1. INTRODUCTION

Sudan is the largest country in Africa and is rich with diversity of forest resources which constitute a base for substantial contributions in economic development. It is characterized by variation in edaphic and climatic zones from north to south with the desert and semi-arid areas constituting almost 50% of the country area. The Savanna zone (40% of the area) is the richest in forest resources and most inhabited part of the Sudan. Agricultural expansion in the savannas constitutes the major factor that causes deforestation and forest degradation at a rate of 0.74% per year. However, forests which are presently believed to cover 29.4% of the country area contribute significantly in the dominant traditional sector that revolves around traditional land use. As of 9th July 2011, Sudan split into two countries, namely the Republic of Sudan and the Republic of South Sudan. Following the split, the Republic of Sudan has, according to FAO's classification, become a low forest cover country with about 11% of its total surface area under forest cover. Yet, the high dependency on forest products and service remains as it was before separation **(Gafaar, 2011).**

Non-wood forest products ($NWFP_S$) have received high attention since they have many important usages throughout the world during the last year. Forest fruits are one of these $NWFP_S$. Sudanese forest fruits are used traditionally as food as well as medicines. However, only little information is available about its manufacture **(Abdel-Rahman, 2011).**

Deafalla, *et. al.*, (2014) focused on the much precious species according to local knowledge, namely, *Zizyphusspina-christi, Balantitesaegyptiaca, Adansoniadigitata,Tamaraindusindica, Acacia nilotica, Grewiatenax, Acacia Senegal, Croton zambesicus and Sterculiasetigera* in South Kordofan State (Sudan).

One of the most valuable naturally growing shrubs in Sudan is Guddiam (Grewiatenax) that belongs to the family *Tiliaceae* which is classified under the class *Mangolipsida* (**EL-Siddig, 2002; Gebauer, *et. al*., 2007**).

Orwa, *et al* (2009) indicated that, some species of *Grewia* were found in Algeria, Botswana, Chad, Djibouti, Ethiopia, Iran, Kenya, Mali, Mauritania, Morocco, Namibia, Niger, Nigeria, Senegal, Somalia, Tanzania, Uganda, Zimbabwe, India and Pakistan.

In Sudan, *Grewiatenax* is distributed in the dry grass savanna, in Red Sea Hills, Northern and Central Sudan, Blue Nile, White Nile, Kassala, Kordofan**(El-Amin, 1990).**

Some studies indicated that Guddaim fruits were used in Sudanese traditional medicine for treading pustulents skin lesions, intestinal infections and also as a tranquillizer, anti-anaemic, diuretic and laxative drink. In Tanzania, part of the plant are used as a remedy for cold or chest complaints as well as a main ingredient of a remedy for syphilis and small pox **(Von-Maydell, 1990; Rahamtalla, 1999).**

Guddaim, when ripped is either eaten fresh or stored for consumption later. Also, the fruits of Guddaim are usually prepare as sweetened drink or light porridges (nasha) which are normally served during the fasting month of Ramadan or during pregnancy and lactating periods in order to improve mother health and lactating ability **(EL-siddig, 2002).**

1.1 Objectives of the study

1.1.1 Main objective

The main goal of this study is to determine the nutritional value of Guddaim fruits.

1.1.2 Specific objectives

1. To determine the proximate chemical composition and mineral content of guddaim fruits.
2. To find out the energy values of guddaim fruits.

2. LITERATURE REVIW

2.1Guddaim (*Grewiatenax*)

2.1.1 Botanical classification

The genus *grewia* belongs to the family *Tiliaceae* which is classified under the class *Mangolipsida*. In fact, the genus *grewia* consist of about 150 species and some of them are used in traditional medicine or as traditional food such as *Grewiatenax, Grewiabetulyfolia, Grewiapobulifolia, Grewia bicolor, Grewiaflavefcens, Grewiavillosa*. The name of *Grewia* has been derived from the name of British plant scientist "Grew"(**EL-Siddig,2002;Gebauer,*et. al*.,2007**).

Also, it is commonly namedas Gudaaim, Gaddein, Goden, Umm Ageda in Arabic, Damak, Defarur, Dekah, Duferu in Somalia and as Gangukager, Gangerum, Gango, Gundu kadira kadadari, kaladi, Achchu in India **(Orwa, *et .al*.,2009).**

2.1.2 Botanical description

Grewiatenax is a multi-stemmed small shrub up to two meters tall usually a rounded but generally battered and untidy due to browsing. Thebark is smooth, grey, and very fibrous so that twigs are hard to break. The leaves alternate almost circular in outline, 1.5-4 cm in diameter, the vein network is very clear below, margins toothed and prominently tri-nerved at the base, often hairy, falling early. The flowers are yellow, purple or white, solitary or in two or four axillary placed in a terminal head about 5cmlong.The central flowers opining first, with many stamens in the center, petals are white about 1cmlong.The fruit is orange- red at maturity, with 1-4 spheroid lobes each rounded and fleshy about 5mm across **(Orwa, *et. al*., 2009).**

2.1.3 Distribution

In general, *Grewia* species are found to be widely distributed in the tropical and subtropical areas of Africa, Southeast Asian continents, Arabian Peninsula, Australia **(Gebauer*, et. al.*, 2007;Aboagarib,*et al.*, 2014).** Also, **Orwa*et al*, (2009)** indicated that some species of *Grewia* were found in Algeria, Botswana, Chad, Djibouti, Ethiopia, Iran, Kenya, Mali, Mauritania, Morocco, Namibia, Niger, Nigeria, Senegal, Somalia, Tanzania, Uganda, Zimbabwe, India and Pakistan**.** In addition to that, some species of *Grewia* were found in Oman **(Ghazanfar, 2003;Gebauer, *et. al.*, 2007 and Patzelt 2007).**

In Sudan, *Grewiatenax* is distributed in the dry grass savanna, in Red Sea Hills, Northern and Central Sudan, Blue Nile, White Nile, Kassala, Kordofan**(El-Amin, 1990).**

2.1.4 Ecology

Grewiatenax is highly drought resistant and occure in the driest savannas at desert margins and regions of higher rainfall, where it grows in thickets on termite mound in otherwise seasonally flooded country. In the sahel it grows in rocky placed on hills and slopes, in regions with 100-600mm of rain per annum **(Gebauer, *et. al.*, 2007).**

Grewiatenax common plant species are available in all seasons in semi-desert area and potentially important as forage sources for honeybee. Seed dormancy is a typical feature of *Grewiatenax* for seed survival under unfavorable climatic conditions **(Sohail, *et. al.*, 2009).**

Intercropping with *Grewiatenax* may not affect crop growth adversely. The plant is soil improver as leaf litter from the shrub improves physical and chemical properties of soil **(Orwa, *et. al.*, 2009)**.

2.1.5 Utilization of guddaim

2.1.5.1 Food utilization

Guddaim, when ripped is either eaten fresh or stored for consumption later. Also, the fruits of Guddaim are usually prepare as sweetened drink or light porridges (nasha) which are normally served during the fasting month of Ramadan or during pregnancy and lactating periods in order to improve mother health and lactating ability **(EL-siddig, 2002).**

The fruits are widely used as food for their high nutritive values and also, it is considered as the main source of food during famine **(Leborgne, *et. al.*,2002 and Mabry- Hernandez, 2009).**

Also, the fruit was mentioned to be very rich in iron and usually made into refreshing drink. Moreover, the dead leaves are eating but only while they remain on the plant**(Orwa, *et. al*., 2009).**

In Sudan, *Grewiatenax*fruit grow in Kordofan region are eaten fresh or dried for later consumption. A drink is also prepared by soaking the fruit overnight, and then hand – pressed, sieved, and sweetened. Porridge, called (Nasha), is also prepared from this drink by addition of custard and flour then given to mothers to improve their health and lactation, **(Sena, *et. al.*, 1998).**

In India, the orange fruit is usually eaten raw, while, leaves are boiled and eaten as vegetable, in Ethiopia the ripen fruit is collected and eaten raw either as a whole or chewed and only the sweet juice is swallowed, the fruits are always collected and consumed between September and April **(Orwa, *et. al*., 2009)**.

2.1.5.2 Medicinal utilization

Reported by **Shrivastara, *et. al.*, (2000)**that, alcoholic extract of the fruit help in faster wound healing**.** While the fruit powder is mixed with milk and

consumed to accelerate bone fracture healing and to suppress swelling, in addition to that, the fruit bark infusions are also use in wounds healing **(Shekhawat and Batra, 2006).**

Grewiatenax is used as medicine to treat various diseases including jaundice and hepatic disorders **(Khemiss, *et. al*., 2006 and Jahan, 2011).** In Kenya plant parts are used as a remedy for colds and chest complaints and also as a chief constituent in a typhoid remedy. Also A mucilaginous bark preparation is used by women against hair vermin **(Orwa, *et. al*., 2009)**.

Some *Grewia* species (*G.sapidaroxb, G.pinnataroxb, G.nervosalour*) were found to have 65-97% antioxidant activities, the gum mucilage isolated from *Grewiaoptiva* had comparable binding ability and appears suitable for use as pharmaceutical binder **(Kshirsagar, *et. al*., 2009). AL-Said, *et al* (2011)** reported that, Guddaim fruit are usually eaten to treat anemia and chest diseases.

In general, the genus *Grewia* has many medical properties, *Grewia* hirsute is used in the ayrvedic management of menopause and included in the class of drug called (Rasayanas) that have an overall anti-aging effects in the body **(Kumar, *et. al*., 2011).**

2.1.5.3 Folkloric uses

The branches of *Grewiatenax* are used as firewood, and can be used in charcoal making. The bark is also used to make ropes and for binding purposes in house construction. Moreover *Grewiatenax* wood is used in making weapons such as bows, arrows and for other general purposes (**Orwa, *et. al*., 2009 and Prasad, *et. al*., 2010).**

2.1.5.4 Fodder

Young leaves of *grewiatenax* are consumed by livestock, they are slightly palatable at the end of dry seasons, and have fairly good feed value **(Orwa, *et. al.*, 2009 and Prasad, *et al*., 2010).**

2.1.5.5 Other uses

Grewiatenax was found with an aggressive root system which holds fast to the soil protecting it from water and wind erosion. Also, the plant was found useful as a dune fixing plant in desert reclamation. Besides, the leaf litter from the shrub improves soil physical and chemical properties. Moreover, the shrub is widely used for hedging **(Orwa, *et. al.*, 2009)**.

2.2 Nutritional value of Guddium (*Grewiatenax*)

As reported by **Rahmatalla (1999),**the moisture, protein, reducing sugars, non-reducing sugars and ashcontents was vary between 9.82 % and 12.29%, 6.3% to 7.8%, 39.6%, 1.8%,4.7% respectively. Also the content of iron, zinc and copper in the pulp of Guddium cultivar were found to be 8.8,0.24 and 0.7mg/100 g pulp, whereas, that of Guddium wild type were 9.3,o.1 and 0.36 mg/100 g pulp respectively.

Also, reported by **Onsa (2007),** the moisture, available carbohydrates, crude fiber, protein, fat, ash, reducing and non-reducing sugars was 94.46%, 65.39%, 17.53%, 7.60%,5.32%, 4.16%, 29.11% and 1.32% respectively, and the mineral of Guddaim whole fruit was found to be rich in calcium, magnesium, sodium, iron was 9021.27, 2638.29, 510.64, 140.43mg respectively and vitamin-C 120.21 mg. While the content of other minerals (Mn, Cu and Zn) ranged from 22.55 to 25.95 mg /100 g (DM %).

The nutritional evaluation of guddaim fruits was carried out, the contents of moisture, ash, fat, fiber, protein and carbohydrate were 7.20%, 3.50%, 0.13%,

14.0%, 8.20%, 66.97% respectively. Guddaim fruits were found to contain about 25.5% D-fructose, 15 mg/100g ascorbic acid, 25 mg/100g iron and 40 mg/100g calcium **(Abdualrahman, *et. al*., 2011).**

The fruit represents only 40-50% of the whole fruit, and contains 10-15% moisture, 20% crude fibre, 5.2% ash, 1.7% protein, 0.4% fat, 66.75% carbohydrates, 13.8% reducing sugar and 44.4% starch. The fruit is rich in iron (20.8 mg/100 g), potassium (817 mg/100 g), sulphur, phosphorus, magnesium, calcium and sodium, and a good source of amino acids (aspartic acid, threonine, serine, glutamic acid, proline glycine, alanin, valine, cysteine, methionine, isoleucine, leucine, tyrosine, phenylalanine, lysine, histidine and arginine). The fruit is low in tannin (1.13%) and high in pectic substances (6.26%), and is traditionally used for the treatment of anaemia **(Gebauer, *et. al.*, 2007; Elhassan-Yagi, 2010).**

3. MATERIALS AND METHODS

3.1 Materials

Sample of Guddaim fruits (*Grewiatenax*) was purchased from local marked in north Darfour state. Then, the fruits were cleaned from foreign materials (leaves, stem, stone) and tightly packed in polyethylene bags and stored at (20^{o}C) until needed for the different investigations.

3.2 Methods

3.2.1 Chemical methods

3.2.1.1 Moisture content

The moisture content of the fruit pulp or flesh was determined following the standard method described by the **Association of Official Analytical Chemists (AOAC, 2003).**

Principle

The moisture content in a weighed sample is removed by heating the sample in an oven (under atmospheric pressure) at 105 ^{o}C. Then, the difference in weigh before and after drying is calculated as a percentage from the initial weight.

Five grams (5±1 mg) of ground and well mixed sample was weighed accurately in cleaned, dried petri dished using a sensitive balance (No. AR2140, OHAC, SCORO. USA).Then, the sample was placed in an oven (Carblite, Sheffield, England) at 105 ^{o}C until a constant weight was obtained. Then, the moisture content as per-cent was calculated as loss in weight after drying:

Moisture content (%) =

$$\frac{(W1 - W2) \times 100\%}{\text{Sample weight (g)}}$$

eq.[١]

3.2.1.2 Crude protein

The crude protein in the sample was determined by the micro-Kjeldahl method following the method of the **AOAC (2003).**

Principle

Guddiam fruit sample was digested with a strong acid (sulphuric acid) so that the sample releases its nitrogen content which can be determined by a suitable titration technique. The amount of protein in the sample is then can be calculated from the nitrogen concentration of the sample. A conversion factor of 6.25 (equivalent to 16 g nitrogen per 100 grams of protein) was used in this study. The kjeldahl method is divided into three steps which can be summarized under the following:

A) Digestion

The guddaim fruit sample (0.2 grams) was transferred into a digestion flask and then digested by heating the sample for 2-3 hours in (3.5N) sulphuric acid. The digestion process was catalyzed by a mixture 0.4 of 10 parts k_2so_4 to one part of $Cuso_4$. The heating was continued till the black colour turned to pale blue and the fumes disappeared.

B) Distillation

After the digestion has been completed the digestion flask was cooled and transferred to a distillation unit using a minimum volume of water. The solution in the distillation unit was then turned alkaline by addition of 20 ml of sodium hydroxide (40%) to release the ammonia. The released ammonia was distilled into 20 ml of 2% boric acid in a conical flax, adding to it 2 to 3 drops of Bromochresol Methyl red as indicator.

C) Titration

The nitrogen content in the sample was then estimated by titration of the ammonium borate formed with a standard hydrochloric acid (0.1N).The titrations continued till the colour of the solution turned to red-pink. The protein concentration as per-cent was determined by using the following equation:

$$\%\text{Crude protein} = \frac{TV \times N \times 14.00 \times F \times 100\%}{\text{Sample weight(g)} \times 100}$$

eq. [٢]

Where:

TV: actual volume of HCL used for sample titration (ml sample- ml blank).

N: normality of HCL.

F: Protein conversion factor = 6.25

3.2.1.3 Fat content

The sample oil content was determined by using a continuous extraction apparatus (soxhlet type), as described by **Pearson (1970).**

About five gram (5±1) samples were weighed and transferred to an extraction thimble covered with a piece of glass wool and then placed in the soxhlet apparatus .After that, the solvent (petroleum ether) was added into a dried weighted soxhlet flask and the extraction process was continued for about six hours. Then, the oil sample was dried in an oven (Carblite, Sheffield, England) for a 30 min to eliminate any remaining amounts of the solvent and the flask was reweighted. The fat per-cent was calculated by using the following equation:

$$\%\text{Crude fat} = \frac{(W1 - W2) \times 100\%}{\text{Sample weight (g)}}$$

eq. [3]

Where:

W1= weight of the empty soxhlet flask (g).

W2= weight of soxhlet flask with oil content (g).

3.1.2.4 Determination of total and available carbohydrates

The total carbohydrates and available carbohydrates as per-cent were calculated by difference as described by **West, *et. al.* (1988).**

3.2.1.5 Crude fiber

The crude fiber of the fruit pulp or flesh was determined following the standard method described by the Association of Official Analytical Chemists **(AOAC, 2003).**

Principle

The crude fiber is determined gravimetrically after the sample is chemically digested in chemical solutions. The weight of the residue after ignition is then corrected for ash content and is considered as crude fiber.

A sample of grams 2.0 gram was weighted and two hundred (200) ml of sulphuric acid (0.26N) were added, boiled for 30 min and then filtered. The residue washed three times by using hot water and after that 200 ml of NAOH (0.26N) was added, boiled again for 30 minutes and filtered. Then, the reside was carefully washed three time with hot water and until it was free from alkali. After that, the sample was dried in an oven (Carblite, Sheffield, England) at 105 ^{o}C(overnight) and reweighted. The residue was ached in a muffle furnace (LEF- 103S, serial No. 07033002, Korea) at 550 C^{o} for three hours till a light grey ash was formed and a constant weight was obtained .Then, the total crude fiber per-cent was calculated using the following equation:

$$\text{Crude fiber \%} = \frac{(W1 - W2) \times 100\%}{\text{Sample weight (g)}}$$

eq. [٤]

Where:

W1= weight of the sample before ignition (g).

W2= weight of sample after ignition (g).

3.2.1.6 Sugar determination

Total sugars, reducing and non-reducing sugars were determined following **Lane and Eynon** method as described by the **Association of Official Analysis Chemists (AOAC, 1990).**

Principle: Reducing sugar in pure solution or in plant materials after suitable pre-treatment (to remove interference substances) may be estimated by using copper sulphate as oxidizing agent in standard Fehling‘s solution.

Sample preparation:

(A)Reducing sugars

A sample of 5g± 1 mg sample was weighed and transferred to 250 ml beaker. Then 50 ml water was added, boiled gently and left to cool to room temperature. After that, the sample solution was transferred to a 250 ml volumetric flask and 2 ml of standard lead acetate **(NO.5032, Analar, England)** was added with stirring and left to stand for 10 min at room temperature. Finally, the excess amount of lead acetate was precipitated by using an appropriate amount of potassium oxalate solution (22%) and the solution was made up to volume and filtered.

(B) Total sugars

From the previous sample solution, 50 ml was pipette into a 250 ml conical flask and 5g of citric acid and 50 ml water added. Then, the mixture was boiled for 10 min to complete the inversion of sucrose and left to cool at room temperature. After that, the solution was transferred to 250 ml volumetric flask, neutralized with 0.1N NAOH by using phenolphthalein **(NO. 8987 J.T. Baker, Holland)** as indicator and the sample was made up to volume.

Procedure: 10 ml of the mixed Fehling's solution was pipette into a 250 ml conical flask. Then, sufficient amount of clarified sugars solution was added from the burette to reduce Fehling's solution in the conical flask. After that, the solution was boiled until a faint blue color is obtained. Then a few drops of methylene blue indicator was added to Fehling solution and titrated under boiling with sugar solution until a brick-red color of precipitate cuprous oxide was observed. Finally, the titer volume was recorded and the amount of invert sugar was obtained from Lane and Eynon table.

Calculation:

$$\text{Reducing sugars[\%DM]} = \frac{\text{invert sugar(mg)} \times \text{dilution factor} \times 100}{\text{titor} \times \text{wt of sample (g)} \times (100\% - \text{moisture\%})\ 1000 \times}$$

eq. [5]

$$\text{Total sugars [\%DM]} = \frac{\text{invert sugar(mg)} \times \text{dilution factor} \times 100}{\text{titer} \times \text{wt.of sample (g)} \times (100\% - \text{meisture\%})\ 1000 \times}$$

(as invert sugar)

eq. [٦]

Non –reducing sugar[%DM] = total sugars[%]- reducing sugars[%]

eq. [٧]

3.2.1.7Sugar determined by HPLC device

The sugars determination was conduction in Environment and Natural Resources and Desertification Research Institute. The high performance Liquid Chromatography is used for determination of sugar in Guddaim fruits.

The device was first set before estimating the sugar in Guddaim fruits. The device conditions were as follows:

Mobile phase: Acetonitrite 75% and distilled water 25%.

Stationary phase: Inert Sustain NH_2 5µm – 250×4.6 id mm.

The flow rate, oven temperature and the injection volume were 1.o ml/min, 27.1-27.8^{o}Cand 20µl. Fig (1),(2), (3), (4),(5), (6)shown the concentration of the standard glucose, fructose, maltose, sucrose and lactose.

3.2.1.8 Determination of ash content

The ash content of the sample was determined according to the **AOAC (2003).**

Procedure:

The empty crucibles were accurately weighed and then two grams of ground Guddiam fruit flesh were transferred to each crucible by using a sensitive balance. Then, the crucibles and their content were placed in muffle furnace (LEF- 103S, watts: 2KW10A serial No. 07033002, Korea) at 550^{o}C to 700^{o}C for more than 6 hours until while to grey ash was obtained. After that, the crucibles were transferred from the furnace toa desiccators to cool to room temperature and re-weighted. The ash content was calculated by following equation:

$$\text{Ash content (\%)} = \frac{(W1 - W2) \times 100\%}{\text{Sample weight (g)}}$$

eq. [^]

Where:

Wt1= weight of crucible with the remaining ashed sample (g).

Wt2= weight of empty crucible (g).

3.2.1.9Determination of minerals

Ten milliliters (10 ml) of HCL (2N) were added to the remaining ash sample and placed in hot sand path for about 10-15 min. After that, the sample was filtered and diluted to 100 ml in a volumetric flask. Then, the trace elements ferrous (Fe^{++}) and manganese (Mn^{++}) were determined according to **Perkin Elmer (1994)** by using Atomic Absorbance Spectroscopy (JENWAY 3110, UK). Sodium (Na) and potassium (K) were determined by using Flam Photometer (Model PEP7 JENWAY). While, calcium (Ca), magnesium (Mg), and phosphorus (P) were determined as described by **Chapman and Parratt (1961).**

3.2.1.10 Food metabolizable energy value

The energy values of the Guddaim fruit was calculated based on Atwater factor for protein, fat and available carbohydrate as indicated by **Leung (1968).**

Fat factor = 8.37 (Kcal/g)

Protein factor = 3.87 (Kcal/g)

Carbohydrate factor = 4.12 (Kcal/g)

1 Kcal = 4.184 (Kj)

3.2.1.11 Ascorbic acid content

Ascorbic acid content was determined according to the method that described by **Pearson (1976).**

Principle: The estimation in this method was based on the reduction of 2,6-dichlorophenol indophenol by ascorbic acid. The dye, which is blue in alkaline solution and red in acid solution, is reduced by ascorbic acid to a colorless solution.

Preparation of stander ascorbic acid solution: 0.05g ascorbic acid was dissolved in 250 ml of 10% oxalic acid.

Standardization of 2,6-dichloropheol – indophenols dye solution: 5ml of stander ascorbic acid solution was added to 5 ml 10% oxalic acid solution in a beaker and titrated against dye solution to a faint pink color (dye strength).

Procedure: A sample of 10g ±1mg was weighed and transferred to 250ml beaker, and blended with reasonable volume of (0.4%) oxalic acid. Then, the mixture was filtered through filter paper (Whatman No.1) and the volume was made up to 250ml with 0.4% oxalic acid in a volumetric flask. Finally, 20ml of the filtrate was taken into a beaker and tittered against stander 2,6-dichloropheol indophenol dye solution to faint pink color.

Calculation:

$$\text{Ascorbic acid[mg/100g]} = \frac{\text{titer (ml) x dye strengthen x 100}}{\text{factor}} \qquad \textbf{eq.[9]}$$

$$\text{Factor} = \frac{\text{sample wt. x sample volume for titration}}{\text{Total volume of sample}} \qquad \textbf{eq.[10]}$$

$$\text{Dye strength} = \frac{1}{\text{Titer}} \qquad \textbf{eq.[11]}$$

4- RESULTS AND DISCUSSION

4.1 Nutritional value of Guddaim fruit

4.1.1 Chemical composition

Table (1) shows the chemical composition of whole Guddaim fruit on wet and dry basis. The moisture, protein, fat, carbohydrates, crude fiber, ash , total sugars and calorie value were found to be 22.25%, 12.43%, 4.79%, 43.23%, 14.15%, 4.14% ,45.93% and 261.75%,respectively on dry basis. Among the total sugars, the reducing sugars and non-reducing sugars constitute about 20.90% and 25.03%, respectively. The results obtained in this study disagrees with those reported by **Rahmattalla (1999);Gebauer, *et. al.*, (2007) and Elhassan-Yagi, (2010),** expect ash content.Also the results obtained in this study disagrees with those reported by **Onsa(2007),** expect ash, fat and fiber contents.

Table (2) shows the main reducing sugars were found to be glucose 15.2603% and fructose 16.9111%. The results obtained in this study disagrees with those reported by **Abdualrahman, *et. al.*, (2011).**

4.1.2 Minerals and vitamin-(C) contents of Guddaim fruits

Table (3) presents the minerals and vitamin-(C) contents of Guddaim fruits on wet and dry basis as (mg/L). From the results, Guddaim whole fruits was found to be very rich in calcium 42.29, magnesium 48.40, sodium 0.430, iron 0.280, zinc 0.190, copper 0.046, manganese 0.060 and vitamin-C110.36 mg/ 100g, on dry weight basis. The results obtained in this study disagrees with those reported by **Onsa(2007)**

Table (1):Chemical composition and energy value of Guddaim whole fruits

Chemical composition and energy value	% on wet basis	% on dry basis
	[%, n = 3 ± SD]	
Moisture content	018.19 ± 0.96	022.25 ± 1.44
Crude protein	010.17 ± 0.29	012.43 ± 0.30
Fat content	003.92 ± 0.42	004.79 ± 0.57
Crude fiber	011.60 ± 0.14	014.15 ± 0.27
Ash content	003.39 ± 0.09	004.14 ± 0.11
Total Carbohydrates	064.33 ± 1.28	060.53 ± 2.27
Total sugars	037.58 ± 0.26	045.93 ± 0.70
Reducing sugars	017.09 ± 0.08	020.90 ± 1.62
Non-reducing sugars	020.50 ± 1.14	025.03 ± 2.20
Available carbohydrates	052.73 ± 1.01	046.38 ± 2.52
Caloric value/ 100 g	286.88 ± 7.51K.cal	261.75 ± 4.29K.cal

n ≡ number of independent determination.

SD ≡ Standard deviation.

Table (2): Sugar Contents OF Guddaim whole fruits by HPLC

Sugar	Guddaim fruits (%)
Fructose	16.9111
Glucose	15.2603
Sucrose	ND
Maltose	ND
Lactose	ND

ND ≡ not detected

Table (3): minerals and vitamin-(C) contents of Guddaim fruits

Minerals	On wet basis	On dry basis
	[Mg/ L, n = 3 ± SD]	
Calcium[Ca]	34.60 ± 2.81	42.29 ± 2.87
Copper[Cu]	0.038 ± 0.00	0.046 ± 0.00
Iron[Fe]	0.227 ± 0.00	0.280 ± 0.00
Magnesium[Mg]	39.60 ± 2.95	48.40 ± 3.06
Manganese [Mn]	0.048 ± 0.00	0.060 ± 0.02
Sodium [Na]	0.350 ± 0.00	0.430 ± 0.01
Zinc[Zn]	0.154 ± 0.00	0.190 ± 0.00
Vitamin-[C] (mg/100g)	090.28 ± 0.88	110.36 ± 0.50

n ≡ number of independent determination.

SD≡ Standard deviation.

5. CONCOLUSION AND RECOMMENDATION

5.1 Conclusion

From the results obtained in this study, it can be concluded that Guddaim fruits is found with high nutritional value, rich in minerals especially calcium, magnesium, and vitamin (C) and high energy value.

5.2 Recommendations

1-We recommend Guddaim fruit to be used as food because it high nutritional value in mineral, vitamin-C and high energy value.

2- Utilization of Guddaim as medicine in calcium deficiency disease (osteoporosis).

3- Efforts should be directed towards increasing production and improving the utilization of Guddaim fruit in Sudan at commercial scale level.

4- A comprehensive survey for the different Guddaim varieties in Sudan is also necessary.

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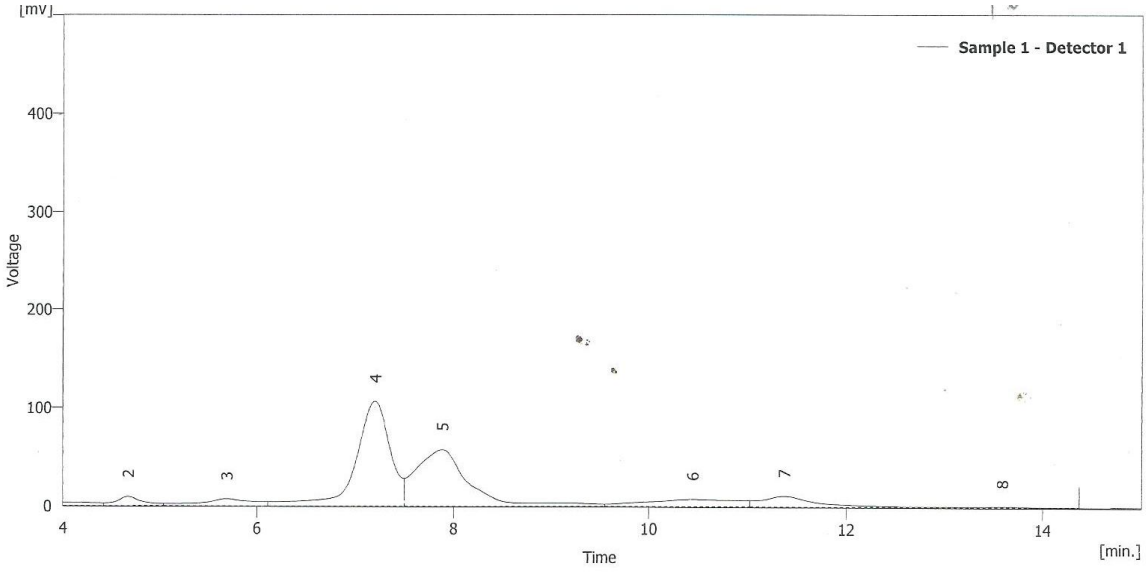
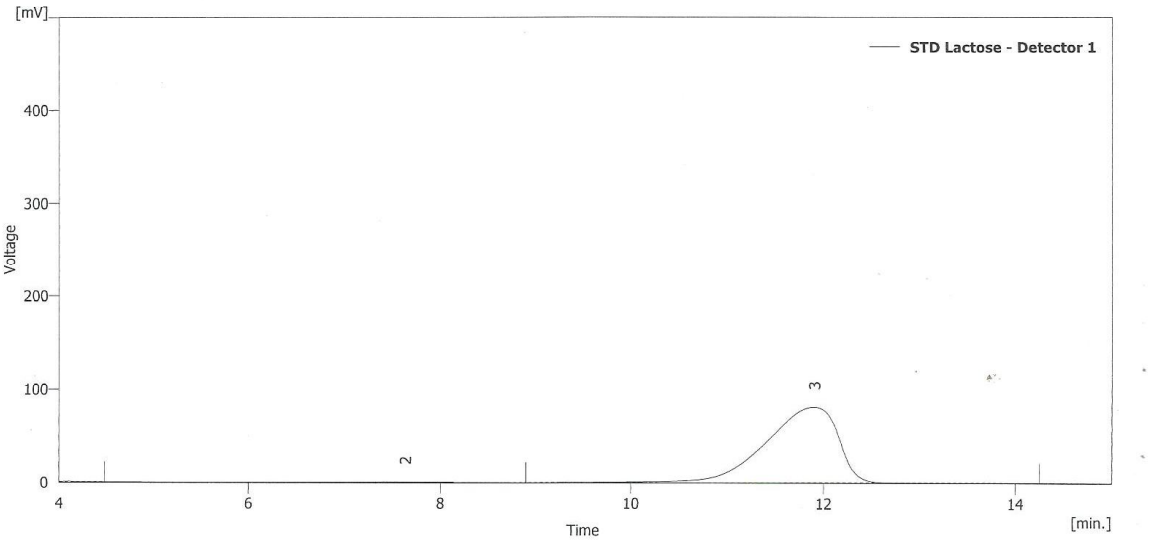
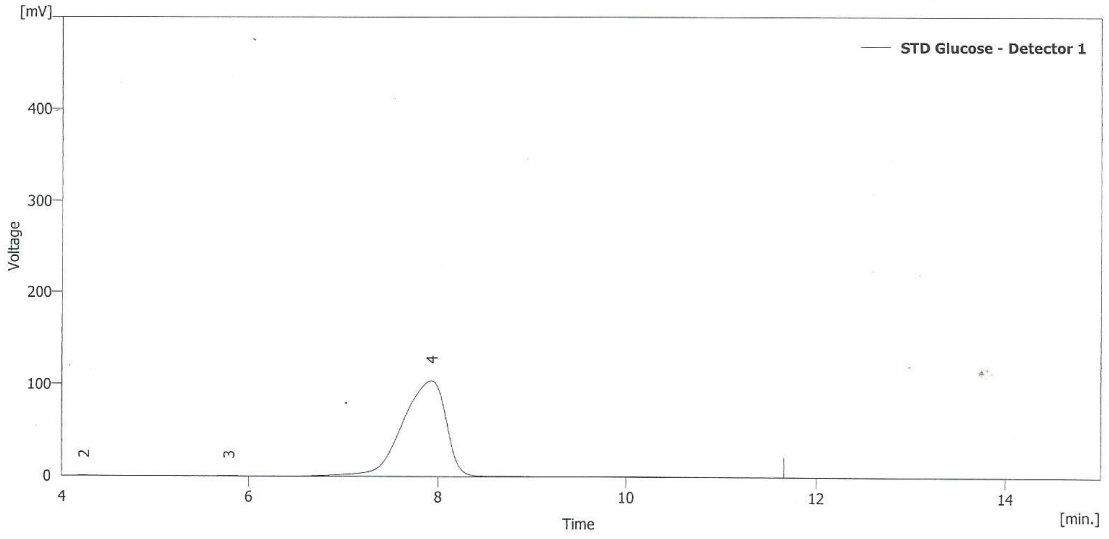
APPENDICES



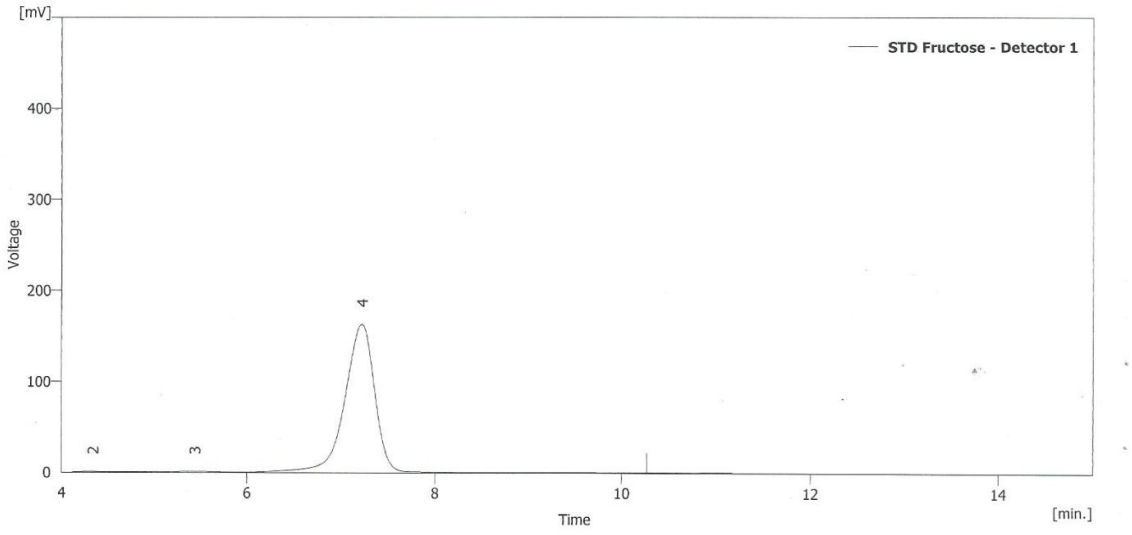
Appendix (1) Concentration of Sugar in Guddaim Sample



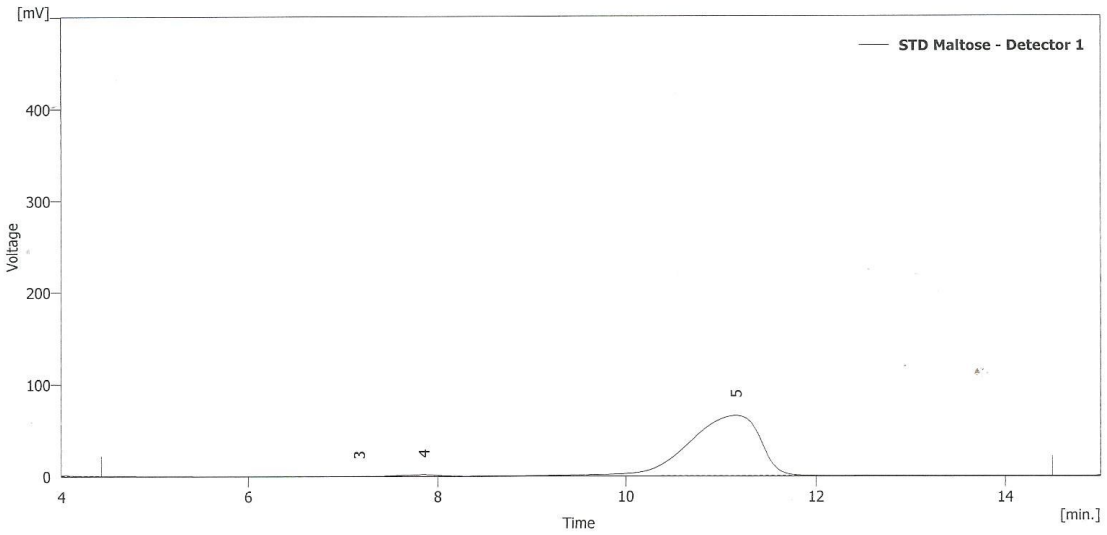
Appendix (2) Concentration of Standard Lactose



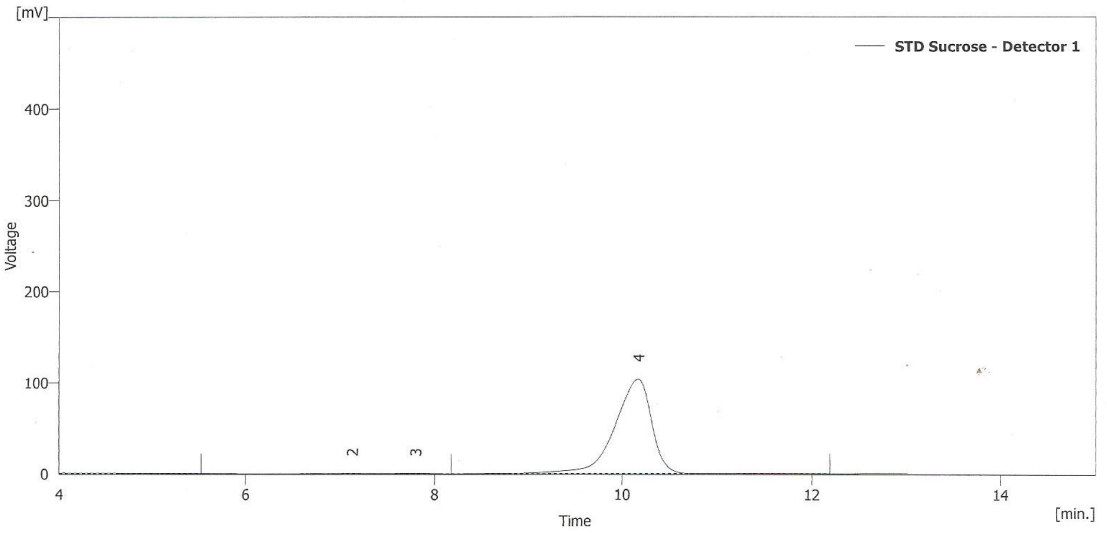
Appendix (3) Concentration of Standard Glucose



Appendix (4) Concentration of Standard Fructose



Appendix (5) Concentration of Standard Maltose



Appendix (6) Concentration of Standard Sucrose