ijcrr
Vol 04 issue 13
Category: Research
Received on:19/04/12
Revised on:11/05/12
Accepted on:09/06/12

COMPARATIVE ANALYSIS OF TWO VARIETIES OF CYPERUS ESCULENTUS TUBERS

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ABSTRACT

This study reports on the comparative analysis of two (large and small) varieties of *Cyperus esculentus* tubers and the utilization of the By-product. Proximate analysis of the tubers using standard methods showed that the large variety contains: 54.74% carbohydrate, 30% fat, 7.01% protein, 6.30% fiber and 1.95% ash while the small variety contains : 41.76% carbohydrate, 40% fat, 9.19% protein, 6.80% fiber and 2.25% ash. The mineral elements, Ca, Mg, K, Na, Fe, Zn and Cu were determined by atomic absorption spectrophotometric method. Phosphorus was assayed colourimetrically as the phosphor-molybdovanate complex at 450nm. The reducing sugar as D-glucose was also determined colorimetrically at 540nm and it was found to be362.50 and 372.50 mg/ml for the large and small varieties respectively. Starch and oil were extracted from the tubers and physicochemical properties assessed. The amylase content of the starches were 22.60 and 28.27% for the large and small varieties respectively. The small variety is richer in mg, K, Zn and phosphorus while the large variety is richer in Fe, Na and Ca. Commercial lecithin obtained as a by-product of starch extraction was utilized as an emulsifier in the body cream.

Keywords: Cyperus esculentus, proximate analysis, colourimetry

INTRODUCTION

Cyperus esculentus is sedge of the family Cyperaceae, order Cyperales or Graminales, and gene, Carex produces rhizomes from the base and bears two varieties of subterraneous spheroid tubers: large and small (with sitting diameters ranging up to 9-17mm and 4-10mm respectively), whose yellow kernels are surrounded by a brown fibrous sheath (Umerie et al. 1997). It is popularly known as “chufa sedge”, “yellow nut sedge”, tiger nut” and “earth almond”.(Ade-Omowaye, et al, 2008). The tubers are edible and rich in stored carbohydrates and fats and are available in different parts of the world such as Senegal, Ghana (Lowe and Stanfield, 1974; Gronquist, 1977; Swift, 1989) and Northern part of Nigeria (Anon 1992). In Span, it is extensively used for human consumption (Mason, 2008). The plant itself is merely a weed and the sweet tasting tubers serve only as casual masticator and no other industrial uses (Umerie and Enebeli, 1996). In complementary and traditional systems of Asian medicine, the tubers (seeds) are used as an aphrodisiac and as stimulant (Evans, 2002).

The large variety is light brown in colour while the small variety which has a darker brown colour tastes sweeter. The oil is a stable, non-drying oil and requires only degumming for purification. It is

also known to share the common features of remaining liquid at room temperature with coconut oil (Berger, 1994) the oil has a low solidification point (titre of oil) and will require no mintering to remain uniformly liquid at refrigeration temperatures, hence good for salad and cooking oils (Black, 1991, Umerie et al, 1997).

C. esclentus qualifies to be considered as an economically important crop and no more a mere weed since it can serve as a cheap source of raw material for the food and oleochemical and allied industries. There is still a dearth of studies on the full economic potentials of C. esculentus tubers, and even on the varieties to ascertain the advantages of one over the other. Therefore, the work investigates the variations of properties between the two varieties of C. esculentus tubers.

EXPERIMENTAL

Materials

Samples of *Cyperus esculentus* tubers from the local market in Awka, Anambra State, Nigeria. All other chemicals were of analytical grade.

METHODS

Preparation of Samples

Dried samples of the tubers were purchased from the local market in Awka, Anambra State Nigeria. The samples were sorted to eliminate the bad ones, milled to fine state using a Moulinex Type 276 mil and stored in a well-stopper container in a refrigerator prior to subsequent analyses.

Proximate analysis and Determination of mineral contents of Tubers

The standard procedures described by the Egan et al (1981) and AOAC methods (1975) were used for the determination of moisture, ash, fiber, fat and crude protein contents. The carbohydrate content was calculated by difference. The gross energy value of tigernut was calculated using the Atwater formula: gross energy value (kcal/100g) = (4×%carbohydrate)+ (9×%fat/oil) + (4×%crude protein). The minerals, Ca, Mg, K, Na, Fe, Zn and Cu were determined by the atomic absorption spectrophotometric methods. Phosphorous was determined by vanado-molybdate colourimetric method as phosphomolybdate complex at 450nm. Reducing sugar as D-glucose was equally assayed at 540nm using a colourimeter (Bohz 1958).

Extraction of Oil

The tubers were kilned at 50^{o}C for 24 hours after which they were milled. The granulated sample was weighed out into an extraction thimble and extracted with petroleum ether (60-80) in a soxhlet apparatus. After the extraction, the solvent was distilled off at 80^{o}C and the oil content calculated from the weight of oil and weight of the milled tuber sample from which the oil was extracted

Physic-chemical properties of oil

The acid, saponification and iodine values of the oil were determined by standard procedure described by Plummer (1987), AOCS (1960) and Glasser (2008). The free fatty acid (FFA) was calculated from the relationship given by Norris (1965): 1 unit of Acid value = 0.503% × FFA (calculated as oleic acid). The ester value was obtained by subtracting the acid value from the saponification value (Baltes, 1964).

Extraction of C. esculentus starch

The starch was extracted using wet milling method. 200g of C. esculentus tubers was weighed and steeped in a solution of potassium metabisulphite(1.22g/l of $Na_2S_2O_5$) which served as a preservative to prevent fermentation, and left over night after which the water was decanted and the tubers washed with clean water. The tubers were milled to slurry and then separated using tiny-pored sieve cloth after which the chaff was discarded and the liquor allowed standing over-night in order to settle. The floating lipid emulsion containing oil and phospholipid was carefully skimmed off into a separating funnel.

Water was then decanted and the starch deposit washed severally with water and passed through a 260-mesh sieve (fine sieving) and the suspension allowed to settle for 8h. The water was decanted

leaving behind pure starch cake, which was the sun-dried for about 24hrs and finally oven-dried at 50^{o}c for 3h and stored.

Extraction of commercial lecithin

The floating lipid emulsion containing oil and phospholipid obtained as a by-product of starch extraction was carefully skimmed off into a separating funnel where the oil fraction was removed from the phospholipid using petroleum ether (60-80^{o}C boiling range). The extraction was repeated until the solvent gave a clear solution. The phospholipid (commercial lecithin) was then transferred to a beaker, washed and dried using acetone.

Analysis of starch

Granule size was measured in iodine-stained suspensions of the starch granules at 10× and 100× magnification under an optical microscope and using a Neubauer counting chamber. The method of Chrastil (1987) was employed for the determination of the amylase content.

Cream Formulation

A body cream was formulated using commercial lecithin as an emulsifier and the result compared favourably with that of the standard in which a combination of lanolin and triethanolamine was used as the emulsifying agent.

RESULTS AND DISCUSSION

The result of comparative analysis of the varieties of C. esculentus tubers and utilization of the by-product (commercial lecithin) in the body cream formulation.

Levels of nutrients in large and small varieties of C. esculentus tubers

The low moisture levels of the two varieties of C. esculentus tubers (Table 1) remain an asset in storage and preservation of the nutrients. The tubers contain reasonable amounts of carbohydrate. They were also found to very rich in sugar reserves. This means that the tubers can conveniently serve as carbohydrate sources in brewing. Their low protein content qualifies them for use as brewing adjuncts (Umerie et al.1997). The fiber content which is a measure of cellulose and lignin content of food is high in both sources of dietary fiber whose high consumption reduces the incidence of large intestine, e.g. diverticulosis and neoplasm. The quality of food and its content of mineral elements like K, Na, Ca, P, Fe, in the varieties of C. esculentus tubers were found to be moderate. However the small variety is richer in mg, K, Zn and phosphorus, while the large variety is richer in Fe, Na, Ca and Cu

Characteristics of Oils of varieties of C. esculentus

From the result of oil analysis, (Table 2) it is obvious that the yield of oil from both species were quite high and comparable with the recorded values from some oil seeds e.g. soyabeans, cotton seed, rubber seed etc (Nerris, 1965) that are extracted industrially. This implies that extraction of the oil from the tubers especially the small variety is a viable worthwhile venture. The oils from the varieties can be classed as stable, non – drying oil as implicated by low iodine value (< 100) and low saturation. The saponification values of the oils are very high as can be seen in the Table 2 and so can be used in the formulation of soap, shampoo, polish, resin etc. the low acid values are indicative of the absence of oxidative rancidity, which prove that the oils have high shelf life.

Analysis of Starch from varieties of C. esculentus

Table 3 shows that the starch obtained from varieties of C. esculentus tubers are white in colour. The starch yield percentage of the large specie is more than that of the small specie; though both are quite high and thus profitable. From the result of the granule size determination, it is very clear that the starches are of premium quality. The high amylase contents of the starches show that they can easily complex and form strong gel.

Body cream formulation

The body cream formulated using commercial lecithin obtained from the tubers as an emulsifier in Table 4, was found to compare quite favourably with 'oil of ulay' cream in which a combination of lanolin and triethanolamine was used as the emulsifying agent in terms of consistency and pH value (Echeta 1997).

CONCLUSION

Finally, having established the fact that commercial lecithin from these tubers can give a good quality cream, cosmetologists are therefore enjoined to make use of it in body cream formulations. It was also confirmed that the small variety of C. esculentus are richer in oil content while the large vatiety are richer in starch content. However, both varieties can serve as a cheap source of raw materials for the food, oleochemical and allied industries.

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Table 1 Level of nutrients in large and small varieties of C. esculentus tubers

Proximate composition (%)	Large		Small	
Moisture	0.68		2.68	
Ash	1.95		2.25	
Crude protein	7.01		9.19	
Crude fat	30.0		40.0	
Crude fiber	6.30		6.80	
Carbohydrate	54.74		41.76	
Reducing sugar as D-glucose (mg/ml)	362.50		372.50	
Gross energy (kcal/100g)	517.00		563.80	
Minerals	(mg/I)	(mg/100g)	(mg/I)	mg/100g
	0.33	0.99	0.28	0.84
Cu	18.39	55.17	24.61	73.83
Mg	1.34	4.02	1.50	4.50
Ca	12.51	37.53	8.67	26.01
Na	5.77	17.31	4.96	14.88
Fe	86.85	260.55	117.52	352.56
K	6.11	18.33	9.09	27.27
Zn	1300	778.44	2200	1317.37
P				

Table 2 Characteristics of oils from large and small varieties of C. esculentus tubers

Parameters	Large	Small
Oil content (%)	30	40
Iodine value (g/100g)	30.46	30.52
Saponification value (mgKOH/g)	210.53	215.32
Acid value (mgKOH/g)	1.96	9.53
Free fatty acid (% as oleic acid)	0.99	4.79
Lecithin content (%)	11	13
Ester value (mgKOH/g)	208.57	205.79

Table 3 Analysis of starch from large and small varieties of C. esculentus tubers

Parameters	Large	Small
Colour	White	White
Starch yield (%)	26.79	17.61
Granule size (µm) :		
Small	3-5	3-5
Medium	6-8	6-8
Large	8-12	8-12
Amylose content (%)	22.60	28.27

Table 4 pH Values of Body creams formulated using the Emulsifiers below

Emulsifiers	pH value of cream
Lanolin + Triethanolamine	7.0
Commercial Lecithin	7.5
Commercial Lecithin + Lanolin	8.0
Commercial Lecithin + Triethanolamine	8.3
Triethanolamine	9.0
lanolin	8.5