African Journal of Agriculture and Food Security ISSN 2375-1177 Vol. 7 (6), pp. 001-005, June, 2019. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Physico-chemical properties of cashew tree gum

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Accepted 17 March, 2019

The physico-chemical properties of cashew gum (CG) collected from four cashew growing districts, Sampa, Wenchi, Bole and Jirapa in Ghana were studied to help promote the utilization of cashew gum in the food industry. The gum was collected from trees of two different age groups, those that were 10 years and below and those above 10 years. Physico- chemical properties of CG were compared to those of gum Arabic. Parameters studied included pH (3.8 - 4.2), total ash (0.5 - 1.2%), protein content (1.27 - 1.80%), total sugars (0.96 - 2.10 mg/g), total phenols (0.21 - 2.26%), moisture content (9.8 - 13.2%) and insoluble matter (1.9 - 4.8%). Gum from mature trees was generally found to have higher levels of protein, moisture, sugars and phenols than that from young trees, with the exception of pH which was lower in gum from mature trees. There were also variations in some of the physico-chemical properties of the CG from the different locations. The predominant minerals in cashew tree gum were Ca, K, Na and Fe and their nutritional benefits is discussed. This study showed that CG possesses good physico-chemial properties and high levels of minerals

Key words: Cashew gum, physico-chemical, gum Arabic, nutritional benefits.

INTRODUCTION

Ghana has a land surface area of about 23.9 million km^2 and six main ecological zones put into two categories, the closed forest area which covers about 34% of the country (8.22 million ha) and the savanna area which covers 15.62 million ha or about 66% of the land area (Nsiah-Gyabaah, 1995). The climate is tropical in Ghana and rainfall decreases from south to north (Dickson and Benneh, 1988). Plant exudates are gums from various plant species obtained as a result of tree bark injury. They are normally collected as air-dried droplets (Fitwi, 2000). Synthesis of these gums generally occurs in all organs of the plant with different qualitative composition, appearing to be genetically controlled and influenced by environmental conditions (Glicksman, 1969).

Cashew gum, which is the exudate from *Anacardium occidentale* L have been found to have many lucrative possibilities for industrialization. The art of its use began in China centuries ago, reaching its climax of develop-ment during the period of 1368 – 1644 AD (Glicksman,. 1969). The gum is a complex polysaccharide of high molecular mass comprising 61% galactose, 14% arabi-nose, 7% rhamnose, 8% glucose, 5% glucuronic acid and 2% other sugar residues (Glicksman and Sand, 1973). CG is similar to gum Arabic and can be used as a substitute of liquid glue for paper, in the pharmaceutical and cosmetic industries as agglutinant for capsules and pills and in food industry as a stabilizer of juices (Smith and Montgomery, 1959). Thus, CG extraction can repre-sent one more source of revenue for the producer, in addition to the nut. Therefore, there is the need to study the physico-chemical properties of cashew gum.

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MATERIALS AND METHODS

Collection of cashew tree gum

Farms were selected from two districts each within the Guinea Savannah (Bole and Jirapa) and the transitional belt zones (Wenchi and Sampa). Selection was done based on two different age groups. These are farms that were 10 years and below (young farms) and those above 10 years (mature farms). These age groups were used because cashew production was introduced into Ghana by the Adventist Development and Relief Agency (ADRA) in the early 1990s and this made most of the farms fall within the ages of

Table 1. Mean values of physico-chemical parameters of cashew gum.

Parameter	Sampa		Wenchi		Bole		Jirapa	
	Young	Mature	Young	Mature	Young	Mature	Young	Mature
Phenol (%)	0.21	0.50	0.29	0.51	0.35	1.35	0.34	2.26
	0.002	0.008	0.001	0.04	0.001	0.03	0.01	0.02
MC (%)	11.8	12.0	11.2	13.2	9.8	11.3	11.5	12.5
	0.29	0.00	0.27	0.29	0.76	0.29	0.02	0.00
IM (%)	3.1	1.9	2.8	3.8	2.0	4.8	2.4	2.2
	0.56	0.42	0.57	0.20	0.28	0.28	0.42	0.28
Sug(mg/g)	2.10	0.89	1.20	1.37	0.96	0.85	1.64	1.36
	0.30	0.29	0.37	0.27	0.30	0.30	0.10	0.16
pH	4.1	3.9	4.2	3.8	4.1	3.8	4.0	3.8
	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00
Ash (%)	1.0	1.0	1.0	0.5	1.0	0.8	1.0	1.2
	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.29
Protein(%)	1.56	1.35	1.40	1.41	1.80	1.27	1.58	1.38
	0.10	0.00	0.04	0.01	0.28	0.01	0.20	0.39

*Std dev in italics

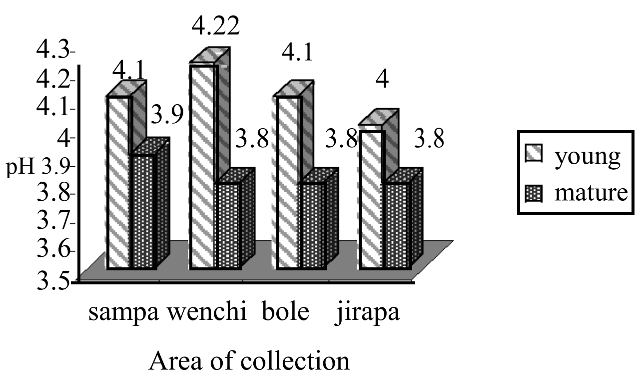

Figure 1a. Effect of maturity on pH.

10 - 20 years. Under each age group a maximum of five farms were selected and six trees selected from each farm. The gum exudates collected were then sorted to remove pieces of bark and other foreign matter and dried in an oven at 30^{o} C for two weeks. The dried and cleaned gum samples were then milled with a Ken Wood Blender (UK) for physico-chemical analyses.

Physico-chemical analysis

This included the determination of pH, moisture, and ash contents by AOAC (1990) methods. Protein content was by the Kjedahl's method (AOAC, 1990) and insoluble matter determined according to British Pharmacopoeia (1993) method. The total sugar concentration was determined using phenol-sulphuric acid method (Dubois et al., 1956). Total phenols were extracted with 80% aqueous acetone and phenolic content was determined with Folin-Ciocalteu reagent, using catechin as a reference compound (Singleton et al., 1999). Ca, Fe, K, Zn and Na contents were determined by Atomic Absorption Spectroscopy using Unicam 929 AAS model (UK). Data obtained were analyzed using Statgraphic Plus for Analysis of variance (ANOVA) and multiple comparison tests.

RESULTS AND DISCUSSION

The average values of the physico-chemical parameters determined are presented in Table 1. The pH of CG ranged from 3.8 to 4.2 with gum from mature trees being more acidic than that from young trees (Figure 1a). This compared favourably with that of gum Arabic which is reported to be between 4.0 and 4.8 (Belitz et al., 2000). The pH of gums coming from trees of the different age groups and also from the different locations were found to be significantly different ($p < 0.05$) from each other with some significant interaction between the locations and the ages of the trees ($p < 0.05$).

The ash contents of CG also ranged from 0.5 to 1.2% and these fall within the acceptable level of less than 4% for gum Arabic (Belitz et al., 2000) . Ash content is an important property considered as a purity parameter in gums (Glicksman, 1969). The very low values of ash show that cashew gum has a good quality of mineral content. Gums from both young and mature trees from Sampa had the same ash content but those from mature trees in Jirapa had higher ash content than that from young trees. For Bole and Wenchi, gum from mature trees had lower ash contents (Figure 1b). There were significant differences in the ash contents for gums from trees of the different age groups and also from the different locations ($p < 0.05$). These findings were supported by multiple comparison tests, which showed that gums from Sampa and Wenchi were significantly different from those from Bole. However, there was no interaction between the locations and the ages of the trees.

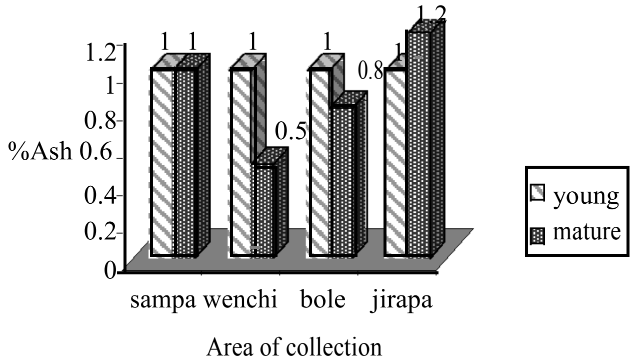

Figure 1b. Effect of maturity on ash

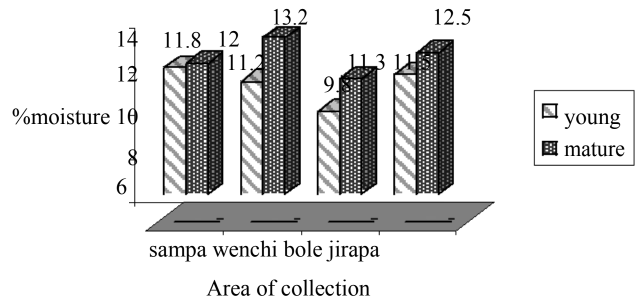

Figure 2b. Effect of maturity on moisture content of cashew gum.

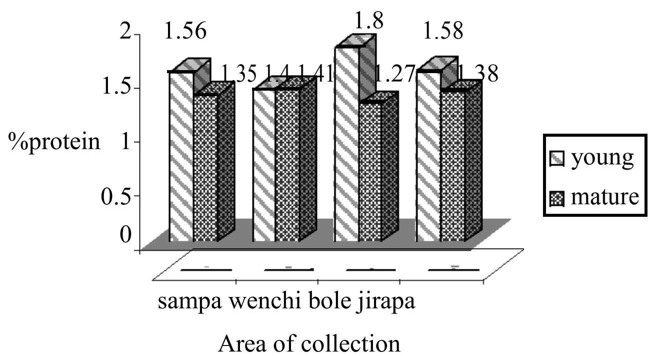

Figure 1c. Effect of maturity on protein.

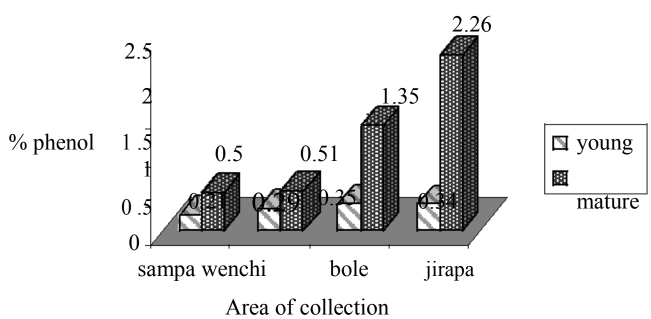

Figure 2a. Effect of maturity on phenols.

The protein content of CG ranged from 1.27 to 1.80% (Figure 1c). It was observed that cashew gum from young trees had higher protein content than that from mature trees with the exception of that from Wenchi (Figure 1c). Gums from the two age groups showed significant differences ($p < 0.05$) but the differences in the locations were not significant.

The total sugar concentrations of the gums were between 0.96 and 2.10 mg/g and these results compares well with that for gum Arabic, which is found to be in traces (TIC gum, 2001). Cashew gum from young trees traces generally had higher sugar content than that from mature trees with the exception of that from Wenchi. There were no significant differences in the sugar concentrations of gums from the different locations and also from trees of different ages.

The total phenolic contents of the gums were between 0.21 and 2.26%. Gum from mature trees had higher phenolic content than that from young trees for all the locations (Figure 2a). The phenolic contents of gums from the different locations and from trees of different ages were significantly different ($p < 0.05$) with the phe-nolic contents of gums from Sampa and Bole being significantly different from that from Jirapa.

The moisture content of CG was found to be between 9.8 and 13.2% and this results falls within the acceptable level for gum arabic (12 - 17%) (Belitz et al., 2000). Gum from mature trees have higher moisture content and this may be due to the fact that they produced more gum and would need longer time to dry (Figure 2b). There were significant differences in the moisture content for gums from trees of the two age groups coming from the different locations ($p < 0.05$). However, there was no interaction between the locations and the ages of the trees indicating that they were independent of each other. Multiple comparison tests again showed that cashew gums from Sampa, Wenchi and Bole were significantly different from that from Jirapa.

The insoluble matter content was found to range from 1.9 to 4.8% and was mainly debris. This agrees with the report of Glicksman (1969) that most exudate gums yield some amount of insoluble residue when mixed with water. The low levels of insoluble matter indicate that CG is highly soluble in water. The levels of insoluble matter in gums from young trees in Sampa and Jirapa were found to be higher whilst those in Bole and Wenchi were lower. The differences may be attributed to the abilities of the gums to trap dirt and loose bark during and after exudation. However the differences were not significant for the locations and the age groups of the trees. Cashew gum was found to have very high levels of calcium, sodium, and potassium, which are the essential minerals required by the body to meet metabolic needs Cashew gum was

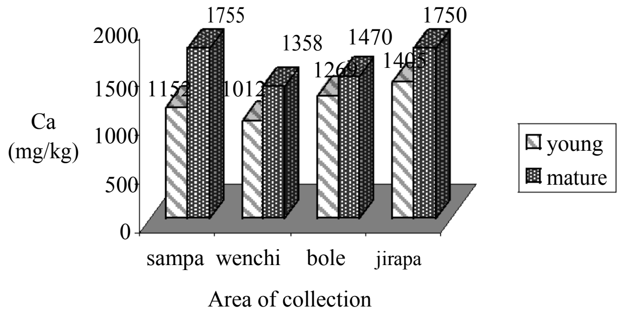

Figure 3a. Effect of maturity on calcium.

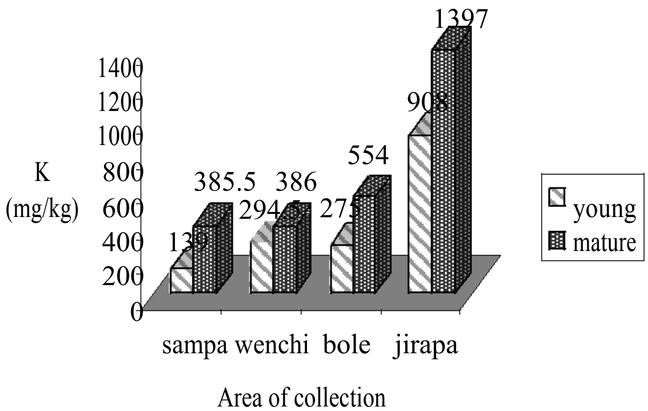

Figure 3b. Effect of maturity on potassium.

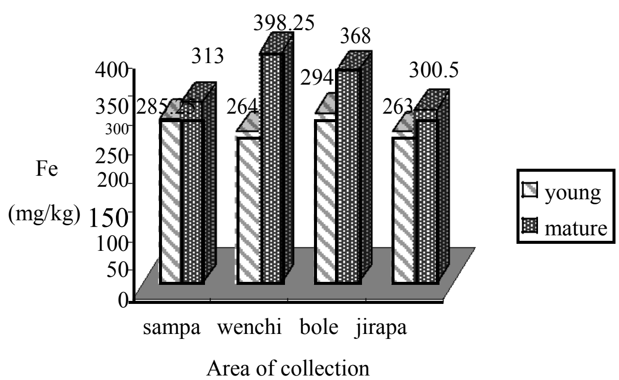

Figure 3c. Effect of maturity on iron.

found to have very high levels of calcium, sodium, and potassium, which are the essential minerals required by the body to meet metabolic needs (Welch and Graham, 2003). The levels of minerals ranged from 1012 to 1750 mg/kg for calcium, 139 to 1397 mg/kg for potassium (Figure 3a and 3b) and 114 to 301 mg/kg for sodium. The calcium contents of the gums showed significant differences between the locations and the ages of the cashew trees ($p < 0.05$) with gums from Wenchi being significantly different from those from Jirapa ($p < 0.05$). Levels of potassium also showed significant differences between the locations and the ages of the trees ($p < 0.05$) with gums from Sampa, Wenchi and Bole being significantly different from that from Jirapa. However, there were no significant differences between gums from trees of the different ages and from the locations in terms of the sodium content.

The levels of iron and zinc in CG were also found to be 258 to 398 mg/kg and 6.3 to 35.5 mg/kg respectively (Figure 3c). Zinc showed no significant differences between the gums from cashew trees of different ages and also from the different locations. Iron also showed some significant differences ($p < 0.05$) in gums from cashew trees from the different locations and different age groups.

Gums from mature trees were generally found to have higher levels of protein, phenols, moisture and minerals than those from young trees and this may be due to the storage of starch and the production of cellulose, hemicellulose and proteins in the mature trees (Rayburn, 1993). Also much of the soil nutrient is stored in the mature trees. The variations in the physico-chemical properties of cashew gums from the different locations may also be due to the mixed species of cashew trees found in the collection areas, the different soil composition of the different regions together with the varying climatic conditions.

Conclusion

Cumulatively, this study explains that CG possesses good physico-chemical properties and high levels of minerals. Therefore, it can be used in meal replacers, nutritional beverages and weight-loss products. Health-conscious consumers demand natural ingredients and hence, this offers cashew gum tremendous potential. Location and maturity also showed significant effects on the physico-chemical properties of cashew gum.

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