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Recipes and Proximate Composition of Some Traditional African Nightshade Dishes Consumed in the North West Region of Cameroon

Njong Clementine Endam[1], Feumba Romelle Dibanda[2], Ejoh Richard Aba[1],

[1]Department of Nutrition Food and Bioresource Technology, College of Technology,

P.O Box 39, University of Bamenda, Bambili, Cameroon

[2]Department of Biochemistry and Molecular Biology, Faculty of Science,

P.O Box 63, University of Buea, Cameroon

Corresponding Author's E-mail: clemseybanks@yahoo.com

Abstract

Purpose: The objective of this study was to describe the methods of preparation of African nightshade (*Solanum scabrum*) and to determine the proximate composition of the African nightshade dishes consumed by Cameroonians living in Boyo, Momo, Mezam and Menchum divisions of the North West Region.

Methodology: The African nightshade used in the preparation of all the 25 recipes was purchased from the same farmer at kedjom ketingoh in Mezam division and the dishes were prepared at the laboratory of the College of Technonolgy – University of Bamenda (COLTECH-UBa).The 25 African nightshade dishes were then transferred to the Nutrition Centre for Research (CRAN) of the Ministry of Scientific Research and Innovation Cameroon for proximate composition determination. The contents in dry matter, ash, crude proteins, total lipids, crude fibres and total sugars were determined by standard AOAC methods.

Findings: The African nightshade dishes consumed are prepared from leguminous seeds : (egusi seeds and groundnut seeds), fluted pumpkin seeds, tomatoes, Irish potatoes and palm oil. The results obtained are expressed in percentage DW for ash, dry matter, proteins, lipids, crude fibres and Total sugars. The dry matter content ranges from (90.130g/100gDW to 95.626g/100gDW); ash content (9.301g/100g to 18.548g/100g), crude protein (16.7g/100g DW to 22.8g/100g DW), total lipid (7.50g/100g DW to 54.49g/100g DW), crude fibre (6.70g/100g to 20.10g/100g), Total sugars (0.64g/100g to 9.14g/100g). This study also reveals that a higher consumption of dishes made from leguminous seeds: egusi seeds, and groundnuts seeds such as "Scrubbed nightshade leaves boiled in *egusi*", "Seasoned *Mbas a sekoyn",* "Seasoned *Mbas a mtsong mbi*" and "English style with groundnuts" and low consumption of their complements will lead to a good nutritional balance. The study further reveals that the African nightshade dishes are good sources of proteins, crude fibres and poor sources of Carbohydrates.

Unique Contribution to Theory, Policy and Practice: This study provided information on: the nutrient composition of African nightshade dishes consumed in the North West Region of Cameroon; nutritional data of this species of vegetable that will be useful for nutrition

education as a means to improve the nutritional status of the population and also made available documented food composition database for reference by consumers, dieticians and researchers.

Keywords: *Recipes, African nightshade dishes, proximate composition, North west, Cameroon.*

INTRODUCTION

Malnutrition, in the forms of protein–energy malnutrition and micronutrient deficiencies, are major health burden in developing countries (FAO, 2010). Malnutrition, in addition to non-communicable diseases (NCDs) bear a combined burden of disease for every country in the world, no country is immune (UNSCN, 2018). Malnutrition is the consequence of a range of factors that are often related to poor food quality, insufficient food intake, and severe infectious diseases, or most times, combinations of the three (Muller & Krawinke, 2005). It is consequently the most important risk factor for the burden of disease in developing countries (Black, 2003). It is the direct cause of about 300,000 deaths per year and is indirectly responsible for about half of all deaths in young children (Black *et al*., 2003).

In Cameroon, approximately 45,000 children die each year due to malnutrition (UNICEF Cameroon, 2009) as well as NCDs accounts for 31% deaths annually (Mapa –Tassou *et al*., 2017). Malnutrition and NCDs are both linked to poor quality diets**.** Despite sufficient quantity and diversity of food resources in Cameroon, malnutrition and NCDS rates keep rising, (EDS-MICS, 2011). One of the contributing factors to malnutrition is the lack of nutritional and composition information of foods eaten in a given area. Because eating habits differ from one region to another n Cameroon, one of the effective approaches to fight against malnutrition is to make an inventory of food ready for consumption in each of the 10 regions of Cameroon and investigate their nutritional values (Ponka *et al*., 2016).

In Cameroon, especially in the Northwest, garden huckleberry (African nightshade) locally called *jamajama* is one of the most popular vegetables, preferably consumed (Fontem & schippers, 2004; Asongwe *et al*., 2014) and to a lesser extent in the Southwest, Littoral and Center regions (Schippers, 1998). The young shoots and leaves of the plant are the main components of the Cameroonian *jamajama* soup (Njong *et al*., 2022). The leaves are used alone or together with okra (*Abelmoschus caillei*), dika nuts (*Irvingia gabonensis*), or *egusi* (some *Cucurbitaceae*) seeds (Stevels, 1990) and serve as a complement to most cereals and tubers. Some studies in and out of Cameroon have shown that the leaves of raw African nightshade are rich in proteins, carbohydrates, dietary fibres (Ngobidi *et al*., 2016; Akubugwo *et al*., 2007; Kamga *et al*., 2013). The methods of production, processing, and preparation of garden huckleberry (African nightshade) have a direct bearing on the nutritional composition and bioavailability. These methods vary within and without different ethnic groups in Cameroon (Njong *et al*., 2022).

Cameroon has an extremely mixed population consisting of so many diverse ethnic groups (Wikipedia, 2009). In Cameroon, there have been limited studies to establish recipes of dishes

prepared using the African nightshade vegetable (Chagomoka *et al*., 2014). Moreover, the nutritional value of the vegetable prepared in different forms by different ethnic groups have not been well investigated as these different forms when consumed may affect the quantity and quality of nutrients consumed. In this regard, some works were done on dishes of Littoral, Centre, and West regions of Cameroon (Ponka *et al.*, 2005; Sharma *et al*., 2007; Ejoh *et al*., 2007; Djuikwo *et al.*, 2015; Kana *et al*., 2008; Fokou *et al.*, 2009; Ponka *et al.*, 2016) and none was done in the North West Region. However, nutritional data and information on traditional dishes from the Northwest Region of Cameroon are limited. Thus, the current study aims to establish traditional recipes of African nightshade dishes consumed in the Northwest Region of Cameroon, and to determine their proximate (Ash, protein, total lipids, carbohydrates and crude fibre) compositions.

MATERIALS AND METHODS

Survey and Sampling

A survey was carried out to identify and establish traditional/local recipes of African nightshade dishes in five ethnic groups of four divisions of the North West Region of Cameroon viz: Momo, Mezam, Boyo, and Menchum divisions. Hence 600 households were interviewed and examined, 150 for each division. During the household visits, concise observations and measurements were made to identify the type and quantity of ingredients (groundnuts, fluted pumpkin seeds, *egusi,* red palm oil, refined vegetable oil, tomatoes, onions and Irish potatoes) as well as the chronology of operations used to prepare the dishes and the time of preparation.

Samples Pretreatment and Preparation

Ingredients Procurement

The African nightshade used in the preparation of all the recipes identified was purchased from the same farmer at Kedjom Ketingoh in Mezam Division. The groundnuts, fluted pumpkin seeds, and *egusi* were the *country type* purchased from Guzang market in Batibo in Momo Division. Red palm oil was purchased from Widikum in Momo Division and refined vegetable oil (star oil) was purchased from the Bamenda main market in Mezam Division.

Sample Pretreatments

The purchased African nightshade vegetable was de-stalked, and the leaves were washed with distilled water to remove dirt. Exactly 0.5kg of the vegetable sample was weighed and blanched in 1L of boiling water for 2 minutes and immersed in ice-cold water for 2 minutes to minimize premature cooking process.

Preparation of Traditional African Nightshade Dishes

Twenty-five African nightshade recipes identified from the survey were prepared at the laboratory of Food Science and Technology of the College of Technology, University of Bamenda, Cameroon to obtain 25 African nightshade traditional dishes.

Chemical Analysis

Dry Matter Determination

The dry matter of the samples (25 African nightshade dishes) in triplicates were determined by method described by (Horwitz, 2000) Drying containers were prepared by forming moulds using aluminium foil which were then placed in the drying oven at 105^{O}Cuntil constant weight for 1hr. The containers were then cooled in a desiccator for about 30 mins and weighed (**M_1**). A representative portion of each sample was taken using a spatula into the containers in triplicate of each sample and weighed (**M_2**). The weighed samples were then put back into the oven using tongs and allowed for 24 hrs. After which the samples were removed and placed in a desicator for 30mins and later weighed to obtain **M_3**.

Determination of Ash Content

The ash content of the samples in triplicates was determined by methods described by (AFNOR, 1982).Marked porcelain crucibles were heated in a furnace at 500 - 550ºC for 30min.The temperature of the furnace was lowered to180ºC and the crucibles were transferred into a desiccator, cooled for 30 min and weighed (**M_1**).Representative portions of the samples were weighed in triplicates into the pre-weighed crucible dish to obtain (**M_2**). The weighed samples were then incinerated in the furnace at 500-550ºC until the residues were uniformly white or nearly white for 24 hrs. The temperature of the furnace was decreased to 180ºC and the crucibles were transferred into a desiccator, cooled for 30 min and weighed (**M_3**).

Determination of Total Lipids

The total lipids of the samples (25 nightshade dishes) in triplicates were determined by method described by (Horwitz, 2000). About 200 mL of ether (hexane) of boiling point of 40-60ºC is placed in the flask. Clean and dry filter papers are weighed (**M_1**) and unknown masses of the samples in triplicates were wrapped in the filter papers and weighed **(M_2**) and then placed into a thimble and the thimble was plugged with cotton wool. The thimble with content was placed into the extractor; the ether in the flask was then heated. As the ether vapour reaches the condenser through the side arm of the extractor, it condenses to liquid form and drop back into the sample in the thimble, the ether soluble substances are dissolved and are carried into solution through the siphon tube back into the flask. The extraction continues for at least 6 hrs. The thimble was removed and most of the solvent was distilled from the flask into the extractor. The flask was then disconnected and the samples wrapped in filter papers are then placed in an oven at 65^{o}C for 4hrs, cooled in desiccator and weighed (**M_3**).

Determination of Crude Fibre

To obtain crude fibre from the samples, the determination was done by methods described by Weende (Wolff, 1968). This method consists of treating the samples with sulphuric acid at boiling point followed by sodium hydroxide. The residue obtained is then dried, ashed and weighed. A weighed amount of the fat-free material (samples) in duplicates denoted **P_E** were transferred into a beaker and 15ml of pre-heated 1.25% H2SO4 was added and the solution was gently boiled for about 30mins. The buckner flask funnel fitted with whatman filter was pre-heated by pouring hot water into the funnel. The boiled acid sample mixture was then

filtered hot through the funnel under sufficient suction. The residue was then washed several times with boiling water (until the residue was neutral to litmus paper) and transferred back into the beaker. Then 15ml of pre-heated 1.25% NaOH was added and boiled for another 30mins. Filtered under suction and washed thoroughly with hot water and twice with acetone. The residue was dried at 105^{o}C for about 24hrs and weighed (**P1**). The residue was transferred into a crucible and placed in muffle furnace (550 ^{o}C) and ashed for 3hrs, then cooled in desiccator and weighed (**P2**).

Determination of Total Sugars

Total sugars was estimated by spectrophotometry using methods described by (Fischer & Stein, 1961) at a wavelength of 540nm. An amount of 2.5 mL of 1.5N sulphuric acid was introduced into a test tube. A weighed amount of 0.1 g of sample (25 African nightshade recipes each) was introduced into the test tube containing the sulphuric acid. The 25 different mixtures were then put into a water bath with boiling water for 45mins. They were then cooled at room temperature. Into each test tube 5mL of 70% ethanol, 0.5 mL of $ZnSO_4$ and 0.5mL of potassium ferrocyanide were added. The mixture was then filtered through a filter paper into a 25mL volumetric flask and the filtrate level was completed to 25mL with distilled water.

Determination of Crude Protein Content

Samples were mineralized by the Kjeldahl method as described by (AFNOR, 1982) and nitrogen was quantified using the reaction of HANTZSCH as described by (Devani *et al*., 1989). An amount of 0.5g of the sample (25 African night shade recipes each) was introduced inside a mineralization tube and 5mL of sulphuric acid added. The samples were heated for 2hrs to obtain a clear solution and then left to cool. The mineralized samples were then transferred into plastic containers and the tubes rinsed with 40mL of distilled water and added into the samples in the plastic containers to give a total sample volume of 50mL.A small quantity of the sample (0.4mL) in triplicates was pipette with 0.6mL of sodium acetate and 0.8ml of reactive solution(acetyl acetone and anhydrous formaldehyde).The samples were immersed in a hot water bath at 97.5^{o}C for 15mins and then cooled in cold water after which 3.2mL of distilled water was added. A blank was prepared in a similar way but excluding the sample. Absorbance was read at 412nm.

Statistical Analysis

Chemical analyses of the samples were carried out in triplicate. Data on the proximate composition of the 25 African nightshade dishes were evaluated using a one-way analysis of variance using the statistical package SPSS 20.0. Differences between samples were determined according to the Fischer test and considered to be significant when $P < 0.05$.

RESULTS AND DISCUSSION

Ethno African Nightshade Preparations

A survey of the different methods of preparing African nightshade was conducted to identify ethno recipes of African nightshade commonly consumed in the Northwest region of

Cameroon. A total of 25 ethno recipes of African nightshade were collected. The ethnic names, common names of the dish, main ingredients, and their proportions are listed in table 1. The ethnic preparations of African nightshade commonly consumed in the Northwest region of Cameroon are prepared from seeds of *egusi* and fluted pumpkin, tomatoes, onions, groundnuts, crude palm oil, red palm oil, and Irish potatoes.

Table 1: Recipes and Traditional names of the African nightshade Dishes

Recipe Number	Local/Tradition Names Of African Nightshade Dishes	Main Ingredients	Duration of Preparation (Min)
1	African nightshade stir fried in tomatoes and onions	500g nightshade, onion 75g, tomatoes 100g , Red palm oil 125mL, Water 250mL,2 red fresh pepper corns	30
2	*Mbep Tarti*	500g nightshade, red palm oil 31mL, Water 250mL, 2 red fresh pepper corns	30
3	*Sautee* Nightshade Leaves	500g nightshade, onion 75g (optional), Red palm oil 62mL, Water 250mL, 2 red fresh pepper corns	25
4	All in one pot nightshade	500g nightshade, onion, red palm oil 62mL, Water 125mL, 2 red fresh pepper corns	25
5	*mbep woyih*	500g nightshade, red palm oil 31mL, Water 125mL, 2 red fresh pepper corns, salt 10g	25
6	scrubbed nightshade leaves boiled in *egusi*	500g nightshade, red palm oil 31mL, Water 1L, *Egusi* ground 100g, 2 red fresh pepper corns salt 10g	45
7	Nightshade leaves boiled with Irish potatoes	500g nightshade, red palm oil 31mL, Water 500mL, Irish potatoes 1 kg, 3 red fresh pepper corns	35
8	Raw sliced nightshade leaves cooked in fried onions and	500g nightshade, red palm oil 31mL, Water 180mL, Onions 60g, Groundnut's ground 100g, 2 red fresh pepper corns	30

	ground groundnuts		
9	Nightshade leaves in lumpy *egusi*	500g nightshade, red palm oil 31mL, Water 660mL, egusi ground 100g, 2 red fresh pepper corns	40
10	Raw sliced nightshade leaves fried in tomatoes	500g nightshade, tomatoes 150g, red palm oil 62mL, Water 1.125 L, 2 red fresh pepper corns	30
11	Nightshade leaves in ground fluted pumpkin seeds	500g nightshade, Fresh fluted pumpkin seeds ground 150g , Red palm oil 62mL, Water 375mL , 2 red fresh pepper corns	40
12	*Mbep Tarti Gu Nang*	500g nightshade, 1500g cocoyam, red palm oil 125mL, Water 1L, 4 red fresh pepper corns	30
13	*Mbeup Cerie*	500g nightshade, red palm oil 31 mL, Water 125 mL, Handful of fresh green pepper corns	30
14	*Mpoub*	500g nightshade, red palm oil 31 mL, Water 250 mL, 4 fresh red pepper corns	25
15	*Basifhei*	500g nightshade, red palm oil 31 mL, Water 125 mL	25
16	*Mbas a sekoyn*	500g nightshade, *Egusi* ground 150g, Water 1L	40
17	*Mbas a mtsong mbi*	500g nightshade, Groundnut's ground 150g, Water 1L	40
18	Seasoned *Mbas a sekoyn*	500g nightshade, *Egusi* ground 150g, Water 1L, 2 pepper corns	40
19	Seasoned *Mbas a mtsong mbi*	500g nightshade, Groundnut ground 150g, Water 1L, 2 pepper corns	40
20	*Mbusa*	500g nightshade, Onion 75g, Tomatoes 100g, Red palm oil 125mL, Water 250mL , 2 red fresh pepper corns	20

21	*Mborueh*	500g nightshade, red palm oil 31mL (optional), Water 125mL, 2 red fresh pepper corns	25
22	*Mbep Tarti ga mowot whow*	500g nightshade, Raw palm oil 31mL, Water 250mL, 3 red fresh pepper corns	25
23	unsqueezed nightshade fried in tomatoes	500g nightshade, Tomatoes 100g, red palm oil 31mL, Water 250mL, 2 red fresh pepper corns	35
24	English style with *egusi*	500g nightshade, Tomatoes 150g, Onion 50g, Refined palm oil 31mL, Ground *egusi* 100g, Water 250mL, 2 red fresh pepper corns	40
25	English style with groundnuts	500g nightshade, Tomatoes 150g ,Onion 50g, Refined palm oil 31mL, Ground groundnut 100g, Water 250mL, 2 red fresh pepper corns	50

African nightshade stir-fried in tomatoes and onions This is African nightshade fried in heated red palm oil with tomatoes and onions.

***Mbep Tarti*: This** is nightshade that is boiled, squeezed, sliced, and mixed in unheated red palm oil in a wooden mortar using the fingers.

***Sauteed* Nightshade Leaves:** This is boiled nightshade stir-fried with onions in heated red palm oil. This is otherwise known as sautéed nightshade dish.

All in one pot African nightshade: This is nightshade sorted washed and cooked in red palm oil. Also known as *all in one pot* because it is not squeezed nor removed from the pot after boiling.

***Mbep Woyih:* T**his is nightshade scrubbed with the palms before boiling all in one pot in red palm oil.

Scrubbed Nightshade Leaves Boiled in *Egusi:* This is one in which the nightshade is first scrubbed with salt, rinsed, and squeezed, and then subsequently fried in ground egusi in heated red palm oil.

Nightshade leaves boiled with Irish potatoes:This is nightshade cooked together with peeled Irish potatoes in red palm oil.

Raw sliced nightshade leaves cooked in fried onions and ground groundnuts: This is one in which the nightshade is first of all sliced raw and then cooked in fried onions and ground groundnuts in heated red palm oil.

Nightshade leaves in lumpy *egusi:* This is one in which boiled, squeezed, and sliced nightshade is cooked in boiling ground egusi that has formed lumps.

Raw sliced nightshade leaves fried in tomatoes: This is one in which the nightshade is sliced raw and then blanched after which it is fried in tomatoes in heated red palm oil.

Nightshade leaves in ground fluted pumpkin seeds: Nightshade boiled, squeezed, and sliced is cooked in boiling ground fluted pumpkin seeds in red palm oil.

Mbep Tarti Gu Nang: This is one in which the nightshade vegetable is cooked by steam from boiling cocoyam lined with plantain leaves. The vegetable is squeezed, sliced, and mixed with fingers with red palm oil in a wooden mortar in ground pepper, salt and Maggi.

Mbeup Cerie:The nightshade vegetable is sliced raw just like eru and cooked in very little water in red palm oil. The dish is served with pepper made separately with a variety of spices. This recipe is otherwise known as the *Widikum country style.*

Mpoub: Pepper is cut into halves and thrown on the washed non-sliced nightshade vegetable which is then boiled in a pot in red palm oil with all seasonings and stirred occasionally only with a wooden spoon.

***Basifhei*:** Sorted and washed nightshade is cooked in little water and little red palm oil with no salt, no Maggi, and no pepper. This is typical of the Kom people and is known as the *Kom country style.*

Mbas a sekoyn: This is one in which the nightshade vegetable is boiled with ground-soaked egusi on different portions of the vegetable with no seasonings. This is typical of the Wum culture.

Mbas a mtsong mbi:This is one in which the nightshade vegetable is boiled with ground soaked groundnuts on different portions of the vegetable with no seasonings. This is typical of the Wum culture.

Seasoned *Mbas a sekoyn:* This is one in which the nightshade vegetable is boiled with ground-soaked egusi on different portions of the vegetable with seasonings.

Seasoned *Mbas a mtsong:* This is one in which the nightshade vegetable is boiled with ground-soaked groundnuts and on different portions of the vegetable with seasonings.

Mbusa: This is sorted, and washed nightshade vegetables cooked all in one pot with sliced tomatoes and onions with seasonings and red palm oil. This recipe was common among the Tikari people.

Mborueh: This is one in which the nightshade vegetable is boiled to be partially ready and then strained and seasoned with salt and maggi. Red palm oil may or may not be added and served with A*chu*. This is the *Bafut country style.*

Mbep Tarti ga mowot whow

The vegetable is boiled and seasoned with ground pepper, salt, and Maggi in a wooden mortar and mixed in crude palm oil using fingers.

unsqueezed nightshade fried in tomatoes: The nightshade vegetable is boiled but not squeezed and fried in tomatoes in heated red palm oil.

English style with *egusi:* This is one in which the nightshade vegetable is boiled, squeezed, sliced, and then fried in tomatoes in heated vegetable oil with ground egusi.

English style with groundnuts: This is one in which the nightshade vegetable is boiled, squeezed, sliced, and then fried in tomatoes in heated vegetable oil with ground groundnuts.

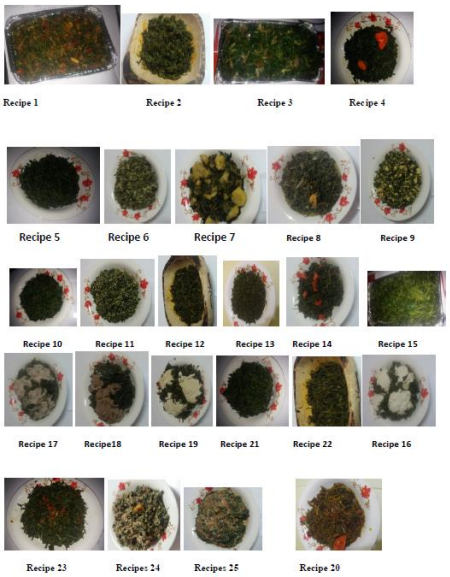

Fig 1. African Nightshade Dishes from the North West Region of Cameroon

Table 2: Ash content of the 25 African nightshade Dishes

Recipe number	African nightshade Dishes	Ash (%/100g)
1	African nightshade stir fried in tomatoes and onions	10.098 ± 0.218^{h}
2	*Mbep Tarti*	14.752 ± 0.130^{lm}
3	*Sautee* Nightshade Leaves	11.247 ± 0.077^{i}
4	All in one pot nightshade	14.109 ± 0.475^{jkl}
5	*Mbep woyih*	9.957 ± 0.272^{h}
6	Scrubbed nightshade leaves boiled in *egusi*	7.789 ± 0.170^{ef}
7	Nightshade leaves boiled with Irish potatoes	7.854 ± 0.230^{ef}
8	Raw sliced nightshade leaves cooked in fried onions and ground groundnuts	8.508 ± 0.079^{fg}
9	Nightshade leaves in lumpy *egusi*	5.045 ± 0.368^{b}

10	Raw sliced nightshade leaves fried in tomatoes	8.643 ±1.163^{fg}
11	Nightshade leaves in ground fluted pumpkin seeds	14.868±0.229^{lm}
12	*Mbep Tarti Gu Nang*	13.649±0.520^{jk}
13	*Mbeup Cerie*	13.635±0.408^{jk}
14	*Mpoub*	14.393±0.888^{kl}
15	*Basifhei*	7.183±0.244^{de}
16	*Mbas a sekoyn*	5.643±0.112^{bc}
17	*Mbas a mtsong mbi*	4.966±1.480^{b}
18	Seasoned *Mbas a sekoyn*	9.811±0.041^{h}
19	Seasoned *Mbas a mtsong mbi*	9.301±0.259^{gh}
20	*Mbusa*	2.353±0.446^{a}
21	*Mborueh*	15.659±0.191^{m}
22	*Mbep Tarti ga mowot whow*	18.548±1.456^{n}
23	Unsqueezed nightshade fried in tomatoes	13.257±0.628^{j}
24	English style with *egusi*	6.551±1.010^{cd}
25	English style with groundnuts	7.680±1.003^{ef}

Mean±SE values within the same column followed by the same superscripts are not significantly different at α=0.05, one-way ANOVA, 95% confidence level, Fischer LSD.

Table 3 : Dry matter content of the 25 African nightshade Dishes

Recipe number	African nightshade Dishes	Dry matter (%/100g)
1	African nightshade stir fried in tomatoes and onions	90.130±0.324^{a}
2	*Mbep Tarti*	95.626±0.503^{l}
3	*Sautee* Nightshade Leaves	92.138±0.210^{bcd}
4	All in one pot nightshade	94.776±0.133^{ijkl}
5	*Mbep woyih*	93.302±0.253^{defgh}
6	Scrubbed nightshade leaves boiled in *egusi*	94.941±0177^{jkl}
7	Nightshade leaves boiled with Irish potatoes	92.806±0.108^{cdef}
8	Raw sliced nightshade leaves cooked in fried onions and ground groundnuts	94.040±0.126^{efghij}
9	Nightshade leaves in lumpy *egusi*	95.028±0.479^{jkl}
10	Raw sliced nightshade leaves fried in tomatoes	94.756±0.581^{ijkl}
11	Nightshade leaves in ground fluted pumpkin seeds	94.194±0.620^{fghijk}
12	*Mbep Tarti Gu Nang*	95.561±0.648^{kl}
13	*Mbeup Cerie*	94.202±0.461^{fghijk}
14	*Mpoub*	90.869±3.547^{ab}
15	*Basifhei*	94.353±1.014^{ghijkl}
16	*Mbas a sekoyn*	94.681±0.210^{hijkl}

17	*Mbas a mtsong mbi*	93.409±0.548^{defghi}
18	Seasoned *Mbas a sekoyn*	92.636±0.616^{cde}
19	Seasoned *Mbas a mtsong mbi*	92.966±0.306^{cdefg}
20	*Mbusa*	91.600±0.510^{bc}
21	*Mborueh*	93.935±1.040^{efghij}
22	*Mbep Tarti ga mowot whow*	95.011±0.502^{jkl}
23	Unsqueezed nightshade fried in tomatoes	93.301±0.568^{defgh}
24	English style with *egusi*	93.649±0.078^{efghij}
25	English style with groundnuts	93.314±0.067^{defgh}

Mean±SE values within the same column followed by the same superscripts are not significantly different at α=0.05, one-way ANOVA, 95% confidence level, Fischer LSD.

Table 4 : Crude Fibre Contents of the 25 African nightshade Dishes

Recipe number	African nightshade Dishes	Crude fibre (g/100gDW)
1	African nightshade stir fried in tomatoes and onions	11.21±0.89^{bcefg}
2	*Mbep Tarti*	12.17±0.18^{efgh}
3	*Sautee* Nightshade Leaves	17.72±2.10^{jklm}
4	All in one pot nightshade	12.27±1.24^{efgh}
5	*Mbep woyih*	15.46±5.39^{hijkl}
6	Scrubbed nightshade leaves boiled in *egusi*	11.58±3.83^{cdefgh}
7	Nightshade leaves boiled with Irish potatoes	7.98±0.22^{abcd}
8	Raw sliced nightshade leaves cooked in fried onions and ground groundnuts	12.21±2.91^{efgh}
9	Nightshade leaves in lumpy *egusi*	9.38±1.08^{abcde}
10	Raw sliced nightshade leaves fried in tomatoes	14.79±1.27^{ghijk}
11	Nightshade leaves in ground fluted pumpkin seeds	8.41±1.44^{abcde}
12	*Mbep Tarti Gu Nang*	13.87±3.65^{fghijk}
13	*Mbeup Cerie*	10.23±0.89^{abcdef}

14	*Mpoub*	13.69±0.80^{fghij}
15	*Basifhei*	17.95±1.52^{klm}
16	*Mbas a sekoyn*	6.70±0.16^{a}
17	*Mbas a mtsong mbi*	7.06±2.62^{a}
18	Seasoned *Mbas a sekoyn*	19.25±0.09^{lm}
19	Seasoned *Mbas a mtsong mbi*	14.46±2.00^{ghijk}
20	*Mbusa*	20.10±1.02^{m}
21	*Mborueh*	16.48±1.05^{ijklm}
22	*Mbep Tarti ga mowot whow*	12.08±1.60^{defgh}
23	Unsqueezed nightshade fried in tomatoes	12.47±1.93^{efghi}
24	English style with *egusi*	7.45±0.22^{abc}
25	English style with groundnuts	7.34±0.44^{ab}

Mean±SE values within the same column followed by the same superscripts are not significantly different at α=0.05, one-way ANOVA, 95% confidence level, Fischer LSD.

Table 5 : Total Sugars Contents of the 25 African nightshade Dishes

Recipe number	**African nightshade Dishes**	**Total Sugars (g/100g DW)**
1	African nightshade stir fried in tomatoes and onions	3.882±1.596^{efgh}
2	*Mbep Tarti*	2.853±1.025^{bcdefgh}
3	*Sautee* Nightshade Leaves	1.674±0.111^{ab}
4	All in one pot nightshade	3.379±0.677^{cdefgh}
5	*Mbep woyih*	3.306±0.397^{bcdefgh}
6	Scrubbed nightshade leaves boiled in *egusi*	2.499±0.541^{bcdef}

7	Nightshade leaves boiled with Irish potatoes	9.139±0.726^{i}
8	Raw sliced nightshade leaves cooked in fried onions and ground groundnuts	4.163±1.151^{fgh}
9	Nightshade leaves in lumpy *egusi*	2.309±0.757^{abcde}
10	Raw sliced nightshade leaves fried in tomatoes	3.192±1.173^{bcdefgh}
11	Nightshade leaves in ground fluted pumpkin seeds	2.959±0.893^{bcdefgh}
12	*Mbep Tarti Gu Nang*	3.352±1.707^{bcdefgh}
13	*Mbeup Cerie*	2.833±0.681^{bcdefg}
14	*Mpoub*	4.549±0.222^{h}
15	*Basifhei*	4.275±1.861^{gh}
16	*Mbas a sekoyn*	1.879±0.188^{abc}
17	*Mbas a mtsong mbi*	1.968±0.220^{abc}
18	Seasoned *Mbas a sekoyn*	0.640±0.293^{a}
19	Seasoned *Mbas a mtsong mbi*	2.169±0.221^{abcd}
20	*Mbusa*	2.137±1.028^{abcd}
21	*Mborueh*	2.905±0.895^{bcdefgh}
22	*Mbep Tarti ga mowot whow*	2.809±1.298^{bcdefg}
23	Unsqueezed nightshade fried in tomatoes	3.687±1.270^{defgh}
24	English style with *egusi*	3.230±2.311^{bcdefgh}
25	English style with groundnuts	1.780±0.220^{abc}

Mean±SE values within the same column followed by the same superscripts are not significantly different at α=0.05, one-way ANOVA, 95% confidence level, Fischer LSD.

Table 6 : Total Lipid Contents of the 25 African nightshade Dishes

Recipe number	African nightshade Dishes	Total Lipids (%/100gDW)
1	African nightshade stir fried in tomatoes and onions	34.012 ± 2.28^{def}
2	*Mbep Tarti*	42.62 ± 1.14^{jl}
3	*Sautee* Nightshade Leaves	30.23 ± 1.62^{cd}
4	All in one pot nightshade	35.87 ± 2.09^{fgh}
5	*Mbep woyih*	41.05 ± 3.66^{ijk}
6	Scrubbed nightshade leaves boiled in *egusi*	34.18 ± 1.75^{defh}
7	Nightshade leaves boiled with Irish potatoes	7.50 ± 1.22^{a}
8	Raw sliced nightshade leaves cooked in fried onions and ground groundnuts	34.47 ± 0.68^{efh}
9	Nightshade leaves in lumpy *egusi*	54.49 ± 1.39^{n}
10	Raw sliced nightshade leaves fried in tomatoes	38.33 ± 0.74^{ghi}
11	Nightshade leaves in ground fluted pumpkin seeds	42.91 ± 6.09^{jkl}
12	*Mbep Tarti Gu Nang*	28.62 ± 3.60^{c}
13	*Mbeup Cerie*	29.02 ± 0.36^{c}
14	*Mpoub*	46.13 ± 2.45^{lm}
15	*Basifhei*	23.60 ± 0.14^{b}
16	*Mbas a sekoyn*	47.59 ± 3.98^{m}
17	*Mbas a mtsong mbi*	35.14 ± 1.26^{efgh}
18	Seasoned *Mbas a sekoyn*	38.65 ± 0.50^{gik}
19	Seasoned *Mbas a mtsong mbi*	31.77 ± 0.02^{cde}
20	*Mbusa*	31.35 ± 3.22^{cde}
21	*Mborueh*	21.33 ± 1.40^{b}
22	*Mbep Tarti ga mowot whow*	21.70 ± 0.77^{b}
23	Unsqueezed nightshade fried in tomatoes	38.40 ± 0.90^{ghi}
24	English style with *egusi*	38.27 ± 2.95^{gi}
25	English style with groundnuts	36.13 ± 0.81^{fgh}

Mean±SE values within the same column followed by the same superscripts are not significantly different at α=0.05, one-way ANOVA, 95% confidence level, Fischer LSD.

Table 7 : Crude Protein Contents of the 25 African nightshade Dishes

Recipe number	African nightshade Dishes	Crude Protein (g/100g DW)
1	African nightshade stir fried in tomatoes and onions	18.621 ± 0.094^{abc}
2	*Mbep Tarti*	18.729 ± 0.560^{bc}
3	*Sautee* Nightshade Leaves	18.587 ± 0.082^{abc}
4	All in one pot nightshade	19.564 ± 0.387^{cd}
5	*Mbep woyih*	18.557 ± 0.430^{abc}
6	Scrubbed nightshade leaves boiled in *egusi*	22.813 ± 1.667^{e}

7	Nightshade leaves boiled with Irish potatoes	20.306±5.380^{de}
8	Raw sliced nightshade leaves cooked in fried onions and ground groundnuts	17.231±0.155^{ab}
9	Nightshade leaves in lumpy *egusi*	17.425±0.181^{ab}
10	Raw sliced nightshade leaves fried in tomatoes	16.709±0.059^{a}
11	Nightshade leaves in ground fluted pumpkin seeds	17.193±0.097^{ab}
12	*Mbep Tarti Gu Nang*	17.937±0.277^{ab}
13	*Mbeup Cerie*	18.699±0.954^{bc}
14	*Mpoub*	18.565±0.159^{abc}
15	*Basifhei*	17.635±0.080^{abc}
16	*Mbas a sekoyn*	17.199±0.653^{ab}
17	*Mbas a mtsong mbi*	17.225±0.195^{ab}
18	Seasoned *Mbas a sekoyn*	18.653±0.239^{abc}
19	Seasoned *Mbas a mtsong mbi*	18.157±0.636^{abc}
20	*Mbusa*	17.517±0.327^{ab}
21	*Mborueh*	18.182±0.216^{abc}
22	*Mbep Tarti ga mowot whow*	17.614±0.252^{ab}
23	Unsqueezed nightshade fried in tomatoes	17.899±0.196^{abc}
24	English style with *egusi*	17.512±0.629^{ab}
25	English style with groundnuts	18.569±0.452^{abc}

Mean±SE values within the same column followed by the same superscripts are not significantly different at α=0.05, one-way ANOVA, 95% confidence level, Fischer LSD.

Ash and Dry Matter Content of the 25 African nightshade Recipes

The ash and the dry matter composition of the 25 different recipes of African night shade is shown in tables 2 and 3. The ash contents of the recipes ranged from 9.301g/100g to 18.548g/100g. There were no significant differences ($p>0.05$) in the ash contents of recipes 11 and 2 ; 12 and 13 ; 8 and 10 ; 6, 7 and 25 and 1, 5 and 18 respectively while the rest of the recipes (13) were significantly different. The lowest ash content (9.301g/100g) was recorded by recipe 19 which is seasoned *Mbas a mtsong mbi* and the highest ash content (18.548g/100g) was recorded by recipe 22 *Mbep Tarti ga mowot whow*. Ash content is an index of minerals in food materials (Ngobidi *et al*., 2016). Generally all the 25 recipes under study had a high ash content when compared to the ash content for vegetables and vegetable products (FAO, 1968). The high values of ash observed in all the recipes is a good indicator that these food samples are good sources of minerals when compared to values obtained for cereals and tubers as well as other leafy vegetables (FAO, 1968). These values were also found to be higher than values obtained for raw African nightshade (Ngobidi *et al*., 2016 ; Zonfac 1984 ; Kibiwot, 2011) ; cooked African nightshade (Kibiwot 2011 ; Ponka *et al*., 2005) ; *Amaranthus* species (Singhal & Kulkarni, 1987) and *amygdalina* species (Ejoh *et al*., 2015). Ash content of all the recipes (table 2) obtained in the study compares favourably with a reported value of (10-18%) for *S. nigrum* from Nigeria (Akubugwo *et al*., 2007).

The dry matter contents of the recipes ranged from 90.130g/100g to 95.626g/100g (table 3.).There were no significant differences ($p>0.05$) in the dry matter contents of recipes 4 and 10 ; 11 and 13 ; 8,20 and 24 ; 6, 9 and 22 and 5, 23 and 25 respectively while the rest of the recipes (12) were significantly different. The nutrients in foods reside in the dry matter portion, which is the material remaining after removal of water (Kibiwot, 2011).The 25 African nightshade recipes had high dry matter values ranging between 90.130g 100g to 95.626g/100g (Table 3). Recipe 2 which is *mbep tarti* exhibited high dry matter values among the other recipes and this signifies its high nutritional properties when compared to some other recipes studied. The dry matter values obtained for the the 25 African night shade recipes (90.130g 100g to 95.626g/100g) in this study are not similar with values (87.2g/100g) obtained by (Kibiwot, 2011).The possible reason for higher values than (Kibiwot, 2011) might be due to the fact that the cooked African night shade by (Kibiwot 2011) was only boiled for 15minutes while all the African night shade recipes in this study under went different processing techniques (tightly squeezing), different major ingredients (tomatoes, onions, egusi , palm oil and groundnuts), different cooking times (30minutes- 60minutes) and different cooking methods (frying, boiling, stewing and steaming) which must have accounted for the increase in nutrients.

Crude fibre Content of the 25 African nightshade Recipes

The crude fibre contents of the recipes ranged from 6.70g/100g (recipe 16) to 20.10g/100g (recipe 20). There were no significant differences ($p>0.05$) in the crude fibre contents of recipes 9 and 11; 10 and 19 and 2, 4 and 8 respectively while the rest of the recipes (18) were significantly different (table 4). Raw African nightshade has been shown to contain crude fibre values from 0.6g/100g to 2.2g/100gDW (Leung *et al*., 1968; K'Opondo *et al*., 2005 ; Zonfac, 1984).Thus from this study it shows that cooking signifantly increase dietary fibre content as values obtained for the 25 recipes were all above the range in the raw vegetable. The crude fibre contents of some of the recipes (12 (13.87g/100g) and 14 (13.69g/100g)) which are *Mbep Tarti Gu Nang* and *Mpoub* respectively concurred with the findings of Ponka *et al*.,(2005) for *zom non sale* (13.89g/100g). (Eun-Hee *et al*., 1993) found the average levels of dietary fibre in leafy vegetables of Asian countries to be 33% dry weight. This study reports values that are slightly lower. The recommended dietary allowance (RDA) values of dietary fibre for children, adults, pregnant and lactating mothers are 19-25, 21-38, 28 and 29g, respectively (Akubugwo *et al*., 2007) therefore most of the African nightshade recipes can significantly contribute to the the RDA for dietary fibres. According to Antia *et al*., (2006) non-starchy vegetables are the richest sources of dietary fibre. Adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer (Hanif *et al*., 2006; Jimoh *et al*., 2010)

Total Sugar Content of the 25 African Nightshade Recipes

The total sugar contents of the recipes ranged from 0.64g/100gDW (recipe 18) to 9.14g/100gDW (recipe 7). There were no significant differences ($p>0.05$) in total sugar contents of recipes 19 and 20; 13 and 22 ; 16, 17 and 25 and 2, 5, 10, 11, 12 21, 22 and 24

respectively while the rest of the recipes (11) were significantly different (table 5). Recipe 7 which is nightshade leaves boiled with Irish potatoes had the highest total sugar content (9.14g/100gDW). This could be attributed to the Irish potatoes found in recipe 7 which is known to contain high amounts of carbohydrates (16.95g/100gDW to 41.30g/100gDW) (Abong *et al*., 2009; Ogunjobi *et al*., 2005). The RDA values of carbohydrates for children, adults, pregnant and lactating mothers are 130g, 130g, 175g and 210g, respectively (Sareen *et al*., 2009). Most leafy vegetable are generally not good sources of carbohydrate even though carbohydrate are pivotal nutrients required for adequate diet (Emebu & Anyika, 2011), The African nightshade recipes (25) studied here are poor sources of carbohydrates as most other leafy vegetables.

Total Lipid Content of the 25 African nightshade Recipes

The total lipid contents of the recipes ranged from 7.50g/100gDW (recipe 7) to 54.49g/100g DW (recipe 9). There were no significant differences ($p>0.05$) in total lipid contents of recipes 12 and 13; 10 and 23 ; 4 and 25 ; 18 and 20 and 15, 21 and 22 respectively while the rest of the recipes (14) were significantly different (table 6). Raw African night shade has been shown to contain low lipid values (5.40g/100g, 1.0g/100g, 0.8g/100g and 1.8g/100g) (Ngobidi *et al*., 2016 ; Leung *et al*., 1968 ; Zonfac, 1984) respectively. However few studies have shown that the the lipid content of African night shade tend to increase when cooked (Ponka *et al*., 2005). This is true for this study as the lipid content increase for all the recipes (table 6). Recipe 7 which is nightshade leaves boiled with Irish potatoes recorded the least lipid content.This is attributed to the use of irish potatoes as one of its main ingredients which has been shown to content very low amounts of total lipids ; 0.08g/100g to 5.75g/100g (Abong *et al*., 2009; Ogunjobi *et al*., 2005). Meanwhile recipe 9 which is nightshade leaves in lumpy *egusi* recorded the highest amount of total lipid. This is attributed to the fact that recipe 9 has as main ingredients *egusi* and palm oil which have been shown to be high in total lipids - 49.05g/100g and 66.69 g/100g respectively **(**Jacob *et al*., 2015; Ravigadevi *et al*., 2000) .Generally the values of total lipids in these 25 African nightshade recipes corroborate the findings of Ponka *et al*., (2005) on 32 dishes consumed in a malaria endemic zone in Ngali II - Cameroon (0.26g/100g to 54.98g/100g)

Crude Protein Content of the 25 African nightshade Recipes

The crude protein contents of the recipes ranged from 16.709g/100gDW (recipe 10) to 22.813g /100gDW (recipe 6). There were no significant differences ($p>0.05$) in crude protein contents of recipes 2 and 13; 8, 9, 11, 12, 16, 17, 20, 22 and 1, 3, 5, 14, 15, 18, 19, 21, 22 and 25 respectively while the rest of the recipes (5) were significantly different (table 7). The protein values obtained in this study compares favourably with values obtained by Ponka *et al,*. (2005) for Zom sale (21.69g/100g and Zom non sale (21.12g/100g). From these analyses, it is seen that dishes (recipes 6, 9, 18, 19, 24, 25) made from leguminous seeds such as egusi seeds and groundnuts have high protein contents. In fact, Fokou *et al*., (2004) showed that egusi seeds are rich in protein (24.3 - 41.6% d.w), (Fokou & Domngang, 1987) showed that protein levels of green leafy vegetables range from 20.48 - 41.66% d.w. On the other hand, the complements

that accompany them, such as cassava, cocoyams, *corn fufu* and plantains are poor in proteins (Ponka *et al*., 2005) For a good protein balance, these inhabitants of Boyo division, Momo division, Mezam division and Menchum division will benefit more by consuming African nightshade dishes prepared from egusi seeds and groundnut seeds, and lower quantities of their complements. The protein levels of the African nightshade dishes are higher than those of dishes consumed in a rural area of the Far North Region of Cameroon with values ranging from 11.6-12.2% d.w (Teugwa *et al*., 1996). A higher consumption of "Scrubbed nightshade leaves boiled in *egusi*", "Seasoned *Mbas a sekoyn",* "Seasoned *Mbas a mtsong mbi*" and "English style with groundnuts" is to be encouraged in the population as this will greatly help in combating malnutrition

CONCLUSION

The proximate composition established for the 25 African nightshade recipes from the North West Region of Cameroon shows that they are rich sources of dietary fibres, moderate to rich sources of proteins and relatively poor sources of carbohydrates. Thus starchy staples like cassava, plantains, cocoyam and cornfufu could be used as complement for these African nightshade recipes to improve on nutrient balance. Similarly all the recipes are rich sources of total lipids except recipe 7 (Nightshade leaves boiled with Irish potatoes).

RECOMMENDATIONS

1) The African nightshade vegetable should be integrated in the Cameroon food systems to alleviate protein energy malnutrition and non-communicable diseases such as Diabetes Mellitus since they contain high levels of proteins and fibres. However, the quantities of palm oil should be used in moderation.
2) African night shade cooked by boiling, addition of *egusi* and groundnuts are good sources of protein while African nightshade cooked by sautéing, All- in –one –pot with tomatoes and onions are good sources of fibres and should be adopted by the population.

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