

Among the seven treatments of storage, kernels stored in sugar syrup were the most accepted ones, both at the first and last months of storage (Fig 1). According to Ponting (1973), sugar uptake by the product kept in sugar solution, through osmotic process, modified the composition and taste of the final product. In this experiment, the scores obtained for flavour (6.40-7.07) and taste (6.00-7.07) were higher for kernels in sugar syrup. The uptake of sugar in the kernel might have resulted in the increased taste and flavour leading to enhanced palatability and higher score. Kernels preserved in 70° B sugar syrup had the highest overall acceptability score (7.40) followed by kernels in 60° B (7.00) and 50° B (6.60) sugar syrup; higher sugar level might have resulted in more absorption.

Kernel stored in 15% brine was the least accepted treatment which might be due to its high salt content that made it unpalatable after four months of storage. Ross *et* al. (2002) reported that macadamia kernel pieces, which were immersed in salt solution, became unacceptable on extended storage. Kernels in 10% brine was found better than 5% and 15% brine solutions in sensory parameters like appearance, colour, texture, flavour and overall acceptability.

According to Hutton (2002), salt act as a preservative against microbial growth and also imparts characteristic flavour. All the quality parameters of organoleptic evaluation were found better for kernels stored in 10% brine after four months of storage compared to the first month. The preservative action of salt leading to enhanced storage life has been reported in many vegetables. Barwal *et al*. (2005) reported that blanched cauliflowers steeped in 10% and 15% salt solution were found acceptable up to 180 days.

In dry storage, the dried kernels had an off taste after four months of storage which could be attributed to the rancidity of the kernels as experienced in nuts with

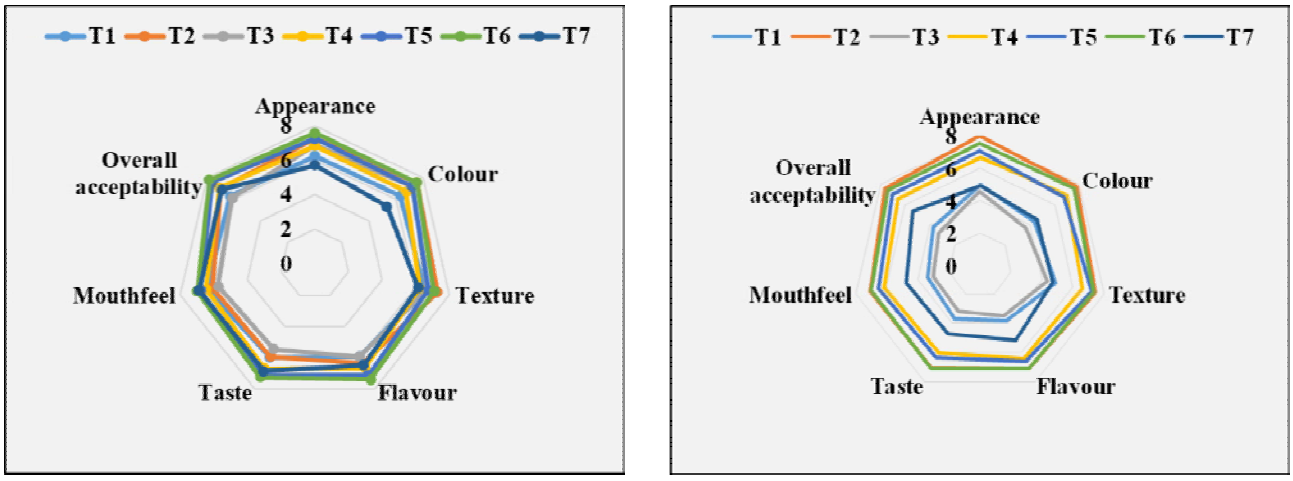


**Figure 1. Effect of different treatments on sensory attributes immature cashew kernel at (a) first month and (b) fourth month of storage**

$T_1$- Kernels preserved in 5% brine; $T_2$- Kernels preserved in 10% brine; $T_3$- Kernels preserved in 15% brine; $T_4$- Kernels preserved in 50° brix sugar syrup; $T_5$- Kernels preserved in 60° brix sugar syrup; $T_6$- Kernels preserved in 70° brix sugar syrup; $T_7$- Kernels preserved by drying

high fat content. According to Mexis and Kontominas (2009), the rancid taste of nuts during sensory evaluation occurred due to lipid oxidation. Young (2007) reported that rancidity was considered as the first sign of deterioration of nuts, since most edible nuts are rich in oil content. Hence the dried immature kernels cannot be used as such for consumption after a storage period of four months.

## CONCLUSION

According to the findings, tender cashew nuts can be stored safely for four months in preserve (70°Brix) and also in 10% brine added with allowed preservatives. This can be followed anywhere in the world, where the mature nuts are affected due to any biotic or abiotic problems.

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