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RESEARCH ARTICLE

PHYSICOCHEMICAL AND FUNCTIONAL CHARACTERISATION OF *DIOSCOREA BULBIFERA* L. AND *COLEUS ESCULENTUS* N. E. BR. TUBERS IN NORTH-CAMEROON

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ABSTRACT

The study aimed to investigate on the physicochemical and functional properties of tubers (*D. bulbifera* and *C. esculentus) "bugumdjigordi"* purchased from the Garoua (*Katasko* market) and Maroua (*Central* market) markets. The physical characteristics (weight, diameters and length) of tubers were measured and the physicochemical properties (dry matter, protein, starch, sugar, minerals and polyphenols) as well as the functional properties (water absorption capacity, swelling rate, solubility) of flour from tubers were analysed. From the results, Physical parameters were generally affected by the site of collection except the mass which was not affected by the collection site and species. The starch and crude protein contents showed a significant difference ($p<0.05$) with respect to site of collection and *D bulbifera* had significantly ($p<0.05$) high total and free sugars contents. The highest ($p<0.05$) total ash, calcium and iron contents was obtained with *C. esculentus*. However, *C. esculentus* from Garoua showed the higher ($p<0.05$) phosphorus content. Polyphenols, phytates were unequally distributed according to species and site and, total oxalates considering to species. Flour from *C. esculentus* had better functional properties than that of D. bulbifera except the flour density which was similar ($p>0.05$). Tubers from *C. esculentus* could be more appropriated for infants' food preparation.

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INTRODUCTION

Yams and potatoes are widely grown and consumed amongst various communities in the tropics (Sanful *et al*., 2013). Among them, *Dioscorea bulbifera* (Annonaceae) and *Coleus esculentus* (Lamiaceae) are two important tuber species originating from the tropical forest of Asia, Africa and America. These species are principally cultivated as edible tubers (Coursey, 1967; Helmfried, 1998; Allemanna, 2003). In Cameroon and particularly in the Southern part, tubers of*D. bulbifera* and *C. esculentus* are highly consumed by the population in boiled form (Westphal, 1981). In the Northern part of Cameroon (North, Far-North and Adamawa), they have been neglected by a great part of the population and grow on the fences or in surrounding of houses (Seignobos, 1988). Tubers can stay on the plant or in the soil for a long duration (05-06 months). However, during the welding period (characterized by exhaustion of food stock), these tubers are fetched as food (Allemanna, 2003; Millogo, 1996 ; Garine, 2002). The Northern part of Cameroon remains part of the country mostly affected by food insecurity issues, where nearly 615 000 persons are plagued by food insecurity each year (9). Faced with this challenge and working towards the goal of eliminating this scourge, efforts have to be made to ensure the availability of these foodstuffs, there by integrating them in the food habits of the local population. In Cameroon, particular in the Northern part of the country, despite the importance and benefits provided by these potentials tuber study concerning consumption, physicochemical and functional properties of these tubers are limited or poorly studied. Therefore, the current work is designed to contribute to a better knowledge of the food value of tubers *D. bulbifera* and *C. esculentus* in North Cameroon.

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MATERIAL AND METHODS

Plant material: Tubers of *D. bulbifera* and *C. esculentus* species were obtained in boiled form in Garoua and Maroua markets. Samples collected were brought for laboratory analysis to the food technology laboratory of Institute of Agriculture research for development (IRAD) of Garoua, North Region of Cameroon.

Selection criteria and physical weight of tubers: Physical selection or sorting had as a goal to select a homogenous population for experimentation and therefore to minimise the variations that have to do with the heterogeneous nature of the sample from the beginning. In this regard, the tubers were selected based on their weight using a sensitive scale (*Sortotorius*) of 0.001g sensitivity. 30 tubers were then randomly chosen in order to measure the following physical parameters: large diameter (cm) and the width diameter (cm) for *D. bulbifera* as well as the length (cm) and median diameter (cm) for *C. esculentus*. These parameters were measured using a foot slide (calliper), Junior Roche (France) type.

Physicochemical analysis

Determination of dry matter

The dry matter content was determined according to the 44-15A method (American Association of Cereal Chemists, 2000). Thus, 1 g of flour was weighed and dried at 105 °C in a drying oven (*MEMMERT, Deutschland*) until constant weight for about 24 h.

Determination of total ash: The total ash content was determined in conformity with the standards (Association Française de Normalisation, 1982). The principle is based on incineration of the dry matter (after the test sample from the oven at 105°C) following drying at 105°C, in a muffle furnace for 24 h at 550°C until a whitish residue is obtained.

Determination of total sugar and soluble sugar: The total sugar is extracted in 1.5N H_2SO_4 for 45 min meanwhile soluble sugar was stabilised in boiled distilled water for15 min. The sugar extracts were analysed using the 3,5-dinitrosalicylic acid (DNS)(12). In presence of sugar substance, the DNS gives a brown-red complex (3-amino 5-dinitrosalicylic acid) which shows a maximum absorption at450nm.0.25 to 1.25 ml of standard solution (glucose at 1mg/ml) was introduced into05 tubes for standardization. 1 ml of each extract was analysed. In each tube, 0.5 ml of distilled water and 0.25ml of DNS were added and maintained at 100°C for 5 min. The volume was then completed to2 ml with distilled water and the optical density read at 540 nm against a blank.

Determination of crude protein: The mineralization of the sample was done according to the Kjeldahl method (Association Française de Normalisation, 1982) and nitrogen analysed according to the method proposed by Devani *et al.* (Devani, 1989). The spectrophotometric method of nitrogen determination used, is based on the reaction of ammoniac (NH_3) with acetylacetone and formaldehyde in an aqueous medium to give a yellow complex (3,5-diacetyl-1,4-dihydrolutidine) having a maximum absorption at 412 nm. The crude protein content was obtained by multiplying the nitrogen content by the conventional factor of 6.25 (14).

Determination of starch: The starch content was determined by the Ewers modified polarimetry method (15). This method comprises of two polarimetric determinations. Firstly, the sample is hydrolysed in hydrochloric acid and the degree of rotation is measured by polarimetry. This degree of rotation is characteristic of the total asymmetric carbon compounds present in the sample. Secondly, an alcoholic extract of the sample is hydrolysed in the same conditions and the degree of rotation of polarised light is measured. This second degree of rotation is representative of the other total asymmetric carbon compounds except starch. The degree of rotation corresponding to starch is the difference between the two polarimetric measures.

Determination of polyphenols: The polyphenolic compounds were determined using the method proposed by Folin-Ciocalteu (Marigo, 1973). Extraction is done in 70% ethanol. The standard solution was0.2g/l gallic acid solution. 0.01 to 0.05 ml of standarc solution was introduced in 05 tubes to which 0.2ml of Folin-Ciocalteu reagent (mixture of phosphomolybdic and phosphotungstic acid) was added and the volume completed at 1.6ml with distilled water. The tubes were mixed and allowed to stand. 0.4 ml of 20% Na_2CO_3 was added in each tube then mixed and incubated in a water bath at 40°C for 20 min. The optical density was read at 725nm against the blank.

Determination of oxalates: The oxalates were extracted in distilled water-hydrochloric acid (6N) solution (1/19(V/V)) for 1 h in a boiling water bath. The oxalate extracts were determined after oxidation by KMnO4 (0,098N) in a hot acid medium (sulphuric acid 1 N). 95% sulphuric acid (1:4 v/v) was added in droplets until the complete dissolution of precipitate. The content of the beaker was heated to boiling point and titrated with potassium permanganate (0.05N) until colour turned to pink. After this process, filter papers are incorporated in the beaker, agitated before ending the titration.

Determination of phytates: The method was used for phytates content determination was that described by Brooks *et al.* with some modifications (2001). This consisted of determining on one hand to the total phosphorus content in the total ash and on the other hand, to the free phosphorus content in the flour. The phytates content was calculated as difference between total phosphorus and the free phosphorus multiplied by 3.552. The standard solution was phosphorus at concentration of 43.48 mg/l. 0.1 to 0.6 ml of standard solution was introduced in 06 tubes. 0.1 ml of the extract was analysed. In each of these tubes were added 0.4 ml reactive solution and the volume were completed at 5ml with distilled water. The tubes were homogenized then allowed to relax for 30 min. The optical density was read at 690 nm.

Determination of iron: The iron was determined by ultra violet absorption spectrophotometry according to Rodier (1978). The standard iron solution (0.01g/1) was prepared from a solution of 70.02 mg/l of Mohrsalt ($(NH_4)_2$, Fe $(SO_4)_2$,$6H_2O$). The prepared tubes for calibration contained 0.1 to 0.5 ml of sodium acetate 40% (w/v), 0.3 ml of ascorbic acid 1% (w/v) and1 ml of orthophenanthrolin1 %(w/v). The absorbance was read at 510 nm against the blank tube.

Determination of calcium: The calcium content was determined using the titrimetric method proposed by AFNOR (AFNOR, 1982). The method consisted of molar titration of ions $Ca^{2+}$and $Mg^{2+}$with a dissodicsalt solution of bethylenediaminetetra acetic acid (EDTA) at pH 10. The indicator used was "noir ériochrome T" (NET) which gives a depth red coloration or violet in the presence of calcium and magnesium ions.

Functional properties analysis

Water absorption capacity and solubility index: The water absorption capacity was done using the method proposed by Phillips *et al.* (1988). 1g of flour (Mo) was introduced in a tube containing 10 ml of distilled water and the total was subjected to agitation for 30 min, and then centrifuged at 3500 rpm for 30 min in a *Sigma Bioblock Compas* centrifuge. The precipitate (M_2) was recovered, weighed and conditioned in an oven pre-set at 105°C for 24h.

Flour swelling capacity: The Flour swelling capacity was determined according to the method described by Okezie and Bello (1988). 2 g of flour were weighed and introduced in a test tube and 25ml of distilled water added. The volume occupied by the sample or final volume was noted after 30 min. The swelling index was expressed in ml/100g of dry matter (DM).

Flour density: The flour density was determined using the method described by Tsague (1997). A graduated tube filled with flour and the surface smoothened to its upper limit.

Statistical analysis: The experimental design was a factorial plan of 2x2 with 2 species and 2 localities. All the measures were carried out in triplicate. Quantitative data were subjected to analysis of variance (one-way ANOVA) and comparisons were done with the Duncan's Multiple Range Test (DMRT) at 95% confidence level.All the analyses have been performed using the Statgraphics 5.0 software.

RESULTS AND DISCUSSION

Physical measurements of tubers: The mass of *D. bulbifera* tubers were significantly ($p<0.05$) higher comparatively to that of *C. esculentus* (Table 1). Concerning *D. bulbifera*, tubers from Garoua were significantly ($p<0.05$) heavy that those from Maroua. Meanwhile, the site of collection did not significantly ($p>0.05$) affect the weight of *C. esculentus* tubers. *D. bulbifera* tubers from Garoua revealed significantly ($p<0.05$) the highest big width and the lowest small width compare to tubers from Maroua. *C. esculentus* tubers from Garoua showed significantly ($p<0.05$) high length compare to that from Maroua.

However, the collection site did not affect their ($p>0.05$) diameter/width. Generally, it can be noted that, the mass, the big diameter and the small diameter of D. *bulbifera* varied according to site of collection. Meanwhile, for *C. esculentus,* only the length changed with regard to locality (site of collection). This variation observed in physical parameters between sites of collection might be explained by many factors including the soil characteristics, the climate, the agricultural practices and the tuber processing techniques (boiling).

Chemical characteristics of tubers flour

Proximate composition: Tuber samples from Garoua had a starch content (average of 76g/100g DM) significantly ($p<0.05$) lower than values registered for samples from Maroua (average of 82g/100g DM) (table 2). Values obtained are between 60 and 88 g/100g DM as reported by previous findings (Trèche, 1989) with *D. cayenensis-rotundata.* However, they seemed to be lower than values revealed by others authors (Aboubakar, 2008) for *Colocassia esculenta* which were ranged from 90 to 94g/100g DM and could be attributed to the type of specie. Also, the nitrogen rich soils cause a decrease in starch content in tubers (Trèche, 1989). This might justify the difference in starch content between tubers (flour) from Garoua and Maroua. Total sugars and free sugar indicated similar trend. In fact, *D. bulbifera* showed significantly ($p<0.05$) low content compare to *C. esculentus* independently of the site of collection (locality). Also, they were not affected ($p>0.05$) by the collection area for the same species. Previous studies recorded 13 to 15 g/100g DM as free sugars content of *Colocassia esculenta* (Aboubakar, 2008). This results seem to be higher comparatively to values obtained. The differences in free sugar content reflect the fragility of starch between the two species.

With respect to crude proteins content, although tubers are not representing a source, samples from Garoua indicated significantly ($p<0.05$) low value compare to those from Maroua. Also, for the same site of collection, there was no significant difference ($p>0.05$) between *D. bulbifera and C. esculentus.* Values obtained are similar with that reported revealed by previous findings on Cassava which were 1.5 g/100g DM (Bokanga,. 2001).

Polyphenols, phytic acid and total oxalate content: Polyphenols contents were between 369.9 ± 34.42 mg/100g DM with *D. bulbifera* from Maroua and 2795.04 ± 30.72 mg/100g DM with *C. esculentus* from Maroua (table 3). In fact, *D. bulbifera* tubers from Maroua had significantly ($P<0.05$) the lowest polyphenols content and *C. esculentus* from Maroua, significantly ($P<0.05$) the highest. Also, with *D. bulbifera* tubers, samples from Garoua indicated significantly ($P<0.05$) high value than that from Maroua and the opposite trend was observed with *C. esculentus*. Values obtained seem to be higher than 311.19 mg/100g DM obtained by Medoua with *D. Dumetorum* (Medoua, 2005). These observed variations might be due to environmental factors notably, nitrogen soil fertilisation which hinders an increase in phenolic compound (Trèche, 1989). Phytates and oxalates are known to adversely affect mineral bioavailability (Bhandari, 2004).

Phytates content of *C. esculentus* tubers from Garoua (55.79±4.43 mg/100g DM) was significantly ($P<0.05$) the highest accross all the samples and that of *D. bulbifera* tubers from Garoua (9.47±1.94 mg/100g DM), significantly ($P<0.05$) the lowest. Also, phytates content varied accordingly to the site of collection and the variety. The high concentration in *C. esculentus* from Garoua could more affect the solubility of cations in the sample thus forming complexes (Rickard, 1997). Values observed are higher than values reported with yam tubers which ranged from 0.89 mg/100g in *D. alata* (Akaba) to 4.16 mg/100g DM in *D.cayenensis* (Pure yellow flesh) (Rickard, 1997). A significant difference ($p<0.05$) in total oxalates content of tubers was observed with regard to species with *D. Bulbifera* tubers having the highest content (461.92

Table 1: Physical characteristics of *D. bulbifera* and *C. esculentus*

	D. bulbifera		*C. esculentus*	
Parameters	Garoua	Maroua	Garoua	Maroua
Mass (g)	32,86± 1,13[a]	33.62 ± 1,24[b]	22.33 ± 0,25[c]	21.78 ± 0,25[c]
Big width (cm)	3.74 ± 0,37[a]	4.46± 0,55[b]	-	-
Small width (cm)	3.64± 0,08[b]	3.22± 0,08[a]	-	-
Length (cm)	-	-	4.21 ± 0,10[a]	5.10 ± 0,10[b]
Diameter/Width (cm)	-	-	1.59 ± 0,25[a]	1.54 ± 0,27[a]

([a,b,c]):Data within the same row with the same superscript are not significantly different (p>0.05).

Table 2: Proximate composition (g/100g DM) of *D. bulbifera and C. esculentus* flours.

	Locality	Dry matter	Starch	Total sugar	Free sugar	Crudeproteins
D. bulbifera	Garoua	91.65± 0.66[a]	76.30± 0.68[a]	37.76±0.66[a]	5.66± 0.20[a]	1.12±0.04[a]
	Maroua	90.8 ± 0.64[a]	81.80± 1.83[b]	37.02± 0.38[a]	5.64± 0.23[a]	2.48±0.07[b]
C. esculentus	Garoua	91.78± 0.27[a]	76.19± 1.81[a]	44.74± 0.23[b]	7.00± 0.18[b]	1.30±0.05[a]
	Maroua	91.68± 0.36[a]	82.20±1.81[b]	43.56± 0.49[b]	7.13± 0.10[b]	2.84±0.07[b]

([a,b]):Data within the same column with the same superscript are not significantly different (p>0.05). DM: Dry Matter

Table 3: Polyphenols, phytates and oxalate contents (mg/100g DM) of *D. bulbifera* and *C. esculentus* powder

	Locality	Polyphenols	Phytates	Total oxalates
D. bulbifera	Garoua	508.61±26,04[b]	9.47±1,94[a]	461.92±0,00[b]
	Maroua	369.9±34,42[a]	19.75±4,35[b]	460.49 ±7,57[b]
C. esculentus	Garoua	1818.7 ±13,00[c]	55.79±4,43[d]	313.20 ±8,35[a]
	Maroua	2795.04±30,72[d]	24.49±3,91[c]	312.86±22,06[a]

([a,b,c,d]):Data within the same row with the same superscript are not significantly different (p>0.05);

Table 4: Total ash content (g/100g DM) and some minerals (mg/100g DM) of *D. bulbifera* and *C. esculentus* powder

	Origin	Total ash	Calcium	Iron	Phosphorous
D. bulbifera	Garoua	3.32 ± 0.50[a]	30.25 ± 7.48[a]	2.62 ± 0.02[a]	20.30 ± 0.81[b]
	Maroua	3.26 ± 0.58[a]	29.69 ± 3.03[a]	2.47 ± 0.03[a]	16.04 ± 1.40[a]
C. esculentus	Garoua	4.27 ± 0.07[b]	37.86 ± 3.45[b]	5.07 ± 0,03[b]	30.41 ± 0.73[c]
	Maroua	4.18 ± 0.41[b]	36.87 ±1.73[b]	5.09 ± 0,09[b]	20.70 ± 0.6[b]

([a,b,c]):Data within the same column with the same superscript are not significantly different (p>0.05).

Table 5: Functional properties of *D. bulbifera* and *C. esculentus*tubers flour

	Origin	Water absorption capacity	Swelling rate	Solubility index	Density
D. bulbifera	Garoua	475.66±4.47[a]	238.67±2.31[a]	25.37±0.38[a]	0.84±0.09[a]
	Maroua	447.76±19.44[a]	237.33±.062[a]	25.03±0.06[a]	0.82±0.01[a]
C. esculentus	Garoua	514.79±7.09[b]	229.33±0.31[b]	27.03±0.12[b]	0.85±0.02[a]
	Maroua	513.12±2.20[b]	228.00±4.00[b]	26.97±0.06[b]	0.83±0.07[a]

([a,b,c]):Data within the same column with the same superscript are not significantly different (p > *0.05).*

and 460.49 mg/100g DM for Garoua and Maroua sites, respectively) and *C. esculentus* tubers the lowest (313.20 and 312.86 mg/100g DM for Garoua and Maroua sites, respectively).These results is in conformity with observations of Trèche who showed that oxalates concentration varied with respect to tuber varieties (Trèche, 1989). Results obtained appear to be lower than 483-781 mg/100g, values reported by other authors (Wurzburg, 1986), but higher than 0.20-0.63 mg/100g for *C. esculentus* and *D. bulbifera* reported by (Bhandari, 2004). Oxalic acid has the capacity to link to proteins or divalent cations rendering them insoluble (William, 2006). Thus, high oxalate content in tubers could induce low digestibility of proteins and minerals.

Total ash, Calcium, iron and phosphorus content

Results in table 4 show minute levels of total ash content. The contents were 3.26 and 3.32 g/100g DM with *D. bulbifera*and,4.18 and4.27g/100g DM with *C. esculentus* respectively, for Maroua and Garoua. *D. bulbifera* variety indicated significantly ($p<0.05$) low ash content comparatively to *C. esculentus*. Also, ash content for each variety was not affected ($p>0.05$) by the locality. This low levels in total ash observed in tubers supposes that these tubers are not a real source of minerals. Low values (0.10-0.92 g/100g DM) of ash content were also found on Cameroonian yams by (Agbor-Egbe, 1985). The calcium content in tubers are in a general manner high compare to phosphorus and iron contents. *D. bulbifera* (30.25 and 29.69 from Garoua and Maroua, respectively) showed significantly ($p<0.05$) low calcium content comparatively to *C. esculentus* (37.86 and 36.87 from Garoua and Maroua, respectively). For the same species, no significant ($p>0.05$) difference was observed with respect to site of collection. In starch plants, calcium is less mobile therefore difficulty in transportation from roots to the aerial parts (Agbor-Egbe, 1995). This could justify the low calcium content in *D. bulbifera*. As observed from results, tubers are not an iron source. However, amongst the studied species, *D. bulbifera* tubers (2.47 and 2.62 mg/100g DM respectively for Maroua and Garoua) showed significantly ($p<0.05$) low iron

content. Also, the collection site did not affect ($p>0.05$) the tubers iron content. The iron content of D. *bulbifera* tubes are lower than 8.2 to 10.5 mg/100g, values found on different *D. bulbifera* samples as reported by Sanful *et al*. (2013).Values obtained (2.47-5.09 mg/100g DM) are higher comparatively to that of sweet potato which was 1.3 mg/g DM (32) and closer to 1.30-2.00 mg/100 g recorded with *Dioscorea bulbifera* tubers (Trèche, 1982). All the difference observed could be associated with the difference between varieties or species and other factors including soil characteristics and agricultural practices.

As Concerns phosphorus content, *C. esculentus* tubers from Garoua (30.41±0.73 mg/100g DM) indicated the highest ($p<0.05$) amount. However, *C. esculentus* tubers from Maroua (20.70±0.6 mg/100g DM) and *D. bulbifera* tubers from Garoua (20.30±0.81 mg/100g DM) revealed similar ($p>0.05$) values which were significantly higher ($p<0.05$) than that of*D. Bulbifera* tubers from Maroua (16.04±1.40 mg/100g DM) which was the lowest ($p<0.05$).The present values were lower than values obtained for fresh tissue of bulbifera (64.40 and 150.00 mg/100 g on wet and dry basis respectively) by Abara (2011). They are also lower compare to 37.00 and 62.15 mg/100g recorded by (1984).The variations in phosphorus content between tubers in the different localities might be due to environmental factors notably soil content in phosphates.

Functional analysis

The functional analysis has been performed on Water absorption capacity, swelling rate, solubility index and flour density. The results are presented in table 5.Water absorption capacity, the swelling rate and solubility index of flour varies with tuber species and *C. esculentus* having significantly ($p<0.05$) the highest values. *C. esculentus* flour absorbed a more water (513.12 and 514.79% respectively for Maroua and Garoua) than *D. bulbifera* (475.66 and 447.76% respectively for Garoua and Maroua). At high temperature (temperature ≥70°C), starch grains absorb water, swell and liberate their contents which are principally amylose and amylopectin. Amylose, due to its amorphous structure traps more water molecules through hydrogen association (Egbe, 1984).

Then, the observed result might be explained by the fact that *C. esculentus* starch content more amylose than *D. bulbifera* and thus will be preferable for infant food preparations. The swelling rate of flour, generally registered very high values. The flour of *C. esculentus* had significantly ($p<0.05$) high rate of swelling (237.33 and 238. 67% respectively for Maroua and Garoua) than D. *bulbifera* (228.00 and 229.33 % respectively for Maroua and Garoua).When starch grains are submitted to high temperatue (temperature ≥70°C) as in the case of cooking, the pores open and expose hydroxide group of amylopectin which absorbs water, hence swelling (Ahmed, 2005). The solubility index of flours is relatively weak. The results obtained indicate around 25% for *bulbifera* and 27% for *C. esculentus.* The insolubility of native starch could be explained by the presence of semi-crystalline organisation in starch grains as reported by Zobel (Zobel, 1984). Concerning flour density, no significant difference ($p>0.05$) was observed amongst samples. It might be justify by the same granulometry (100) of flours. The weak density registered (0.82-0.85) could be due to the presence of air bubbles between starch particles which might prevent the water penetration. However, the porosity between the starch granules could be one of the factors that prevent water infiltration (Zobel, 1984).

Conclusion

The study whose main goal was to study the physicochemical and functional properties of tubers species *D. bulbifera* and *C. esculentus,* revealed that the mass is not affected ($P>0.05$) by the tubers' species and collection site. Other physical parameters depend on the collection site except the diameter/width of C. esculentus. Tubers from Maroua have more ($P<0.05$) starch and crude proteins content while *C. esculentus* has more ($P<0.05$) total and free sugars than *D bulbifera*. Tubers from *C. esculentus* has high ($p<0.05$) total ash, calcium and iron contents than *D. bulbifera*. However, that of *C. esculentus* from Garoua indicate the higher ($p<0.05$) phosphorus content. Total oxalates are affected by the tubers species and *D. bulbifera* has the higher ($P<0.05$) content. However, polyphenols and phytatesvarie according to the tubers and the site of collection (*C. esculentus* from Maroua and from Garoua has high polyphenols and phytates contents, respectively). The results on functional properties indicate that flour from *C. esculentus* tubers has better ($p<0.05$) water absorption capacity, swelling rate and solubility index than *D. bulbifera.* For future work, it is envisaged to conduct the depth study of the nutritional properties of powder produce from tubers for their incorporation into infant nutrition and evaluate the cost of production geared towards artisanal production.

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