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Full Length Research Paper

Effect of period of steaming and drying temperature on chemical properties of cashew nut

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This study investigated effect of period of steaming (20, 30 and 40 min) and drying temperature (50, 60 and 70°C) on the chemical properties of cashew nut. The nuts were packaged in glass bottle, polyethylene bag and plastic bottle and stored under ambient condition (28 ± 3°C) for 12 weeks. The samples were analyzed immediately after drying and at two weeks interval during storage for chemical properties. The ranges of the properties studied are - moisture content (4.16 to 6.76%), oil extracted (40.08 to 47.01%), oil colour intensity (0.08 to 0.58A), residual sugar content (1.57 to 6.04%), residual cashew nut shell liquid (CNSL) (0.30 to 3.77%), acid value (0.58 to 12.32 ml/g), peroxide value (2.80 to 25.32 mEq/kg) and anisidine value (0.85 to 5.94 ml/g). Steam boiling time and drying temperatures has significant differences ($p < 0.05$) on the chemical properties of the dried cashew nuts. Cashew nuts processed by steam boiling for 40 min and dried at 70°C recorded the best quality, as it reduces both the residual CNSL and the moisture content of the kernel. It also had a positive influence on the % residual sugar of the sample.

Key words: Cashew nut, steaming period, drying temperature, chemical properties.

INTRODUCTION

Cashew nut tree, *Anacardium occidentale L*. is a medium size tree belonging to the family *Anacardiaceae* (Woodroof, 1979). The nut (a fruit seed enclosed in a woody covering - the pericarp) is attached to the end of the fruit of cashew tree (Ranken and Kill, 1993). The cashew nut has within itself a whole kernel, a membrane and a thick covering shell which effectively protect the kernel from the ravage of nature from time of harvesting to processing.

In Nigeria, cashew nut tree ranked among the tree crops like cocoa, rubber, kola and coffee that have great cultivation potentials (RMRDC, 2004). But the crude oil boom of the early 70's and 80's has depressed local production and international marketing of these produce (Ihimodu, 1993). However, the on-going economic reform of the government is now giving more attention once again to the agricultural sector as it has the potential of contributing substantially to the overall growth and economic development. Cashew nut being a nut with a unique smell and mouth feel (Esuruoso, 1974) and being recognized as a luxury snacks that may be sold in every market which may be eaten at every meal time and in-between regardless of age (Hollingsworth, 1995) are priced accordingly (Ranken and Kill, 1993) making it an industrial and export cash crop yet to be fully exploited by Nigerian farmers and industrialist.

However, the unprecedented interest in "healthy" food by the consumers is of great importance (Hollingsworth, 1995) and the quality of cashew kernel like most other product is very important in today's export market (Smithy, 2004). This quality is determined by the processing conditions, which the product is subjected to among other things (Smithy, 2004). So, for Nigeria to reap the full benefit from international market, the quality of this product must also meet the international standards. Hence, there is need for better control of production processes in order to ensure a safe and high product

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Table 1. Chemical properties of processed cashew kernel produced from different period of steaming and drying temperature.

Period Of Steaming (Min)	Drying Temp (^{0}C)	Moisture Content (%)	Oil Extracted (%)	Oil Colour Intensity (Abs)	Residual Sugar (%)	Residual CNSL (%)	Acid Value (ml/g)	Peroxide Value (mEq/kg)	Anisidine Value (ml/g)
20	50	5.01d	44.58a	0.08a	3.85a	3.73h	0.61ab	2.81a	0.94cd
	60	4.37c	46.63b	0.12b	5.92b	3.07g	0.61ab	2.80a	0.85a
	70	4.20a	46.95d	0.14b	5.95b	2.85f	0.58a	2.79a	0.81a
30	50	5.03d	44.53a	0.08a	3.89a	1.75e	0.64b	2.80a	1.03e
	60	4.34bc	46.76c	0.11b	5.95b	1.33d	0.62b	2.82ab	0.91bc
	70	4.19a	46.97d	0.15c	6.03b	0.89bc	0.60ab	2.79a	0.87ab
40	50	5.03d	44.53a	0.07a	3.87a	1.09c	0.64b	2.84b	1.06e
	60	4.28b	46.82c	0.12b	5.95b	0.65b	0.58a	2.82ab	0.98d
	70	4.16a	47.01d	0.15c	6.04b	0.43a	0.61b	2.80a	0.94cd

Values are means of 3 replicate. Mean values with the same letter within column are not significantly different at 5% confidence level.

(Awonrin and Rotimi, 1992). And with the current effort to stimulate local production leading to the establishment of various cashew plantation and few labour intensive processing Industries (RMRDC, 2004), there is need for research into some conditions that will affect the quality of cashew nut.

Esuruoso (1974) studied the fungi associated with kernel rot disease of cashew. Prichavudhi and Yamamoto (1987) also studied the effect of drying temperature on chemical composition and quality of Macadamia nuts while Kershaw (1985) worked on aflatoxions in imported edible nut. Adebayo and Diyaolu (2003) worked on the mycology spoilage of retailed cashew nuts. This study investigated the effects of period of steaming, drying temperature and packaging materials on the chemical properties of cashew nut.

MATERIALS AND METHODS

MATERIALS

Raw cashew nuts, weighing scale, knife, metal tool (for the removal of the kernels), hand gloves (rubber), glass bottles, plastic bottles and high density polyethylene bags.

METHODS

Collection of cashew samples/Production of cashew nut

Raw cashew nuts (50 kg each) were steam boiled using a steam boiler (at a pressure of 0.62 Mpa) for 20, 30 and 40 min contact time (between steam and cashew nuts). The steamed nuts, after cooling (24 h), were shelled (using a foot-pedaled shelling machine. It makes use of a pair of knife each shaped into the contour of half nut. When the knives come together by means of a foot operated lever, they cut through the shell all around the nut, leaving the kernel untouched. The kernel is then removed from the shell using a small metal tool resembling pen knife) to remove the Kernels form the nuts. The kernels were then pre-dried in a cabinet drier (model LEEC F2, LEEC Ltd, Colwick, Nottingham), at a temperature of 50, 60 and 70°C for 2½, 3 and 4 h respectively to allow for the easy removal of the peels from the Kernel. The peeled nuts were then further dried in the cabinet dryer for 8, 6 and 5 h at 50, 60 and 70°C, respectively. The dried nuts were packaged in glass bottles, plastic bottles and high density polyethylene bags (glass bottles, plastic bottles and high polyethylene bags were chosen because they are the most common means by which cashew nuts are being sold in the retail market) and stored at ambient condition [28 ± 3°C and 78 ± 2% (relative humidity)].

Analyses

Moisture content, % oil extracted, total soluble sugar and residual total polyphenol were carried out using AOAC, (1990) method while acid value, peroxide value and anisidine value were done using Kirk and Sawyer (1991) method.

The analyses were carried out with samples in powdery form using a dry milling blender (Moulinex - Model MR, Type 276. No.-2424A0F716. Made in France). These were done upon the preparation of the product prior to packaging and at intervals of 2 weeks up to 3 months of storage. The analyses were made in triplicates.

Collection of cashew samples

Cashew nut samples for the research work were procured after some preliminary quality tests (raw nut weight, floatation and cut test) on the raw nut to determine the quality of the raw materials.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) and means separated using Duncan's multiple range test using SPSS version 10.0.

RESULTS AND DISCUSSION

Table 1 shows the results of the chemical composition of cashew kernel produced from different combination of steaming period and drying temperatures prior to storage,

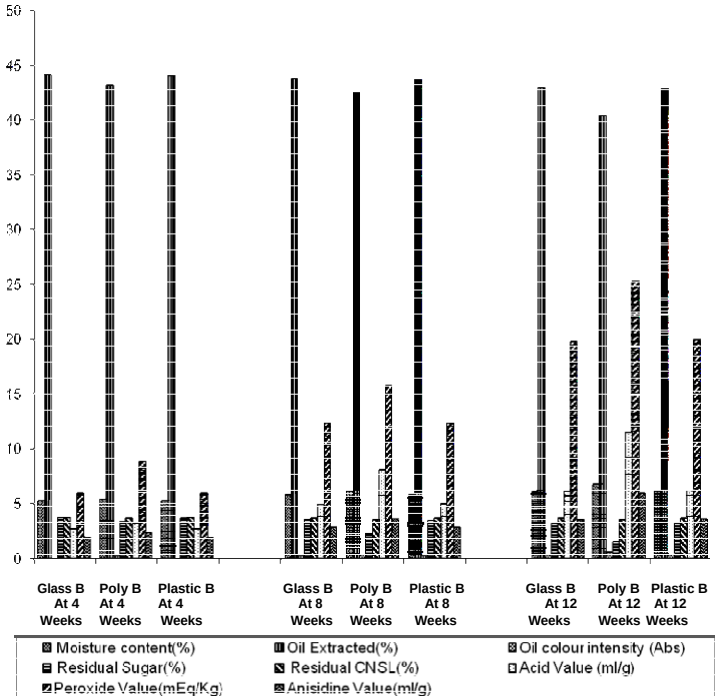

Figure 1. Changes in the chemical properties of cashew kernel boiled for 20 min and dried at 50^0C. Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

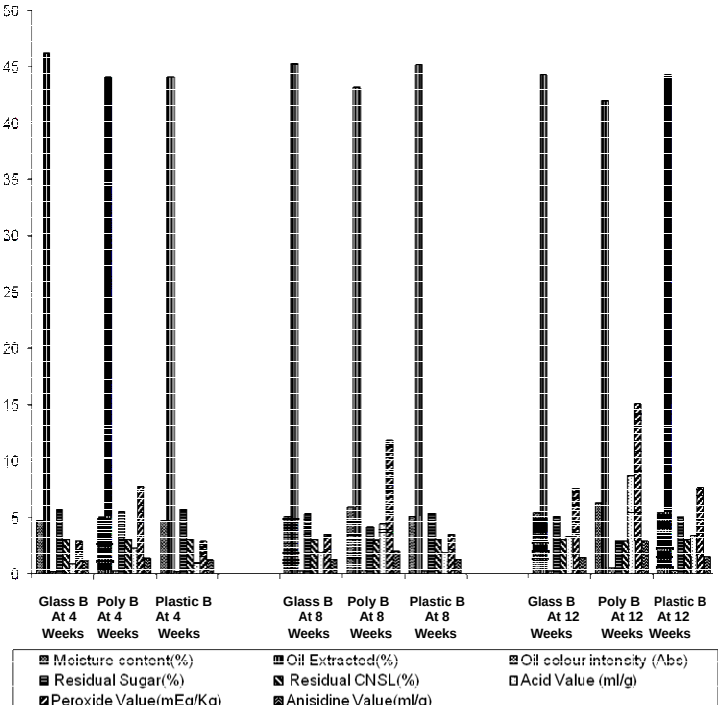

Figure 2. Changes in the chemical properties of cashew kernel boiled for 20 min and dried at 60^0C. Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

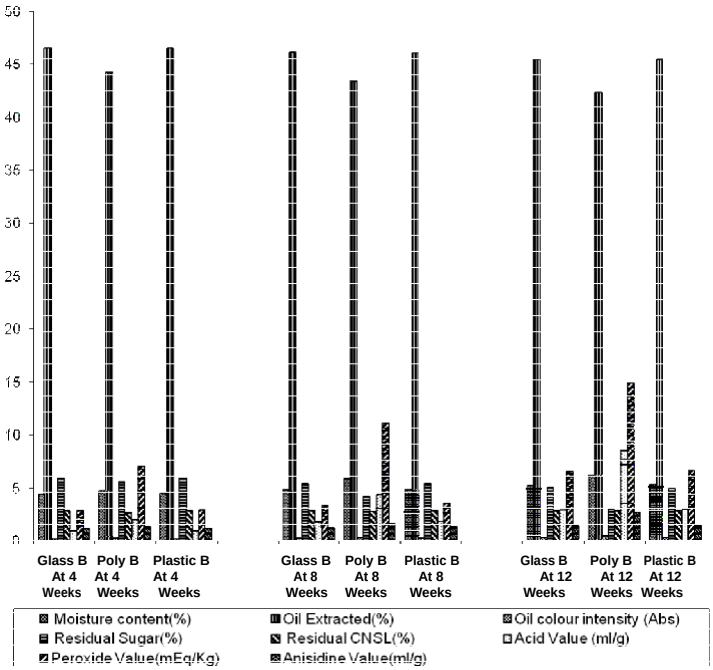

Figure 3. Changes in the chemical properties of cashew kernel boiled for 20 min and dried at 70^0C. Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

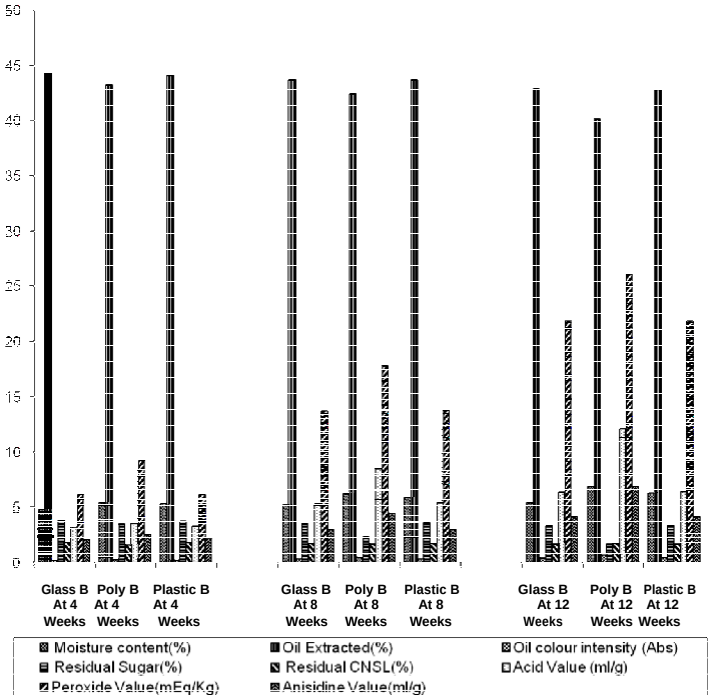

Figure 4. Changes in the chemical properties of cashew kernel boiled for 30 min and dried at 50^0C.Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

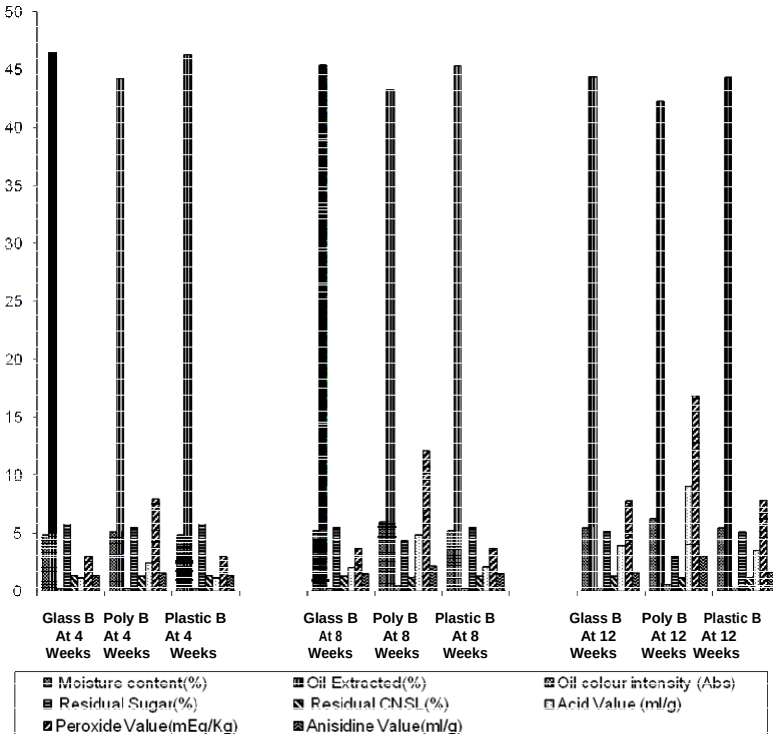

Figure 5. Changes in the chemical properties of cashew kernel boiled for 30 min and dried for 60^0C.Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

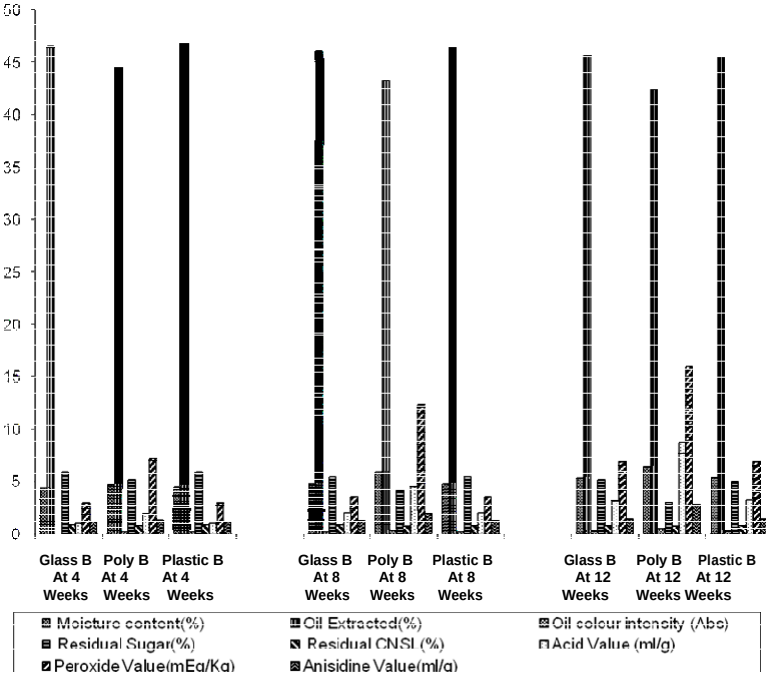

Figure 6. Changes in the chemical properties of cashew kernel boiled for 30 min and dried for 70^0C. Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

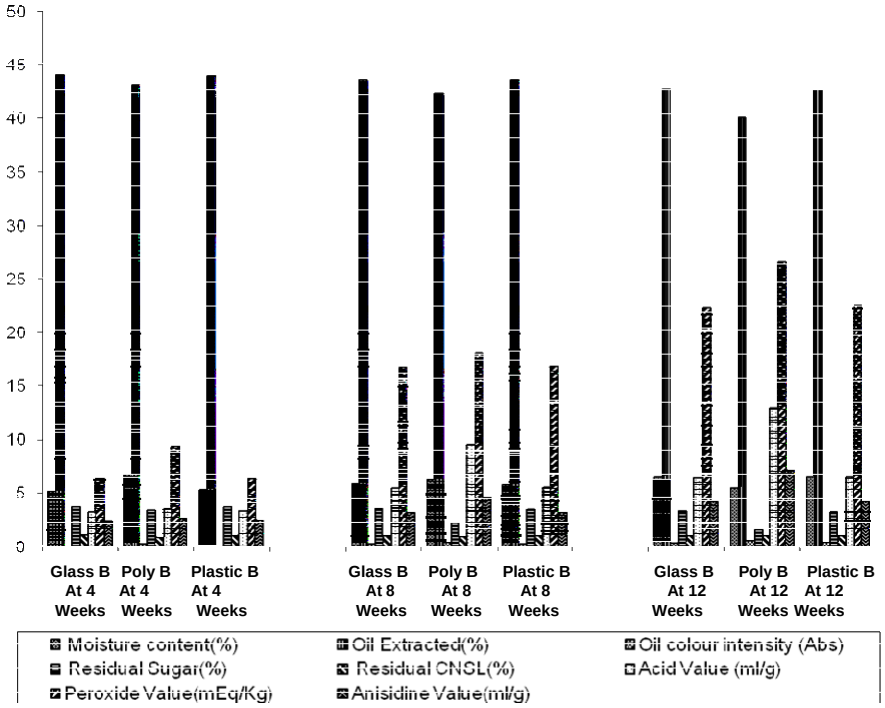

Figure 7. Changes in the chemical properties of cashew kernel boiled for 40 min and dried for 50^{0}C.Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

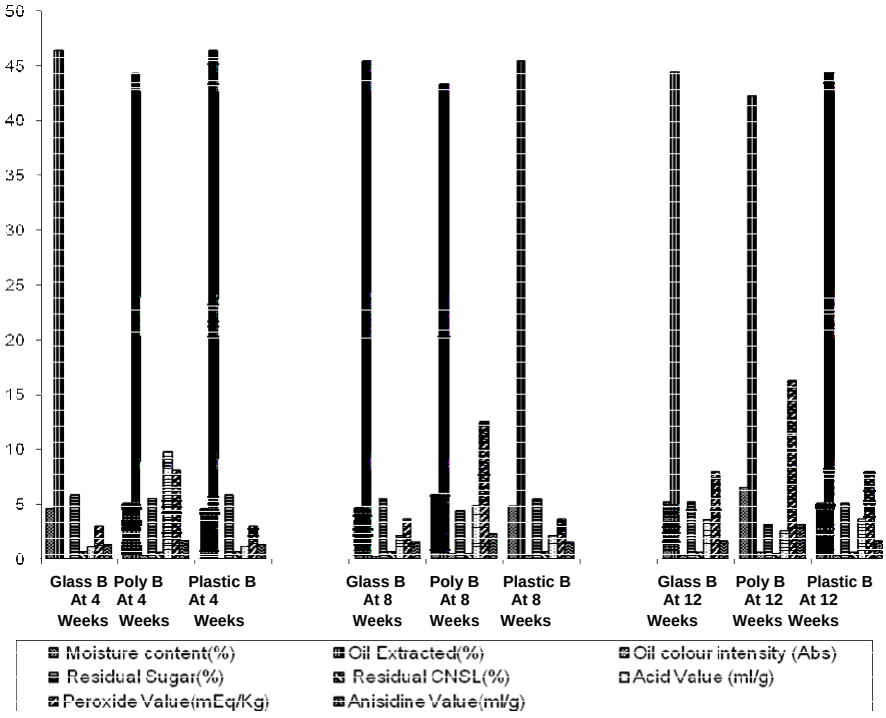

Figure 8. Changes in the chemical properties of cashew kernel boiled for 40 min and dried for 60^{0}CNote: Glass B- glass bottle, poly B- polyethylene bag, Plastic B- plastic bottle.

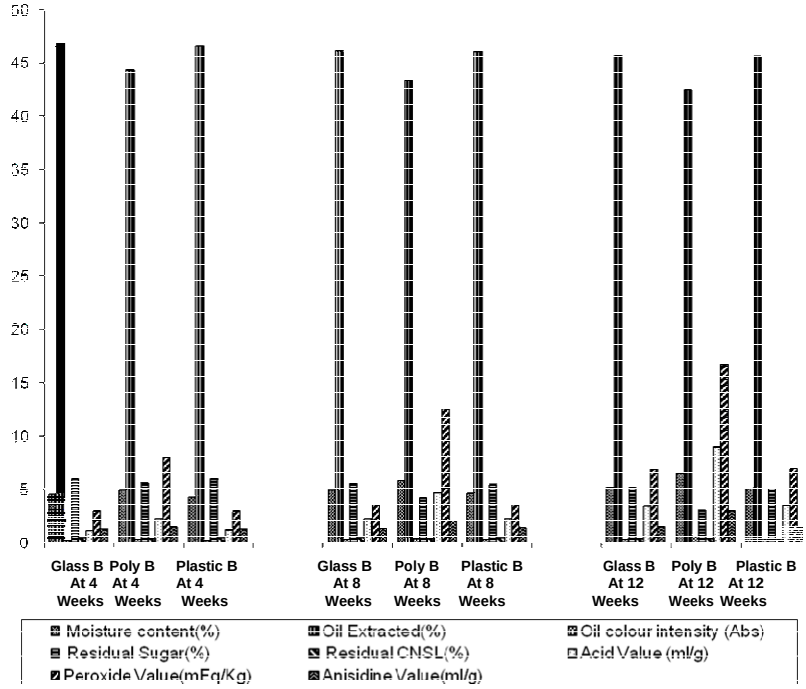

Figure 9. Changes in the chemical properties of cashew kernel boiled for 40 min and dried for 70^0C. Note: Glass B- glass bottle, poly B- polyethylene bag, plastic B- plastic bottle.

while Figures 1 - 9 depict the changes in chemical composition of the processed cashew kernel packaged inside glass bottle, plastic bottle and polyethylene bag during storage at ambient condition for 12 week. The decrease In percentage moisture content with increase in drying temperature can generally be attributed to the higher energy supplied with increase in drying temperature, which helps in removing bound water from the product (Rozis, 1997). Moisture content, oil colour intensity, acid value, peroxide value and anisidine value increased during storage irrespective of the packaging material. Residual sugar content and % oil extracted decreased during storage while there appears to be no marked changes in the % CNSL during storage in all the packaging materials (that is, glass bottles, plastic bottles and polyethylene bags which are chosen because they are the most common means by which cashew nuts are being sold in the retail market). The general increase in the % moisture content of the kernel with storage period is in agreement with the findings of Butt et al., (2004). Changes in moisture content vary with the packaging materials during storage. This might be due to differences in the level of moisture permeability possessed by the packaging materials (Brown, 1992) with glass and plastic bottle offering a better protective barrier against moisture than polyethylene bag. This is in agreement with the report of Fellow and Axtell (1993).

Both drying temperature and storage period have a significant effect ($P < 0.05$) on the percentage oil extracted from the sample. The oil extracted was found to be increasing as the drying temperature increases. This is probably due to the fact that drying at a higher temperature helps in the removal of more bound water from the product (Rozis, 1997) and this also aid the extraction of the oil as the product becomes drier the extraction of the oil in it is enhanced. This same trend was observed by Vossen (1984), who reported that it was difficult to extract oil form fruits that have high moisture content than fruits with low moisture content.

The oil colour intensity showed a significant differences ($P < 0.05$) and increased with increasing drying temperature and storage period. The same trend was reported by Hebbar and Ramesh (2004). The increase in oil colour intensity with increase in temperature may be due to the effects of non-enzymic browning of the product with increase in temperature (Rozis, 1997).

The sugar content of the samples generally increased with increase in drying temperature due to the elimination of more water from the sample with increase in temperature leading to concentration of the product giving it a pleasant taste and flavour (Adebayo and Diyaola, 2003). This same trend was also observed by Prichavudhi and

Yamamoto (1987), who reported that higher dying temperature increases the level of sugar in the nuts. However, the decrease in the level of sugar with storage period might be linked with increases in the moisture content as storage period increases.

Residual cashew nut shell liquid (CNSL) of the Kernel decreased with increase in the period of steaming and drying temperature. This decrease with increase in period of steam boiling time might be attributed to the inward movement of the water through the shell of the nuts to the mesocarp where the oil resides causing the softness of the nuts (Azam-Ali and Judge, 2001) as well as ruptu-ring of the cells containing the oil (Andrighetti et al., 1998) which leads to some sort of dilution of the CNSL. The drying temperature also plays an important role in reducing the level of the residual CNSL as it lowers the concentration with increase in temperature. A similar trend was observed by Barroga et al. (1985), who reported that polyphenol content of nuts decreases with increase in drying temperature. However, this study found out that the storage period have no significant ($P < 0.05$) effects on the residual CNSL the sample.

There was a general increase in acid value with the storage time, with the amount differing from one packaging material to another which may be due primarily to the moisture protective barriers offered by the packaging material (Matz, 1989). The increase in the acid value can be directly traced to the increase in free fatty acid which is favoured by higher moisture leading to higher lypolytic activities by enzymes and micro-organisms (Hoseney, 1994). This trend has also been reported by Butt et al. (2004) and Schirra and Agabbio (1989).

The gradual increase in the peroxide value of the sample during storage regardless of drying temperature or packaging materials confirms the development of rancidity irrespective of temperature or packaging materials (Fourie and Basson, 1989). In this study, the peroxide value was considerably high for those samples in polyethylene bags, compare with those in glass and plastic bottles, this is probably due to increase in moisture content lending to the oxidation of the fat which increase the peroxide value of the product (Evranuz, 1993) . Also, anisidine value increased with storage time, with the varied moisture barrier properties of the packaging materials also playing a significant role in the changes in the anisidine value of the sample, the increases in the ansidine value is likely due to the increases in the increase in the formation of secondary oxidation product with the passage of time (Kirk and Sawer, 1991)

Conclusion

This study have shown that the period of steaming, drying temperature and packaging materials have signifi-cant effects on the chemical and storage qualities of processed cashew nut. From the result, cashew nuts processed using 40 min steaming period and dried at 70°C recorded the best quality in terms of the various properties studied. This processing combination reduces the residual CNSL, as well as the moisture content of the kernel.

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