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Morphological Characterization of Baobab (*Adansonia Digitata*) Fruit, Pectin and Some Sugars of Baobab Pulp From Different Locations in Sudan

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Abstract
The aims of this study were to evaluate morphological characteristic of baobab fruit, extract and determine of pectin and some sugars in baobab fruit pulp. Baobab fruit samples were collected from El Obeid, Umm Ruwaba, Damazin and Nyala. The fruit pulp was obtained by breaking the capsules manually, then the seeds were removed and pulp powder was sieved using appropriate mesh. Length, width, thickness of fruit , weight of pulp, weight of seed, number of seed, weight of red fiber and weight of epicarp of samples were determined. Pectin was extracted using water based extraction method. Glucose, fructose and sucrose were determined by HPLC. The results of physical characterization showed high significant differences ($P<0.05$) in, morphological characteristics (length, width, weight, weight of pulp, weight of seed, number of seed, weight of red fiber and weight of epicarp) within fruits from the same location and between those from different locations studied. The highest pectin yield (54.99%) was recorded in sample from Damazin followed by Umm Ruwaba (46.65%), El Obeid (43.93%) and Nyala (40.75%). Glucose content ranged between 1.32-5.32 mg/100g, while fructose and sucrose ranges were 2.33-5.07mg/100g and 13.00-19.44mg/100g, respectively. Moreover, this study exposed high significant variation of physical characteristics, pectin and sugars profile between fruits from different locations was observed. The finding suggests that Sudanese baobab fruit pulp is rich in pectin and could be a potential thickener of beverages, gelling and emulsifying agents and could stimulate growth of beneficial organisms and may be useful as functional food ingredient.
Keywords: Sudanese Baobab fruit, morphological characteristics, pectin, sugars profile

Introduction
Baobab (*Adansonia digitata*) is a large deciduous tree originally found in Africa (Sidibe *et al.*, 1998). In Sudan it is found in belts in Kordofan, Blue Nile, and Darfur (Elamin, 1990), no records on named varieties are available; but it is widely recognized that ecotypes from different areas of the sudan have different fruits in terms of size, shape and sweetness. Gebauer and luedeleng (2013) reported variations in fruit phenotypes and percent of fruit pulp with fruit phenotype in Kordofan. Baobab fruit pulp has high contents of pectin, low protein, low fat, very little iron and is a relatively poor source of manganese, but contains exceptionally high calcium (Osman, 2004) and high amounts of vitamin C, a powerful antioxidant (Sidibe and

Williams, 2002).

Pectin is a natural carbohydrate in plant cellular walls and it can be extracted from the inner peel of many fruits, a multiuseful component of cell wall is a high value functional food ingredient. It is marketed commercially as a white to light brown powder mainly, extracted from fruits. Pectin backbone that forms a linear chain of α-(1-4 connected D-galacturonic acid.(Willats *et al.,* 2006). Stated that "Pectin's are basically used as gelling agents, but canalso act as thickener, water binder and stabilizer. Low methoxyl pectins (< 50% esterified) form thermo reversible gels in the existence of calcium ions at low pH (3–4.5) while high methoxyl pectin's rapidly form thermally irreversible gels in the occurrence of adequate (for example, 65% by weight) sugars such as sucrose and at low pH (< 3.5); the lower the methoxyl content, the slower the set (Schols and Voragen1996). The physicochemical properties of pectin depend mostly on the raw material and the chosen circumstances for its separation and purification (Chan and Chao, 2013). Pectin substances are frequently extracted by chemical or enzymatic methods, with a methods of physical and chemical several stages, in which the hydrolysis, extraction and solubilization of macromolecules plant tissue are influenced by numerous factors such as acid type, temperature, pH and extraction time (Pagan *et al*., 2001).The objectives of this study were to determine morphological characterization of Baobab (*Adansonia digitata*) fruit from different locations in Sudan, and estimate of pectin and some sugars of fruit pulp.

Material and methods

Materials: Baobab fruits capsules were obtained from El Obeid, Um Ruwaba, Nyala and Damazin, areas in Sudan. Fruit pulp was obtained by breaking the capsules manually, seeds were removed,and pulp powder was sieved using appropriate mesh. The resulting fruit pulp was stored in a dark polyethylene bag at -18ºC until used.

Physical characteristics of baobab fruit from different locations in Sudan: Fruits physical characteristics including fruit length, width and thickness of the wall, were measured using a Vernier Caliper. The weight of fruit pulp, seeds, red fiber and epicarp were determined using a sensitive balance. The number of seeds in baobab fruit was counted manually.

Water based extraction of Pectin: Pectin was extracted by the method of Malviya *et al*.(2010**).** The conventional water based extraction involves extracting the pectin using acidified water (pH 2) at 70˚C for 4h.The hot acid extract was pressed in cheese cloth and the cake was cooled to 4 ˚C. Pectin was precipitated by alcohol (ethanol) and water in a ratio of 2:1 (v/v) followed by continuous stirring for 15 min .The mixture was further allowed to stand for two h for better pectin precipitation. The allowed filtering the pectin substances which remained floatingat the surface of alcohol-water mixture. Suspended pectin coagulate was filtered through cheesecloth, cleaned with alcohol (95%) and pressed. Pressed pectin was further dried to a constant weight at 35–45ºC in a hot air oven. The flowing equation calculated pectin yield:

$$\text{Pectin yield\%} = \frac{\text{weight of extracted pectin X100}}{\text{Weight of dried sample}}$$

Determination of some sugars of baobab fruit by HPLC: The sugars profile of baobab fruit pulp was determined using **HPLC** as described by Legua*et al*.(2012),with some modification. HPLC used for analysis consisted of an autosampler (SIL –Method of sugar analysis by HPLC) 10 ADvp, SHIMADZU, KYOTO, JAPAN), binary pump system (LC-10ADvp solvent delivery module, SHIMADZU,-KYOYO, JAPAN),colum oven(CTO-10 ADvp, SHIMADZU, KYOTO, JAPAN), 20 micro liter of sample were injected onto normal –

phase column (shim-pack clc-NH2(4.6mm i.d *15 cm,5µl practical size SHIMADZU, KYOTO, JAPAN) equipped with a guard column of the same material.

Preparation of sample solution: 5gm of sample was transferred into 50 ml volumetric flask by 20ml of water was added and followed by 12.5 ml ethanol; the volume was completed by water to the mark. Then the final solution was filtered by filter paper (Whatman International Limited, Kent, England) and followed by syringe filter (0.2 µm (Germany)into a sample vial and 20µl was injected into the column .Sugar was eluted and elution was carried out with isocratic mobile phase consisting of 80:20 acetonitrile /water at 30 ˚C at a flow rate of 1ml/min, the retention times of fructose, glucose, sucrose and maltose sugar are monitored using the refractive index detector (RID-10A.SHIMADZU.Kyto,JAPAN); the retention time obtained was compared to that determined using standards of these sugars .

The concentration of these sugars in the sample was determined by the following:-

Preparation of a mixture of these standards:- by dissolving 0.3051,0.2561,0.1523 and 0.1gm from each standard in a 25ml volumetric flask with water, 20µl from the standard solution were injected and the retention time peak area of each standard was recorded to compute the mass of the sugar in unknown sample .

pH determination: The pH of the different samples was determined as described by Ranganna(2001).

Titratable acidity: Ten grams of the pulp sample was diluted with distilled water (150ml) stirred for 15 minutes, then filtered. Ten ml of the pulp preparation was titrated against 0.1N NaOH using phenolphthalein as indicator. Total acidity (mg/100g) expressed as citric acid according to Ranganna (1979).

Where:

eq.wt = equivalent weight of citric acid

$$\text{Acidity (mg/100g)} = \frac{\text{Titre} * \text{N(NaOH)} * \text{dilution factor} * 100 * \text{eq.wt}}{\text{weight of sample} * 1000 * \text{vol.titre}}$$

Statistical analysis: One- way ANOVA was performed to examine significant differences between normally distributed data of replicated measurement. A probability level of less than 0.05 was believed significant ($p<0.05$). All data were analyzed using Version 17 MINITAB statistical software for Windows (2013).

Results and Discussion

Morphological characterization of baobab fruit from different locations in Sudan: Results in (Table 1) indicated high significant differences in physical characteristics of fruit collected from different locations. Eight distinct fruit shapes were observed and were described through visual examination: Oblong pointed, High – Spheroid, Ovate, Ellipsoid pointed, Clavate, Crescent, Ellipsoid and Fusiform shaped, (Fig1). Among them clavate and crescent shapes baobab were found only in El Obeid and Umm Ruwaba (North Kordofan State). However ovate baobab was found only in El Obeid (Kordofan).

Moreover, the physical attributes of baobab fruit from different locations namely: length, width, weight, the weight of pulp, the weight of seed, number of seed,the weight of red fiber and weight of epicarp showed significant ($p<0.05$) difference. As in Table 1, Oblong pointed baobab fruit showed length range of 16.33 -26.30, width range 5.55-7.55, weight of fruit 106.70 -255.07g, weight of seed 70.13 -123.03 g, weight of pulp 19.87-55.58g, number of seeds162.50-201.00 seed , width of wall 5.05-6.10 mm, weight of red fiber 3.9-4.17g and weight of epicarp10.93-72.21g.

Table 1: Fruit characteristics of *Adansonia digitata*, from North Kordofan (El Obeid and Umm Ruwaba) ,Blue Nile (Damazin) and Southern Darfur (Nyala) States.

Fruits shape	Sample	Length (cm)	Width (cm)	Weight of fruit (g)	Weight of seed(g)	Weight of pulp(g)	Number of seed	Width of Wall mm	Weight of red fiber(g)	Weight of epicarp (g)
Oblong pointed	El Obeid	17.32±1.40^{b}	6.11± 0.10^{a}	112.69 ± 3.51^{c}	73.07 ± 3.62^{c}	19.87 ±1.08^{b}	168.50 ± 9.19^{b}	5.48 ± 0.68^{a}	4.17± 0.23^{a}	15.53 ± 1.46 ^{b}
	Umm Ruwaba	26.30 ± 0.37^{a}	7.38± 0.55^{a}	255.07 ± 0.74^{a}	123.03 ±3.57^{a}	55.58 ± 5.54^{a}	162.50 ± 3.54^{a}	6.10 ± 0.14^{a}	4.10± 0.14^{a}	72.21 ± 5.12 ^{a}
	Damazin	25.30 ±0.12^{a}	7.55±0.06^{a}	223.13 ± 3.12^{b}	110.93 ± 0.39^{b}	50.94 ±3.22^{a}	190.00±1.41^{a}	5.35 ± 0.35^{a}	4.15± 0.21^{a}	56.78 ± 6.63^{a}
	Nyala	16.33 ± 0.31^{b}	5.55± 0.16^{a}	106.70 ± 9.18^{c}	70.13 ± 2.84 ^{c}	21.55 ±1.41^{b}	201.00±2.83^{b}	5.05 ± 0.07^{a}	3.90 ± 0.14 ^{a}	10.93 ± 4.50 ^{b}
High - Spheroid	El Obeid	16.72 ± 0.54^{a}	11.48 ± 0.53^{a}	182.57± 3.48^{b}	79.08± 2.02 $^{a\,b}$	50.22 ± 0.16 ^{b}	157.50± 3.54 ^{b}	4.00± 0.00^{a}	3.75± 0.21 $^{a\,b}$	49.73 ± 1.80 ^{b}
	Umm Ruwaba	15.57 ±0.75^{ab}	10.85± 0.42 ^{a}	188.00 ± 3.39^{b}	73.16 ± 2.18^{b}	50.31 ± 2.81 ^{b}	146.50± 7.78^{a}	4.00± 0.00^{a}	3.92 ± 0.11^{a}	61.09± 1.55^{a}
	Damazin	12.48 ± 0.53 ^{b}	9.03 ± 0.11^{b}	200.62± 2.14^{a}	83.03 ± 0.98 ^{a}	68.60 ± 4.31^{a}	203.50± 4.95^{a}	3.85± 0.35^{a}	3.10 ± 0.14^{b}	46.56± 2.06^{b}
	Nyala	12.51± 0.56^{b}	8.60± 0.14 ^{b}	199.72 ± 0.55^{a}	79.11± 2.96 $^{a\,b}$	68.00± 0.00^{a}	191.00± 1.41 ^{b}	4.00± 0.00 ^{a}	3.40 ± 0.28 $^{a\,b}$	48.81± 2.14

Fruits shape	Sample	Length (cm)	Width (cm)	Weight of fruit (g)	Weight of seed(g)	Weight of pulp(g)	Number of seed	Width of Wall mm	Weight of red fiber (g)	Weight of epicarp (g)
Ellipsoid	El Obeid	19.65± 1.91[a]	8.90±0.85[ab]	219.38±5.42[a]	86.52±2.83[a]	47.17±2.61[a]	157.50± 3.54[a]	4.00±0.00[a]	3.10±0.14[a]	82.50± 5.66[a]
pointed	Umm Ruwaba	19.88± 1.87[a]	9.30± 0.28[a]	203.78±4.56[a]	97.85±3.03[a]	37.69±3.34[a]	182.00± 0.90[a]	4.15±0.07[a]	3.75±0.35[a]	64.73± 1.03[b]
	Damazin	17.09± 0.59[a]	7.57±0.33[ab]	151.54±3.59[b]	49.41±1.53[c]	26.82±2.29[b]	128.00± 0.83[b]	4.00±0.00[a]	3.70±0.28[a]	72.56±0.21[ab]
	Nyala	15.15± 1.20[a]	7.05±0.07[b]	148.61±4.24[b]	68.38±4.16[b]	25.22±0.31[b]	125.50± .36[b]	3.25±0.35[b]	3.26±0.37[a]	51.76± .77[c]
Clavate	El Obeid	9.25± 0.35[b]	5.00±0.00[b]	97.34± 2.68[b]	38.41±1.28[b]	20.17±0.23[b]	79.00± 4.24 [b]	6.00±0.00[a]	2.00±0.00[b]	37.06±4.15[b]
	Umm Ruwaba	21.79± 0.65[a]	10.43±0.60[a]	185.99±1.58[a]	79.62±0.86[a]	33.26±2.88[a]	103.50± 6.36 [a]	5.00±0.00[b]	5.77±0.33[a]	67.57±3.63[a]
ovate	El Obeid	9.35±0.35	7.80±0.28	147.8±3.45	61.37±1.16	31.41±1.70	113.00±7.08	4.9±0.14	2.85±0.21	52.79±4.54
Crescent	Umm Ruwaba	22.80±3.39	5.50±0.28	103.80±4.50	30.48±2.23	15.95±0.88	60.00 ± 5.66	5.40±0.14	2.02±0.01	55.70±1.83

Each values of means ±Stander deviation
Values that a bear different superscript that letter in the same Column are significantly differently at $p<0.05$

Fruits shape	Sample	Length (cm)	Width (cm)	Weight of fruit (g)	Weight of seed(g)	Weight of pulp(g)	Number of seed	Width of Wall mm	Weight of red fiber(g)	Weight of epicarp (g)
Ellipsoid	El Obeid	17.25± 0.35 [b]	9.27± 0.09[b]	162.83± 0.65[bc]	86.60 ± 2.26 [a]	24.71± 1.68[b]	210.50 ± 13.44[b]	3.15± 0.07[b]	6.50 ± 0.23 [a]	48.47± 2.47[b]
	Umm Ruwaba	17.20± 0.00[b]	10.42± 0.12 [a]	256.09± 7.68[a]	130.50± 3.54[b]	34.45± 1.07[a]	255.50± 7.78[a]	3.00± 0.00 [b]	6.78 ± 0.32[a]	84.37± 11.96[a]
	Damazin	17.30± 0.28[b]	8.07± 0.09[c]	174.47± 8.68[b]	91.94± 2.12[b]	28.71 ± 1.97[ab]	148.00 ± 9.90[c]	3.45± 0.07 [a]	3.88 ± 0.04 [b]	49.74 ± 4.83[b]
	Nyala	20.20± 0.14[a]	8.45± 0.35[c]	149.50± 2.12[c]	67.55 ± 3.61[c]	25.18 ± 0.77 [b]	130.0 ± 0.00 [c]	3.00± 0.00[b]	3.16 ±0.06 [b]	53.59± 2.24[b]
Fusiform	El Obeid	20.38 ± 0.88 [a]	8.05± 0.07 [a]	154.38± 1.17 [a]	47.92± 0.59 [a] [b]	33.59± 2.74[a]	104.0 ± 14.1 [a b]	4.90± 0.14 [a]	3.20 ± 0.00 [b]	73.10± 0.69[a]
	Umm Ruwaba	21.64± 1.64[a]	21.64± 0.23[b]	149.05 ± 2.89[a]	46.34 ± 0.97 [b]	21.73± 2.27 [b]	84.00 ± 2.83[b]	6.40± 0.57[a]	3.88 ± 0.18[a]	76.70± 0.99[a]
	Damazin	21.48± 0.39[a]	7.66± 0.21[ab]	152.92± 13.31[a]	51.32± 1.58[a]	35.58 ± 2.79 [a]	132.50 ± 3.54[a]	5.43± 0.33 [a]	3.68 ±0.035[ab]	63.30± 9.77[a]


Oblong pointed


Ellipsoid pointed


Fusiform


Ellipsoied


Clavate


Ovate


High – Spheroid

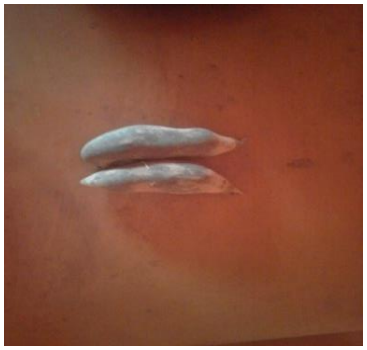
Crescent shaped

Figure 1: Variety in fruit shape of Bobab (Adansoniadigitata L.) in Sudan from North Kordofan state (El Obeid and Umm Ruwaba), Southern Darfur State (Nyala) and Blue Nile (Damazin) sates.

High – Spheroid baobab fruit showed a rangeof length from 12.51-16.72cm, width 8.60-11.48cm, the weight of fruit 182.57-200.62g, the weight of seeds 70.13 -123.03 g, weight of pulp 50.22 -68.60g, numberof seeds 146.50-203.50, the width of wall 3.85-4.00 mm, the weight of red fiber3.10 -3.92g and weight of epicarp46.56-61.09g.

Ellipsoid pointed baobab fruits showed arrange of length from 15.15-19.88cm, width 7.05-9.30cm, the weight of fruit 182.57-200.62g, the weight of seed49.41-97.85g, the weight of pulp25.22-47.17g, number of seed125.50 -182.00, the width of the wall(3.25-4.15 mm), the weight of red fiber3.10 -3.75g and weight of epicarp51.76 -82.50g.

Clavate shape was found in both baobab fruit pulp from El Obeid and Umm Ruwaba as showed measured of length of 9.25-

21.7cm, width 5.00-10.43cm, weight of fruit 97.34 -185.99g, weight of seed 38.41- 79.62, weight of pulp20.17-33.26g, number of seed79.00 -103.50, width of wall 5.00-6.00 mm, weight of red fiber2.00-5.77g and weight of epicarp37.06- 67.57g, respectively.

Crescent shape was found only in a sample from Umm Ruwaba as showed of length22.80cm, width 5.50mm, the weight of fruit 103g, the weight of seed30.48g, the weight of pulp15.95g, number of seed 60.0the width of wall 5.40mm, the weight of red fiber2.02g and weight of epicarp55.70g.

Ellipsoid baobab fruit showed arrange of length from 17.20-20.20cm, width 8.07-9.27cm, the weight of fruit 149.50-256.09g, the weight of seeds 67.55 -130.50g, the weight of pulp 24.71-34.45g,a number of seed 130.0 -255.50, the width of wall 3.00-3.45mm, the weight of red fiber 3.16 -6.78g and weight of epicarp48.47-84.37g.

Fusiform baobab fruit was showed no significant different ($p>0.05$) in mustered of length from range20.38 -21.64cm),while significant ($p<0.05$) different in width 21.64-21.64cm, weight of fruit 149.05 -154.38g, weight of seed 46.34 -51.32g,weight of pulp 21.73-35.58g, number of seed 84.00 -132.50, width of wall 4.90-6.40mm, weight of red fiber 3.20 -3.88g and weight of epicarp63.30-76.70g.

Ovate baobab was found only in a sample from El Obeid as showed a rangeof length 9.35 cm, width 7.80mm, the weight of fruit 147.8g, the weight of seeds 61.37g, the weight of pulp31.41g, number of seed 113.00, the width of wall4.9mm, the weight of the red fiber2.85gand weight of epicarp52.79g.These results of measured parameter (Fruit length, Fruit width, Fruit weight) were slightly different from values(length14.32cm, width 7.78 and Fruit weight 149.75 g) reported by Nasreldin *et al*.,(2014) in morphological variation in fruit shapes of *Adansonia digitata* L. FromBlue Nile and North Kordofan states in Sudan, also the weight of pulp, the weight of seed, number of seed was showed different variation compared that reported by Munthali *et al*.,(2012). Numerously published literature on baobab fruit phenotypic variations: (De Smedt, *et al*. 2011; Barwick 2004; FAO, 1982; Gebauer*et al*. 2002; Gruenwald and Galiza 2005; Nour*et al*. 1980). Gruenwald and Galiza (2005) reported that the percentage of fruit pulp varies according to the provenances. In southern Africa, fruit pulp comprises 16.5% of the fruit weight and seed weight 38% while in Senegal fruit pulp is about 12%.Moreover, the of weight of red fiber and weight of epicarp were investigated for the first time in this study.These findings showed a significant variation of quantifiable characters of fruits among and within the studied states could be attributed to the different climatic gradient and environmental factors. Kasvanga *et al*., (2007) also, fruit characteristics are greatly affected by environmental factors, cultural factors in addition to genetic effects.

Pectin contents of baobab fruit pulp: The result of pectin content presented in Table (2), showed significant ($P\leq 0.05$) difference between baobab fruit pulp from El Obeid, UmmRuwaba, Damazin and Nyala which were found to contain 43.93%, 46.65%, 54.99% and 40.75% respectively. The highest content of pectin was recorded in baobab fruit from Damazin. This variationsin pectin content might be attributed to the origin of baobab, environments, the processing techniques, a probable genetic distinction, ripening age difference as reported by Fagbohun *et al*.(2012).

Table 2: Pectin contents% of baobab fruit pulp from different locations in Sudan

Sample	Pectin (%)
El Obeid	43.93 ± 3.96[bc]
Umm Ruwaba	46.65 ± 0.61 [b]
Damazin	54.99 ± 0.10[a]
Nyala	40.75 ± 1.18[c]

* Each value is a mean of three replicates ± standard deviation.
** Values that bear different superscript letter in the same Column are significantly different at p<0.05.

Some Sugars of baobab fruit pulp from different locations in Sudan: As presented in Table (3) fructose, glucose and sucrose were detected in all Baobab fruit samples. The highest sucrose level was found in baobab fruit pulp from Kordofan (El obied) 19.44mg/100g. Fructose content among differentsample were 5.07, 4.83, 4.44and 2.33mg/100g in baobab fruit pulp from El Obeid, Umm Ruwaba, Damazinand Nyala, respectively. Glucose values ranged between 1.32-5.32 mg/100g in different baobab fruits. The results showed significant (P< 0.05) difference in sugars profile about the source of baobab fruit. However these results were in disagreement with findings of Ibrahim *et al.,* (2013). They reported 7.9 g/100g, 7.0 and 1.7 g/100g in baobab fruit forglucose, fructose and sucrose, respectively. The variations in sugar profile between baobabs pulps might be affected by difference in the soil related to different locations in Sudan as well as a probable genetic variation.

Table 3: Sugar content (mg/100g) of baobab fruit pulp from different locations in Sudan

Sample	Fructose	Glucose	Sucrose
Umm Ruwaba	4.83± 0.03[b]	3.49± 0.01[b]	18.64± 0.27[a]
El Obeid	5.07± 0.05[a]	5.32±0.02[a]	19.44± 0.65[a]
Damazin	4.44± 0.02[c]	1.32± 0.01[c]	13.34± 0.05[b]
Nyala	2.33± 0.01[d]	1.77± 0.02[d]	13.00± 0.05[b]

Each value in the mean of three replicates
Values are Mean ±Standard deviation
Values that a bear different superscript letter in the same Column are significantly different at p<0.05.

Physico-chemical properties of baobab fruit pulp from different locations in Sudan

pH values: Values of pH for different baobab fruit pulp samples are displayed in Table (4). Baobab pulp obtained from Nyala, had a pH value of 3.19, which is significantly (P≤ 0.05) higher as compared with values of 3.04, 3.03and3.02 pH for baobab from Damazin, El Obeid and Umm Ruwaba, respectively. This result was slight lylower as compared to findings by Ndabikunze *et al.,* (2011) who reported a pH value of 3.4. These variations may be due to variations in organic acids content of baobab fruit pulp.

Titratable Acidity (TA): Table (4) shows the titratable acidity of baobab fruit pulp from different locations in Sudan. There is significant (P≤ 0.05) difference (TA) between baobab fruits from different locations. Titratable acidity values recorded for baobab fruit were 2.37, 2.36, 2.67 and 2.06 (mg/100g) El Obeid (Kordofan), Umm Ruwaba **(**Kordofan**),** Damazin (Blue Nile**)** and Nyala (Darfur), respectively. Furtherthere was no significant difference in titratable acidity of baobab fruit pulp from El Obeid and Umm Ruwaba could be attributed to the fact they are of the same ecotypes growing in soils with similar chemical composition.

Table 4: Titratable Acidity and pH value of baobab fruit pulp from different locations in Sudan

locations of samples	pH	Tetratable Acidity
El Obeid	3.03 ± 0.01^{bc}	2.37 ± 0.06^{b}
Umm Ruwaba	3.02 ± 0.01^{c}	2.36 ± 0.05^{b}
Blue Nile	3.04 ± 0.01^{b}	2.67 ± 0.12^{a}
Nyala	3.19 ± 0.01^{a}	2.06 ± 0.01^{c}

* Values are mean ± SD for replicate independent runs.
**Values that bear different superscript letter in the same Column are significantly different at $p<0.05$.

Conclusion

The results from this study indicated that baobab (*Adansonia digitata*) pulp had high variation in morphological characteristics, pectin, and sugars contents. The pulp also had low pH suggesting that it had good keeping quality, as low pH can prevent microbial growth. More studies are required to characterize baobab fruit pectin to evaluate its suitability for industrial applications.

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الخصائص الفيزيائية لثمار التبلدي ,البكتين ومحتوي السكريات للب التبلدي من مناطق مختلفة في السودان

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1-كلية الدراسلت الزراعية –جامعة السودان للعلوم والتكنولوجيا–قسم علوم وتكنولوجيا الأغذية

المستخلص

أجريت هذه الدراسة لتقيم الخصائص الفيزيائية لثمار التبلدي,إستخلاص البكتين وتحديد بعض السكريات في لب ثمار التبلدي التي جمعت من(نيالا,الأبيض , أمروابة و الدمازين) في السودان .تم الحصول على لب التبلدي عن طريق كسر الكبسولات يدويًا ، ثم تمت إزالة البذور ومسحوق اللب باستخدام غرابيل مناسبة. تم تحديد الطول والعرض وسمك الفاكهة ، وزن اللب ، وزن البذور ، عدد البذور ، وزن الألياف الحمراء ووزن القشرة للعينات. تم استخلاص البكتين باستخدام طريقة الاستخلاص المائي. تم تحديد الجلوكوز والفركتوز والسكروز بواسطة كروماتوغرافيا سائلة عالية الأداء . أظهرت النتائج إختلاف واضح بين الثمارفي الخصائص المورفولوجية مثل الطول ، العرض ، الوزن ، وزن اللب ، وزن البذور ، ووزن القشره الخارجية, عدد البذور ووزن الألياف الحمراء للعينه داخل الولاية وبين الولايات المختلفة كما سجلت أعلى نسبة من البكتين (54.99٪) في عينة الدمازين ثم أمروابة (46.65٪) , الأبيض (43.93%) و نيالا(40.75%). تراوحت نسبة قيم الجلكوز بين1.32–5.32 مليجرام / 100 جرام وقيم الفركتوز و السكروز (2.33–5.07 مليجرام / 100 جرام)و(13.00–19.44 مليجرام / 100 جرام) علي التوالي. علاوة على ذلك ، كشفت هذه الدراسة عن إختلاف معنوي كبير في خصائص التوصيف الفيزيائي والبكتين والسكريات في لب ثمار التبلدي بالنسبة للمواقع المختلفة في السودان. تشير هذه النتائج بأن لب ثمار التبلدي غني بالبكتين ويمكن أن يستخدم كعامل مساعد في كثافة المشروبات ,تكوين الجل ومواد الإستحلاب.بالإضافة الي ذلك يمكن أن يحفز من نمو الكائنات الحية المفيدة مما يودي الي إستخدامة ضمن الأغذية الوظيفية.