Proximate constituents of raw and blanched leaves of Chaya (*Cnidoscolus chayamansa* McVaugh, 1944)

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ABSTRACT

Proximate composition of raw and blanched dried leaves of *Cnidoscolus chayamansa* was determine using standard analytical methods. The result revealed the following contents in g/100g;Dry matter, 91.27±0.01 and 91.55±0.07, Moisture, 8.73±0.01 and 8.45±0.07, Crude protein, 20.43±0.026 and 25.14 ± 0.04, Crude lipid, 6.85±0.016 and 7.41±0.03, Crude fibre, 8.64±0.017 and 8.72±0.08, Total Ash, 8.12±0. 02 and 10.03±0.02, Nitrogen free extract, 47.22±0.041 and 40.25±0.10, Gross energy, (Kcal/100g) 275.77±0.082 and 277.76±0.70 for raw and blanched dried samples respectively. The study established the nutritive potential of the leaf for consumption by both human and animal since availability is guarantee all year round with little or no effort in it cultivation. Blanching as a processing method adopted in this study was efficient.

Key Words: Proximate composition, Raw, Blanched, Dried, Chaya, *Cnidoscolus chayamansa*, Leave.

INTRODUCTION

Chaya (Figure 1) is a native plant of Mexico and the Yucatan Peninsula that has been used since pre-Hispanic times (Estrada *et al.,* 2012). According to Ross-Ibarra and Molina-Cruz (2002), the four main cultivated varieties of Chaya are 'Estrella,' 'Pecuda,' 'Chayamansa,' and 'Redonda.' Its high nutritive value, ease of propagation, productivity, tolerance of poor growth conditions, resistance to pests and disease makes it a valuable potential crop that could benefit people of many regions. It is cultivated in domestic gardens rather than in agricultural fields and as such can be used throughout the year (Adeniran *et al*., 2013).Iwalewe *et al*. (2005) and Oyagbemi *et al*. (2008) documented that in Nigeria, it is one of the most productive green vegetables eaten in south western region where it is called IyanaIpaja and also in the south eastern region where it is called "Hospital too far".

According to Fasuyi and Kehinde (2009), protein from plant leaves sources is perhaps the most naturally abundant and the cheapest source of protein. Abowei and Ekubo (2012) reported that leaves are abounding in the tropics growing freely without cultivation they contain diverse levels of protein which can produce an inexhaustible and inexpensive source of nutrient.Therefore, there is the need to properly harness and ascertain the levels of nutrients in such leaves giving the best processing method for their utilization.

This study was aimed at determining the proximate composition of raw and blanched dried leaves of *Cnidoscolus chayamansa*.

MATERIALS AND METHODS

Study location

The study was carried out at the Department of Biological Sciences of Kaduna State University Kaduna, Nigeria.

Sources and processing of *cnidoscolus chayamasa* leaves

Cnidoscolous chayamansa leaves were obtained from the family garden at Barnawa G.R.A near Railway station

Figure 1. Chaya plant (*Cnidoscolus chayamansa*)

Kaduna. Chaya leaves were harvested thoroughly washed with clean water and were chopped to approximately 2-3 cm sizes. The sample of the chopped leaves was divided into two parts; the first part was shade dried at room temperature for three days and label as raw dried sample (RDS).

Similarly the second part of the chopped leaves sample were introduced into a large pot of boiling water at 1000C, and were allowed to blanch for 1 minute during which they were constantly stirred. They were immediately removed and placed in a running cold water to prevent the cooking process. The blanched chilled leaves were squeezed hard to get out as much of the watery content as possible. The clumped of the blanched leaves were further Chopped with a knife, sprayed into trays and were shade dried for three (3) days at room temperature and the sample was label blanched dried sample (BDS). The two samples (RDS and BDS) were ground each separately which produces *Cnidoscolus chayamansa* leaf meal (CCLM), Sieved and were packaged, sealed in polythene bags and stored.

Proximate analysis of *cnidoscolus chayamansa* leaf meal

The proximate constituents of *Cnidoscolous chayamansa* leaf meal (CCLM) was carried out using the methods described by Association of Official Analytical Chemist (AOAC, 2000).

Determination of dry matter

Three (3) dishes with cover were dried at 135^0C for about 2 hrs. The dishes were covered and moved to desiccator. The desiccator was immediately cover and the covered dishes were allowed to cool to room temperature. The dishes with cover were weighed (W4) to nearest 0.1 mg, removing one at a time from desiccator and keeping desiccator closed between dish removal. Approximately 2g of the ground sample (*Cnidoscolus chayamansa* leaf meal) was added to each dish. Weight of dish with cover and sample (W5) was recorded to nearest 0.1 mg. The dish was shaken gently to uniformly distribute the sample and also expose the maximum area for drying. The sample with lids removed was inserted to the side into preheating oven at 1350C and was dry for 2hrs after oven has returned to temperature. The samples were moved to desiccator; each dish placed cover on it, the desiccator seal and allows cooling to room temperature. The dish was then weighed with cover and dried sample (W6) recording weight to nearest 0.1 mg.

Percentage dry matter was then estimated thus;

$$\% \text{ Dry matter} = \frac{W_6 - W_4 \times 100}{W_5 - W_4}$$

Where,

W_4 = Tare weight of dish in grams

W_5 = Initial weight of sample and dish in grams

W_6 = Dry weight of sample and dish in grams

Determination of moisture content of *cnidoscolus chayamansa* leaf meal

Three (3) dried dishes with lids were weighed and into each of the dishes, 2.0 g of the ground samples was weighed and placed in an oven at 100ºC for 3 hours without the lids. The samples were removed from the oven after been dried with the lids replaced. The samples were then transferred to the desiccator containing a suitable moisture absorbing material, until constant weights were obtained at room temperature.

The percentage moisture content was calculated thus:

$$\% \text{ Moisture} = \frac{\text{weight of sample + dish before drying} - \text{weight of sample + dish after drying} \times 100}{\text{weight of sample for analysis}}$$

Determination of crude protein

Ten (10) grams of the sample (*Cnidoscolus chayamansa* leaf meal) was weighed and transferred into a kjeldahl flask. Four tablets of kjheldahl catalysts (the tablet contained 1 g of Na_2SO_4 and 0.5 g of selenium) were added. Concentrated H_2SO_4 (20 ml) and glass beads were introduced to avoid bumping on heating. The flask was set in the fume cupboard; heated gently immediately and then continued until a slight charring begins to clear and the mixture became colourless. The heating process was approximately one hour. The flask was allowed to cool at room temperature and slowly washed the long neck flask with 20ml of distilled water into 500 ml distillation flask.

Distillation

Pieces of hot clips were added into the flask and connected up to the splash head and water cooled condenser. NaOH solution (5%, 4 ml) was added in the dropping funnel and 50 ml of 2% boric acid into the 250 ml receiving flask with methyl red indicator. The dropping funnel tap was opened slowly to allow the 5% NaOH enter the boiling flask. The distillation flask was heated to boiling with water passing through the condenser. Distillation continued until about 150 ml was collected in the receiving flask. The content of the flask was later titrated with 0.1 M HCl until pink end point was obtained. The reading was recorded and blank was run along the same treatment.

Percentage Nitrogen was estimated as:

$$\% \text{ Nitrogen} = \frac{(VS - VB) \times \text{normality of HCl} \times 0.014 \times 100}{\text{Weight of sample in grams}}$$

Where;

VS = Volume of acid used to titrate sample

VB = Volume of acid used to titrate blank

N = 0.1 M of acid

% Crude protein = N% x conversion factor (6.25).

Determination of crude lipid

Ten (10) grams of the ground sample was weighed and transferred into thimbles of Soxhlet extractor containing 250 ml of petroleum ether. The thimble and the contents were placed in a 100 ml beaker and dried in an oven for 30 minutes at 105^0C - 110^0C to expel traces of moisture. The beaker was rinsed with the extractant and added to the soxhlet extractor. The sample was extracted for 7 hours at a condensation rate of 240 drops per minute. After the extraction, the sample was transferred to an already weighed evaporating dish and rinsed 2-3 times with the extractant. The dish was placed in a fume chamber to allow solvent to evaporate. The sample was dried in an oven for an hour at 105^0C - 110^0C and then cooled in a desiccator and weighed.

Percentage Lipid was computed thus;

$$\% \text{ Crude lipid} = \frac{\text{Weight of dish + contents after drying} - \text{weight of empty evaporating dish} \times 100}{\text{Weight of sample taken for analysis}}$$

Determination of crude fibre

Two (2) grams of the ground sample was weighed and placed into a conical flask. The sample was extracted by stirring with petroleum ether. 200 ml of 1.25% H_2SO_4 solution was heated to boiling and transferred to the dried sample. The sample was allowed to settle. The flask was connected immediately to a water-cooled reflux condenser and heated. The flask was boiled gently for 30 minutes and mixed. The flask was then removed and filtered using a filter paper held in the funnel and washed with boiling water until it was no longer acidic to litmus paper. Out of this 200 ml of 1.25% NaOH was brought to boiling under a reflux condenser. This alkaline solution was used to wash the sample back into the initial flask and then boiled for 30 minutes under condenser. The flask was removed and immediately filtered. All the insoluble matter was then transferred to the sintered crucible using boiling water. The residual was washed first with boiling water, 1% HCl and boiling water to render the insoluble matter free of acid. The residual was washed three times with alcohol and diethyl ether and then dried in an oven at 150^0C to a constant weight. The dried sample was also ashed by incineration in a muffle furnace at 560^0C for an hour. The crucible was cooled in the desiccators and then weighed.

Percentage Crude fibre was thus estimated as;

$$\% \text{ Crude fibre} = \frac{\text{Weight of insoluble matter} - \text{Weight of ash} \times 100}{\text{Weight of the sample}}$$

Determination of ash

Clean dry porcelain dishes and two (2) grams of the ground sample were weighed. The dishes were dried in an oven at 100^0C – 110^0C for 3 hours and then removed. The dishes were heated over a burnsen flame to initiate the eradication of carbon until the contents turn black. The dishes were placed into a muffle furnace and heated at 560^0C for 2 hours until grayish-white residues were formed. The hot dishes were removed from the furnace using tongs and moistened with some drops of distilled water to expose unashed material present. The dishes were again placed into muffle furnace and heated

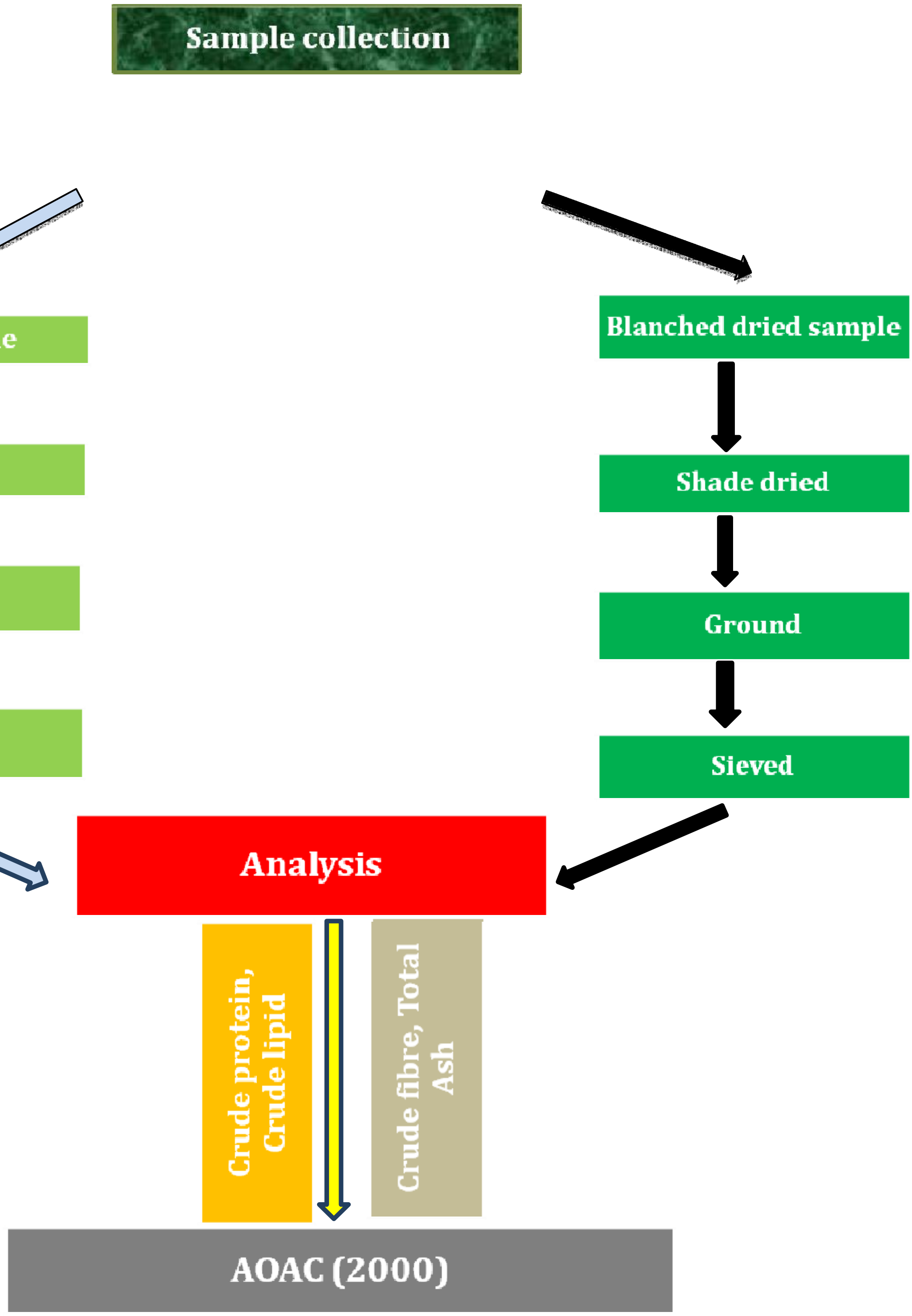

Figure 2. Flow chart of Analytical procedures for proximate composition of Raw and Blanched dried leaves of *Cnidoscolus chayamansa.*

at 560^{0}C for 3 hours. They were removed and placed in a desiccator to cool. Each dish and the content were weighed and the ash content determined.

Percentage ash content was computed as follows;

% Ash = Weight of dish + content after drying – Weight of empty dish x 100
Weight of sample for analysis

Table 1. Proximate composition of *Cnidoscolus chayamansa* leaf meal (dry matter basis g/100g)

Organic Content (%)	Raw Dried Sample Concentration (g/100g)	Blanched Dried Sample Concentration (g/100g)
Dry matter	91.27±0.01	91.55 ± 0.07
Moisture	8.73±0.01	8.45 ± 0.07
Crude protein	20.43±0.026	25.14 ± 0.04
Crude lipid	6.85±0.016	7.41 ± 0.03
Crude fibre	8.64±0.017	8.72 ± 0.08
Total Ash	8.12±0.02	10.03 ± 0.02
Nitrogen free extract	47.22±0.041	40.25 ± 0.10
Gross energy (Kcal/100g)	275.77±0.082	277.76 ± 0.70

Values are mean ± standard deviation of triplicate determination

Determination of carbohydrate (nitrogen free extract) content

This was determined by subtraction rather than by a direct method. The moisture, Crude protein, Crude lipid, Crude fibre, and Ash contents respectively found in the samples were added together and subtracted from the number 100. That is,

% NFE = 100 – (% Moisture + % Crude protein + % Crude lipid + % Crude fibre + % Ash)

Estimation of calorific energy value

This was in accordance to the method described by FAO (2003)

The estimated calorific energy value (Kcal) of the leaf sample was carried out by multiplying the percentages of Crude protein, Crude lipid and Nitrogen free extract (Carbohydrate) by the factors 2.44, 8.37 and 3.57 respectively.

The step by step procedures for proximate analysis of raw and blanched dried leaves of *Cnidoscolus chayamansais* briefly described in Figure 2.

Data analysis

Data collected for the proximate composition were analyzed using Statistical Package for Social Sciences (SPSS) version 15.0 software. Descriptive statistic was determined to tabulate the mean and standard deviation of triplicate samples.

RESULTS AND DISCUSSION

Proximate composition

The results of proximate composition of raw dried sample (RDS) and blanched dried sample (BDS) of *Cnidoscolus chayamansa* leaf is presented in Table 1.0.The dry matter content obtained in *Cnidoscolus chayamansa* leaf meal (CCLM) was lower when compared with the result obtained in Arhar leaf 93.32% reported by Bag et al. (2012). The dry matter is what remains after all the water is evaporated out of a feed. It is an indicator of the amount of nutrients that are available to the animal in a particular feed (AOAC, 1990). This shows that CCLM contained valuable amount of nutrients.

The moisture content of *Cnidoscolus chayamansa* leaf meal (CCLM) of both samples was low, 8.73±0.01 g/100g and 8.45±0.07g/100g for RDS and BDS respectively. However, they falls within the ranged as obtained in the works of Obasa et al. (2007) (11.43%) and Estrada et al. (2012) (3.27±0.94 g/100g) in CCLM. The lower value of moisture in the leaf would prevent the growth of microorganisms thereby increasing their storage life (Emmanuel *et al.*, 2011).

Crude protein content was higher in both RDS and RDS (20.43±0.026 g/100g and 25.14 g/100g) respectively when compared to that obtained in the leaf of *Amaranthus viridus*(16.41 g/100g) (Javid *et al.,* 2009). As can be observed in this present study, after blanching, the level of crude protein increase from 20.43±0.026 (g/100g) to 25.14±0.04 (g/100g) (RDS to BDS) respectively. This is as a result of blanching method adopted which significantly reduces the leaching of valuable nutrients resulting to increase in the level of crude protein. Gilani *et al*. (2005) reported that cooking methods that involve discarding the decoction after boiling is advantageous it leaves cooked vegetables with low content of anti-nutrients thus enhancing the absorption of essential elements. This had demonstrated the nutritive potential of the leaf.

The content of crude lipid in both samples was relatively higher RDS (6.85±0.016) and BDS (7.41±0. 03 g/100g) related to that conveyed in the leaf of *Ipomoea batatas* (3.07 g/100g) Adewolu (2008). However, the one obtained in BDS was similar to that gotten in *Cnidoscolu saconitifolius* leaf (7.39 g/100g) (Shittu *et al.,* 2014).The high content of lipid will enhance energy supply as well as assimilation of food. Besides, lipids serve as carriers for fat-soluble vitamins (Levin and Barnard, 2010).

The value of crude fibre obtained in RDS and BDS (8.64±0.017 g/100g and 8.72±0.08 g/100g) did not differ significantly, although they were lower to those reported by Adebowale et al., (2015) for *Bombax costatum* leaf flour (9.1±0.0g/100g) and *Cissus populnea* leaf flour (9.0±0.0g/100g) respectively.The variances in the proximate composition could be attributed to differences in processing techniques employed .Soluble fibre helps control glucose and reduces blood cholesterol concentrations; insoluble fibre reduces intestinal transit time, helps prevent constipation and may protect against colon cancer Levin and Barnard (2010). According to Wardlaw and Smith (2009), the reasonable values of the crude fibre and the indigestible cellulose they contain may absorb water and provide roughage for better functioning of the alimentary system. This shows that the leaf is a good source of dietary fibre.

The ash content was significantly higher in the BDS (10.03±0.02 g/100g) than the RDS (8.12±0.02 g/100g). This was lower compared to the one obtained in the leaf of *Chanca piedra* (Stone breaker) 5.55±0.01 g/100g reported by Garfar et al. (2012).According to Onyimoniyi and Ernest (2009), disparity in nutritive value of plants may be attributed to alterations in environmental conditions such as soil chemistry, harvesting method, ingredients variability and temperature. It can be deduce that essential mineral abound in the leaf.

The value obtained for Nitrogen free extract (Carbohydrate) was lower in BDS 40.25±0.10 g/100g) compared to that in RDS (47.22±0.041 g/100g), similar results were obtained by Mwakalukwa et al. (2016) 50.14±0.006 g/100g and 54.45±0.006 g/100g) in the blanched and raw dried samples leaf of Crotalaria laburnoides respectively. It was similar when compared with that stated for mulberry leaf meal (47.10g/100g) Kausik et al, (2012). This observation is associated with the effect of heat treatment.

The value of gross energy was relatively higher in the BDS (277.76±0.70 Kcal/100g) than in the RDS (275.77±0.082 Kcal/100g). This shows that blanching method employed enhances the availability of useful energy. This agrees with the finding so fEtong and Abbah (2014)in the leaf of *Telfaria occidentalis* (282.50 Kcal/100g).

CONCLUSIONS

Proximate composition evidently shows 25.14±0.04 (g/100g) level of crude protein, 7.41±0.03 (g/100g) crude lipid and 10.03±0.02 (g/100g) level of Total ash respectively in blanched dried sample higher than that in the raw dried sample of *Cnidoscolus chayamansa* leaf meal (CCLM). This established the nutritive potential of CCLM for consumption by both human and animal since availability of the leaf is guarantee all year round with little or no effort in it cultivation. Blanching as the processing method adopted was efficient, hence an increased in the levels of crude protein, crude lipid, crude fibre and total ash respectively in the blanched dried sample. Going by these findings, it is recommended that to befittingly harness the prospective of promising plant leaves like *Cnidoscolus chayamansa*, processing method such as blanching should be employed for good result.

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