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EXTRACTION AND EVALUATION OF HYDROCOLLOIDS FROM "ACHI" (*BRACHYSTEGIA EURYCOMA*) AND ITS APPLICATION ON A WATER MELON FRUIT JUICE

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ABSTRACT: *Hydrocolloid was extracted from dehulled "achi" (Brachystegia eurycoma) seed with the aim of evaluating its functionality as a food stabilizing ingredientin fruit juice industries. The "achi" seeds were sorted, cleaned, milled into flour and defatted to extract the hydrocolloid (food gum) from it, after which the functional properties were analyzed. 3g of the extracted hydrocolloid was added to 300ml of water melon fruit juice. To compare its effect with other conventional hydrocolloids, Guar gum and Arabic gum were also added to the same quantity of water melon fruit juice. Viscosity analysis was carried out at four different temperatures of 40^oC, 50^oC, 60^oC and 70^oC.The result showed that the extracted hydrocolloid from "achi" seed had a swelling index of 3.67%, a wettability of 43minutes and 23 seconds, and a bulk density of 0.82. There was a decrease in the apparent viscosities of Guar gum, Arabic gum and "achi" hydrocolloid as well as the control water melon fruit juice samples as the temperature increased. Although, it was observed that the melon fruit juices with different hydrocolloids showed that the juice with Arabic gum had the highest mean viscosity value of 56, 54.8 and 52 at 40^oC, 50^oC and 60^oC respectively while Guar gum had the highest mean value of 22 at 70^oC. So, the "achi" hydrocolloid can compete favorably with other hydrocolloids or food gums in the fruit juice industry.*

KEYWORDS: Water melon, fruit juice, achi, hydrocolloid and Functional properties.

INTRODUCTION

Hydrocolloids or gums are a diverse group of long chain polymers characterized by their property of forming viscous dispersions and/or gels when dispersed in water. They have neutral taste and aroma which enable them free access to food insertion. They are used as sugar, fat and gluten substitutes, stabilizers (emulsion, foams), crystallizing inhibitors, thickening agents, and gelatinization substances and also modify gelatinization (Chenlo, 2009; Rosell, 2001). Sources of hydrocolloids are mainly from plant materials of which three of the commonly known plants are *Brachystegia eurycoma* (achi), *Detarium microcarpum* (ofor) and *Mucuna* spp (Ukpo).

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Brachystegia eurycoma is locally known as "Achi" by the Ibos, "Akolodo or Eku" by Yoruba, "Akpakpo or Apaupan" by Ijaw, "Dewen" by Benin, "Okwen" by Edo, 'oyam' by the Kwales and "Okung" by Efik (Adewale and Mozie, 2010; Ikeagwu*et al.*, 2009; Nwosu *et al.*, 2011; Nwosu, 2012). *Brachystegia eurycoma*is a lesser known leguminous plant belonging to the sub-family of Caesalpiniaceae, phylum of spermatophyta and order of fabaceae. It is a dicotyledonous plant which commonly grows in the tropical rainforest of West Africa along river banks. The fruits are very conspicuous and persistently woody, about 5-8 inch (1.5-2.5cm) long slightly broadening towards the apex. The fruit is a dark purplish brown pod containing between 4-6 brown shinning flat seeds, about 0.75 inches across (Uzomah and Ahiligwo, 1999). Its tree is about 35m tall with hole of 2m diameter. According to Nwosu (2012) and Uhegbu *et al*., (2009), nutritionally, "achi" is important and an economic sources of protein, carbohydrate, calories as well as certain vitamins and minerals. They stated further that these nutrients are essential to human nutrition but the composition of these nutrients in them differs. Also, that the protein of these foods are rich in lysine but deficient in sulfur containing amino acids particularly cysteine and methionine. "Achi" contains about 9% proteins, 56% carbohydrate, 15% crude fat, 4.5% ash and 2.9% crude fibre. The seeds are good source of bioactive compounds comprising flavonoids, alkaloids, phenolic compounds, saponins and tannins (Uhegbu *et al.*, 2009). The flour of this seed is used in food majorly as a soup condiment, flavoring agent and for soup thickening (for stabilization and emulsification of soup) in South Eastern Nigeria (Uhegbu *et al*., 2009; Ikeagwu *et al.*, 2009). Also, it is used in bakery products, meat formulation and in the production of starch (Ikeagwu *et al.*, 2009).This research work was aimed at extracting and evaluating hydrocolloids as food gums from "Achi" and checking its viscosity property at varying temperatures and also its usefulness in fruit juice industries so as to increase their utilization and improve the nutritional status of consumers.

MATERIALS AND METHODS

Materials collection

The "Achi" seeds were commercial ones purchased from Ekeonunwa Market, Owerri, Imo State, Nigeria.The chemicals, equipment and facilities used for the generation of samples and their analysis were obtained from the Departments of Food Science and Technology and Crop Science and Technology of Federal University of technology, Owerri and the Global Resources Line E, Bridge Head Market, Onitsha. The chemicals were of analytical grade.

Preparation of samples

The dehulled "achi" seeds were sorted and milled using CORONA attrition milling machine (Landers YCIA, S. A. Colombia) to generate "achi" flour. The flour was sun dried and sieved using a 52µm mesh size (British Standard). The fine flour obtained was defatted using n-hexane and then air dried. The air dried flour sample was dissolved in distilled warm water and hydrated continuously using a magnetic stirrer. It was then kept for 6hrs, centrifuged at 2500rpm for 5mins. Propan-2-ol was used to recover the supernatant was then pooled together and was recovered under suction using a Buchman funnel. The gum was dried in the oven at 60^{o}C for 14hrs. The dried sample was cooled in the desiccator and pulverized using a ceramic mortar and stored in air tight container.

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Determination of functional properties ofextracted hydrocolloid from "achi" *Brachystegiaeurycoma* flour

Determination of water/oil absorption capacity
The procedure described by Onwuka (2005) was followed. 1g of sample was weighed into a conical graduated centrifuge tube. The sample and 10ml distilled water/oil were thoroughly mixed for 30seconds.The sample was allowed to stand for 30minutes at room temperature and then centrifuged at 400rpm for 15minutes.

Determination of swelling index
The method of Onwuka (2005) was adopted. 1g of the sample was transferred into a clean, dry graduated (50ml) cylinder. The sample was then gently leveled and the volume noted. 10ml of distilled water was added to the sample. The cylinder and its content were stirred and allowed to stand for 60minutes, while change in volume (swelling) was recorded every 15minutes. The swelling power of the sample was calculated as a multiple of the original volume.

Determination of wettability
The method of Onwuka (2005) was used. Into a 25 ml graduated cylinder with a diameter of 1 cm, 1g of sample was added. A finger was placed over the open end of the cylinder which was inverted and clamped at a height of 10cm from the surface of a 600 ml beaker containing 500 ml of distilled water. The finger was removed and the rest material allowed to be dumped. The wettability is the time required for the sample to become completely wet.

Determination of bulk density
Method as described by Onwuka (2005) was adopted. A graduated cylinder 10ml was weighed dry and gently filled with the flour sample. The bottom of the cylinder was then tapped gently on a laboratory bench several times. This continues until no further diminution of the test flour in the cylinder after filling to mark, was observed. Weight of cylinder plus flour was measured and recorded.

Bulk density (g/ml) = $\frac{Weight\ of\ sample\ (g)}{Volume\ of\ sample\ (mL)}$

Determination of emulsification
Emulsion capacity was determined by the method described by Onwuka (2005). Two (2) grams of the sample was blended with 25ml distilled water at room temperature for 30 seconds in a warring blender at 1600rpm. After complete dispersion, 25ml vegetable oil was gradually added and the blending was continued for another 30 seconds. The mixture was transferred into a centrifuge and centrifuged at 1600rpm for the period of 5 minutes. After centrifugation, the volume oil separated from the sample was read directly from the tube.

Determination of gelation capacity
The method of Onwuka (2005) was adopted in the determination of gelation capacity. A sample suspension of 2.20% (w/v) in 5ml of distilled water was prepared in test tubes. The samples were heated for 1h in a boiling water bath followed by rapid cooling under running cold tap water. The

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test tubes were then cooled further for 2h at 40°C. The gelation capacity is the least gelation concentration determined as the concentration when the sample from the inverted test tube will not fall or slip.

Determination of viscosity

The method of Onwuka (2005) was adopted. Ten (10) percent of the flour was suspended in distilled water and mechanically stirred for 2h at room temperature. Oswald type Viscometer was used to measure the viscosity.

Determination of gelatinization temperature and boiling point

The method of Onwuka (2005) was adopted in the determination of gelatinization temperature. The flour (10 g dmb) was dispersed in distilled water in 350 ml beaker and made up to 100 mL flour dispersion. A thermometer was clamped on a retort stand with its bulb submerged in the suspension with a magnetic stirrer and the system heated. The heating continued until the suspension began to gel and the corresponding temperature was recorded. The temperature at boiling point was also recorded.

Determination of solubility

The cold water extraction method, as described by Udensi and Onuora (1992), was adopted. Flour dispersion (10% w/v, db) was prepared with each of the flour samples by dispersing 1g (dry basis) of flour in 5 ml distilled water and making it up to 10ml. It was left for 60 minutes while it was stirred every 10 minutes. Then it was allowed to settle for 15 minutes after which 2ml of the supernatant were weighed in a dry Petri dish, evaporated to dryness and re-weighed. The difference in mass is the total soluble solids (Udensi and Onuora, 1992). Solubility was calculated as follows:

$$\text{Solubility} = \frac{TSS\,(\%)Vs(Me - Md)}{2Ms} \times 100$$

where

Vs = Total supernatant/ filtrate

Md = Mass of empty, dry Petri dish

Me = Mass of Petri dish plus residual solid after evaporative drying

Ms = mass of flour sample used in the preparation of the dispersion.

Preparation of single strength water melon juice with hydrocolloid

Unblemished water melon fruits were purchased from Ekeonunwa Market, Owerri. They were sorted, washed and cut into halves. The water melon fruits were peeled, deseeded, cut into slices and blended. The slurry obtained was filtered with the aid of a muslin cloth to extract the juice. 300ml each was weighed out with a measuring cylinder into four (4) conical flasks and 3g of hydrocolloids of “Achi”, Guar and Arabic were put into each of the conical flasks containing the water melon juice and blended for three (3) minutes.

RESULTS AND DISCUSSION

Functional properties of hydrocolloid from defatted “achi” flour.

The functional properties of hydrocolloid defatted from “Achi” flour is shown in Table 1. It was observed that “achi” hydrocolloid had a swelling index of 3.67% which was comparable higher

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than that reported by Nwosu *et al.*, (2011) (1.00-1.25 g/g) for "achi" as affected by storage condition using different media. This could be as a result of the extent of the associative within the granules. Swelling power is an indication of the water absorption index of the granules during heating.

Also, "achi" hydrocolloid had water absorption capacity and oil absorption capacity values as 5.20 ml/g and 2.78ml/g respectively which does not agree with that reported by Nwosu*et al.*, (2011) for "achi" water absorption capacity (0.70-2.70 g/g) and oil absorption capacity (0.73-1.80 g/g) as affected by storage condition using different media. These high absorptions could be due to the ability of protein to form hydrogen bonds between molecules and polar group on the polypeptide chain thereby binding large quantities of water and also due to the processing system which causes dissociation of the native proteins into sub-units that had more water-binding sites than oligomeric proteins. The ability of food to absorb water and oil could possibly have help to enhance the sensory properties such as flavor retention and mouthfeel. It was also observed that "achi" hydrocolloid had gelling and boiling points of 37°C and 45°C respectively, solubility and bulk density value of 4.66 and 0.82g/ml respectively. These could be due to the type of hydrocolloid, network formation mechanism and the processing method used for particle formation (Burey *et al.*, 2008). It took the "achi" hydrocolloid 43min 23sec to wet completely. This probably could be as a result of the type of flour, concentration, pH and temperature of the processing system. The hydrocolloid obtained had no emulsion and this could be as result of the method of processing method used, agronomy of the crop and the method of preservation used in preserving the seeds.
From Table 2, it was observed from the statistical analysis of variance (ANOVA) that there was significant difference in the viscosity of the water melon fruit juice with different hydrocolloid treatment as well as a decrease in the viscosity of the hydrocolloids with increasing temperature. Thus, this obeys the viscosity relationship law which states that "increase in the temperature of a substance lead to a decrease in its viscosity". This increase in temperature mighthave caused the kinetic or thermal energy to increase and the molecules become mobile. Therefore, the attractive binding energy is reduced and the viscosity reduced.

Table 1: Functional Properties of Hydrocolloid from Defatted "achi" flour.

Functional Properties	**Values**
Swelling Index	3.67
Water Absorption Capacity (ml/g)	5.20
Oil Absorption Capacity (ml/g)	2.78
Wettability (min)	43min 23sec
Bulk Density (g/ml)	0.82
Gelling Point GP (°C)	37
Boiling Point BP (°C)	45
Solubility	4.66
Emulsification	Nil

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Table 2: Viscosity Analysis of Water Melon Juice of different Hydrocolloids at varying Temperature.

Hydrocolloid	40°C	50°C	60°C	70°C
Arabic	$56^{a}\pm0.41$	$54.8^{a}\pm1.54$	$52^{a}\pm0.41$	$18^{a}\pm0.41$
Achi	$40^{b}\pm0.41$	$25^{b}\pm0.41$	$20^{b}\pm0.82$	$12^{a}\pm0.57$
Guar	$31^{bc}\pm0.82$	$30.4^{b}\pm0.08$	$23^{b}\pm0.82$	$22^{a}\pm0.41$
Control (Water Melon Juice)	$26^{c}\pm0.57$	$20.4^{b}\pm0.82$	$14^{b}\pm0.82$	$10^{a}\pm0.41$
LSD	13.7	13.7	13.7	13.7

Mean values in the column with the same superscript are not significantly (P>0.05) different.

CONCLUSION

From the result, it could be deduced that hydrocolloid extracted from “achi” seed flour can compete favorably with other hydrocolloids or food gums in the fruit juice industries since it has the ability to swell in water and thus is able to influence the viscosity of the liquid.

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