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EVALUATION OF PROXIMATE COMPOSITION AND ANTI-NUTRIENT CONTENT OF GROUNDNUT SOUP DELICACY PREPARED WITH PROCESSED *FICUS GLUMOSA* LEAVES

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ABSTRACT

Assessment of the proximate composition and anti-nutrient composition of groundnut soup delicacy prepared with *Ficus glumosa* leaves was carried out in this study. Proximate and anti-nutrient composition of all the soups namely groundnut soup made without *Ficus glumosa* (GS), groundnut soup made with unblanched *F. glumosa* (GSUB), groundnut soup with blanched *F. glumosa* (GSBF), with blanched and dried *F. glumosa* (GSBD) were evaluated using standard methods of the Association of Official Analytical Chemists (AOAC) and other standard assay techniques. The results of the proximate analysis showed a high crude protein and crude fat contents (19.87 to 31.77 and 21.11 to 29.10 in percentage dry weight) respectively, in all the soup samples. GS had the highest protein content (31.77%). The crude protein in all the soups were significantly ($p<0.001$) higher than GS. Also, crude protein in GSBD and GSBF had significantly ($p<0.001$) higher value compared to GSUB. The crude fat of GSUB was significantly ($p<0.05$) higher than GS. The GSBD was also significantly higher ($p<0.05$) than GSUB. The soups had moderate carbohydrate (2.43 to 9.46%) and crude fibre content (0.23 to 5.37%). Ash content obtained was significantly ($p<0.001$) high in the *F. glumosa* containing soups and GS. Assessment of oxalate, phytate and tannin showed that cooking reduced the quantity of anti-nutrients in the soups.

KEYWORDS: *Ficus glumosa,* groundnut, soup, vegetable, anti-nutrients

1. INTRODUCTION

Nigeria is a multi-cultural society endowed with different traditional vegetable and seed-based soups which are indigenous to different ethnic groups and consumed with different traditional dietary stables, obtained from cassava, yam, cocoyam, sweet potatoes, plantain, millet, rice and maize (Lawal *et al*., 2018). The groundnut or Peanut soup is a soup which is eaten in some Southern and Northern parts of Nigeria and quite popular in the whole of West Africa. It is popularly called peanut soup or Omisagwe (Etsako people of Edo State) and Maafe amongst the Yorubas and also popular among the people of the Northern part of Cross River State (CRS) (Ogoja, Bekwarra, Obanliku, Yala and Obudu). The soup is a staple diet in most African cuisine as well as some other cultures like Taiwan in East Asia and Virginia in the States (Bassey *et al*., 2020).

The nutritional value of a soup varies depending on the ingredients used and nutrient losses recorded during the cooking process (Agiang *et al*., 2010).

Green leafy vegetables make up a vital part of human diet in Africa generally and West African in particular (Madubunyi *et al.,* 2012), among these is *Ficus glumosa*. *Ficus glumosa* belongs to subgenus *Urostigma*, section *Galoglychia. Ficus glumosa* is widespread throughout most of tropical Africa (Jansen, 2005). It is a small-to medium-sized tree, 5–10m tall, the branches are widely spread, more or less horizontal, and it is often supported by stilt roots (Madubunyi *et al.,* 2012). It is known as “eweipin” in Yoruba, “udiung” and “kunjung” by the Bette and Bekwarra people in Cross River State, Nigeria respectively. In Nigeria, most people in the rural areas depend on leaves collected from the wild as their main source of leafy vegetables for their nourishment

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(Kubmarawa *et al.,* 2009).

This study was aimed at evaluating the proximate composition and anti-nutrient content of groundnut soup delicacy prepared with blanched and unblanched leaves of *Ficus glumosa* thereby contributing to the food data base of Nigeria.

2. MATERIALS AND METHODS

Fresh raw groundnut and fresh *Ficus glumosa* leaves were purchased from Ugidi market in Abuochiche, Bekwarra Local Government Area, Cross River State, Nigeria. Other condiments such as salt, pepper, palm oil, bullion knorr cube, fresh meat, stock fish, dry fish, crayfish and onions were purchased from Edim Otop Market in Calabar Municipality, Cross River State, Nigeria.

Fresh *Ficus glumosa* leaves were plucked from the stalk. It was processed in three different ways namely, unblanched, blanched, and blanched dried *F. glumosa* which was used to prepare groundnut soups. The blanched dried *F. glumosa* was prepared by washing 100 grammes of *F.glumosa* in water; it was put in a sieve to drain some water and sliced into sizeable pieces. It was blanched by dropping the *F. glumosa* leaves into boiled water and allowed for five minutes after which it was drained and dipped immediately inside cold water for the vegetable to cool rapidly. After blanching it was sundried and shade dried for one week. The final weight of the blanched dried *F. glumosa* was 60 grammes. For the blanched *F.glumosa* sample, 100 grammes of *F. glumosa* was washed and sliced into tiny pieces. It was blanched in hot water for five minutes, drained from the hot water and dipped in cold water to cool immediately. It was used fresh, without drying, to cook the groundnut soup. Unblanched fresh *F.glumosa* was made by weighing 100 grammes of *Ficus glumosa* leaves which was washed and shredded into sizeable pieces with kitchen knife. It was used fresh without being blanched or dried.

Fresh raw groundnut weighing 575 grammes was roasted traditionally on a frying pot on a cooking stove by stirring constantly till half golden brown for four minutes. It was blended using a manual grinder (coroner model) into a paste. The final weight was 516 grammes. It was divided into four portions each weighing 129 grammes to be used for the different soups.

TABLE 1: Recipe

Ingredients	Quantity in soups (g)			
	GS	GSUB	GSB	GSBD
Groundnut	129	129	129	129
Palm oil	34	34	34	34
Salt	4.3	4.3	4.3	4.3
Pepper	2.5	2.5	2.5	2.5
Onion	50	50	50	50
Smoked dry fish	10.5	10.5	10.5	10.5
Knorr seasoning cube	6	6	6	6
Steamed beef meat	131	131	131	131
Stock fish	46	46	46	46
Water	450	450	450	450
Blanched dried *F. glumosa*	-	-	-	60
Blanched *F. glumosa*	-	-	100	-
Unblanched *F. glumosa*	-	100	-	-
Cray fish	7	7	7	7

GS: groundnut soup without any leafy vegetable
GSUB: groundnut soup made with unblanched *F. glumosa* leaves
GSB: groundnut soup made with blanched *F. glumosa* leaves
GSBD: groundnut soup made with blanched dried *F. glumosa* leaves

The soup was prepared according to the traditional method used by Bekwarra and Bette people of Northern Senatorial District of Cross River State, Nigeria using the recipe shown in Table 1. The steamed meat with its stock was poured into a dry weighed pot. Water was added to a level almost above the content of the pot and allowed to boil. Boiled stock fish, dry fish and ground cray fish were added and allowed to cook for five minutes. The groundnut paste was added and stirred to avoid lump. It was cooked for fifteen minutes and stirred every four minutes to prevent it from getting burnt. Palm oil was added and stirred, pepper, Knorr seasoning and salt was added for taste. The soup was cooked on low heat till it thickened. The vegetable was added last, stirred and allowed to simmer for three minutes. The pot was brought down, left to cool and weighed. The final weight of GSBD was 817 grammes, GSBF weighed 783 grammes, GSUB weighed 785grammes, and GS weighed 617 grammes. The cooled soup samples were homogenized by electric kenwood 301C-1 blender and dried in an air circulating oven (Gallenkamp oven model SA 9059 B) at 55^0C for 24 hours. The dried soups were blended into powder, stored in plastic containers with screw cap and kept in the refrigerator for analysis.

Each soup sample was analyzed for crude protein, carbohydrate, crude fat, moisture, crude ash and crude fibre in triplicate using the methods of Association of Official Analytical Chemist (2000) and James (1995). Exactly 5.0g of processed sample was boiled in 150ml of 1.25% H_2SO_4 solution for 30 minutes under reflux. It was washed with water and allowed to drain before placing it quantitatively in a weighed crucible where it was dried in the oven at 105^{o}C to a constant weight. It was thereafter placed in a muffle furnace for ashing. The weight of the crude fibre (W_2) was determined by difference and calculated as a percentage of the weight of sample analyzed thus:

$$W_2 = \frac{\text{weight of crucible + sample after washing, boiling and drying}}{\text{Weight of crucible + sample of ash}}$$

The moisture determination was done using the gravimetric method at 105^{0}C for three hours. The crude protein was determined by kjeldahl method. The total nitrogen was multiplied by 6.25, a conversion factor, to obtain the crude protein content. The ash content was determined by heating 5g of each ground soup sample in a porcelain crucible at about 55 ºC for three hours until white ash remained. The ash was cooled in a desiccator and weighed. Crude fat was determined by Soxhlet method of extraction using petroleum ether.

The anti-nutrient analysis: spectrophotometer was used to determine the tannin content of the sample as described by Kirk and Sawyer (1998). Phytate and oxalate were determined following the method of Adeniyi (2009).

3. Statistical analysis:

The data obtained were analyzed for statistical significance by two-way ANOVA (Analysis of Variance) with a post hoc Dennett's test at P value < 0.05 using SPSS (Statistical Package for the Social Science) software and Microsoft Excel.

4. Results and Discussion

Three soups prepared with groundnut and *Ficus glumosa* leave as consumed in Northern Cross River State communities, Nigeria were evaluated. These soups were compared among themselves and with one that was made with groundnut without *F.* glumosa. The results of this study agree with the observation that in developing countries, food stuffs of vegetable origin are eaten in quantities which contain most of the essential nutrients in excess of individual requirements (Obiakor–Okeke *et al.*, 2014).

The proximate compositions of the four soups (Table 2) showed that the groundnut soup with blanched *F.glumosa* (GSBF) had the highest moisture content (wet weight) ($p<0.05$ and $p<0.001$) and crude fibre, GSBD was the richest in crude ash and carbohydrate ($p<0.001$ and $p<0.05$ respectively). This supports the report that sundried and shade dried vegetable had a higher crude ash content than fresh vegetable but also contrary to the report that it also has higher crude fat, crude fibre, and crude protein compared to fresh vegetable (Oguche, 2012). Since GS had the least crude fibre content in this study, the result showed that *F. glumosa* was rich in fibre. The variation in the quantity of crude fibre between the *F. glumosa* containing soups might have been due to the different processing methods used on the vegetable before the actual cooking process. The soups with processed *F. glumosa* had higher fiber content than the unprocessed one. Fiber intake has been found to increase the process of digestion and bowel movement (Wu *et al*., 2003). The fibre content of the soup was mostly from the leafy vegetable (*F. glumosa*) and it tends to increase with the blanching of the vegetable but decreased in the blanched dried *F. glumosa* Soup. The values of fiber in the *F.glumosa* containing soups were higher than the values reported for egusi with ugu soup (1.84%); also higher than 0.88% which was the value reported for edikang ikon soup only and 1.25% reported for edikan ikon with pounded yam (Kayode *et al.,* 2008; Ani *et al*., 2012). Crude fibre in melon soup as reported by Kolawole and Obueh (2012) was 5.34% which was higher than all the soups analyzed in this study except GSBF. These variations could be due to the difference in cooking method, cooking time and ingredients used in the various soups.

The high fat content of the soups might be ascribed to groundnut and palm oil used in preparing the soups because they are good sources of fat. GSUB had the highest crude fat value ($p<0.05$); this might be due to the fact that the *F.glumosa* used in GSUB was not processed and for the other *F. glumosa* containing soups, that fat must have been reduced during the blanching and drying. Comparing the soups with the reported crude fat composition of other soups like melon soup (9.24%), afang soup and beef (9.98%), fufu and egusi soup (14.0%), and egusi with ugu (9.36%), interestingly, they have lower fat content than the soups in this study (Kolawole and Obueh, 2012; Okeke and Eze, 2006; Kayode *et al,* 2008). The Recommended dietary intake for total fat is minimum, 15% for adults, 20% for women in reproductive age, and adults with BMI less than 18.5 and 30-35% maximum (FAO, 2010). Therefore, these soups have the ability to meet the dietary requirements of the various age groups.

The quantity of crude ash in a sample supposedly shows the amount of minerals in it. The crude ash content of a biological material is the organic residue that is left, after organic matter has been burnt. *F. glumosa* containing groundnut soups had higher crude ash content than the groundnut soup without *F. glumosa* ($p<0.001$). This shows that the leafy vegetable was rich in mineral. Therefore, it is advisable to use leafy vegetable such as *F. glumosa* to fortify staple diet as this will enhance its nutritional value**.** Amongst the three soups, the GSBD had the highest crude ash content which affirmed that sun drying and shade drying increases the crude ash content of vegetable (Oguche, 2012). The different processing methods (blanching and drying) used on the vegetable before being added to the soup during cooking, could be the major contributors to the variation in the crude ash content between the *F. glumosa* containing soups. The crude ash content of melon soup and afang soup with beef reported by Kolawole and Obueh (2012) was 1.85 and 2.14% respectively. Kayode *et al.,* (2010) stated that the crude ash in egusi prepared with ugu soup and groundnut made with vegetable soup are 2.94 and 1.87% respectively. Kayode *et al* (2008) also reported the crude ash value of egusi cooked with ugu to be 1.05%. Moreover, Okeke and Eze, (2006) reported the crude ash of foo foo and egusi soup as 2.50 grammes. These values were lower than the values in the soup samples in this study. This variation must have been due to the difference in ingredients used, the cooking time and cooking method. The soups can provide minerals to meet the body's mineral need.

TABLE 2: Energy value and proximate composition of groundnut soups made with *F. glumosa* (% dry weight)

	Moisture Wet Weight	Moisture Dry Weight	Crude Ash	Crude Protein	Crude Fibre	Carbohydrate	Crude Fat	Energy(kcal)
GS	57.44 ± 0.30	42.56 ± 0.37	4.80 ± 0.12	31.77 ± 2.27	0.23 ± 0.04	2.43 ± 1.25	21.52 ± 3.99	330.56 ± 33.16
GSUB	64.56 ± 0.31 ^{c}	35.44 ± 0.33 ^{c}	7.10 ± 0.21 ^{c}	22.01 ± 2.62 ^{a}	2.77 ± 0.15 ^{c}	3.57 ± 1.75	29.10 ± 0.78 ^{a}	354.26 ± 13.36 ^{NS}
GSBD	61.46 ± 0.29 ^{c,f}	38.54 ± 0.06 ^{c,f}	7.83 ± 0.17 ^{c}	19.87 ± 1.32 ^{a}	3.18 ± 0.29 ^{c}	9.46 ± 1.84 ^{a,d}	21.11 ± 0.48 ^{d}	307.34 ± 2.29 ^{NS}
GSBF	66.23 ± 0.27 ^{c,f,x}	33.70 ± 0.29 ^{c,e,z}	7.08 ± 0.36 ^{c}	27.33 ± 4.02	5.37 ± 0.47 ^{c,f,z}	4.19 ± 2.06	22.34 ± 1.23	303.27 ± 26.05 ^{NS}

Values are means ± SEM, n = 3. Values with different subscripts on the same column are significantly different at P ≤ 0.05. NS = not significant vs. sample GS;
a = p < 0.05, c = p < 0.001 vs. sample GS;
d = p < 0.05, e = p < 0.01; f = p < 0.001 vs. sample GSUB;
x = p < 0.05, z = p < 0.001 vs. sample GSBD
GSBD: groundnut soup with blanched dried *F. glumosa* leaves
GSBF: groundnut soup with blanched *F. glumosa* leaves
GSUB: groundnut soup with unblanched *F. glumosa* leaves
GS: groundnut soup without any leaf

On wet weight basis, GSBF had the highest moisture content of 66.23% followed by GSUB with 64.56% and GSBD with a value of 61.46% all showing a significant difference ($p<0.001$) from GS while GS had the least value of 57. 44%. Among the three soups with *F.glumosa*, GSBD had the least moisture content which might be due to the effect of drying on the vegetable. All the soup samples analysed had high moisture content which ranged from 57.94% to 66.30% (wet weight). When compared to the moisture content of other soups like egusi soup which has been reported to have 62.97% moisture and egusi prepared with ugu has 63.11% moisture, GSBF and GSUB moisture content were higher than the values reported. But these reported values are higher than that of GS and GSBD (Kolawole and Obueh 2012; Kayode *et* al 2008). In 2010, Kayode *et al.* stated that the moisture content of groundnut soup with vegetable was 60.67% which is greater than GS but lower than other soup samples. The low moisture content of GS could be attributed to the absence of leafy vegetable in the soup. The high moisture content in all the soups studied suggested that the soups might contribute to the water needs of an individual for cellular activities.

The slightly moderate carbohydrate, crude fat and high crude protein content of the four soups increased the energy value of the soups. Ingredients like groundnut and the vegetable contributed greatly to the carbohydrate content of the soups. The caloric value calculated for these soups were high and same in all the soups. The carbohydrate content of the soups was moderate. The *F. glumosa* containing soups had a higher carbohydrate compared to the groundnut soup (GS). Amongst the soups with *F. glumosa,* GSBD had the highest carbohydrate value. A study revealed that caloric content does not change during drying, but is concentrated into a smaller mass as moisture is removed (Awogbemi and Ogunleye 2009). But the result in this study showed otherwise. Kolawole and Obueh (2012) obtained a carbohydrate value of 16.36% for melon soup which is higher than the soups in this study. Sanni *et al.,* (1999) had a value for vegetable soup which is lower than these soups (1.48% carbohydrate and 39.4kcal energy). Kayode *et al.,* (2008) reported 14.7% 168.8kcal as carbohydrate and energy value of egusi with ugu soup respectively. The carbohydrate value was higher and the energy value is lower than the studied soups. Also 0.24% and 94.5kcal were stated as the carbohydrate and energy value of edikan ikon soup by Kolawole and Obueh (2012). These values are lower than the carbohydrate values reported in this study. The carbohydrate content found in this soup could serve as an energy source to man. FAO (1997) stated that in an ideal food for all ages except children under the age of two, at least 55% of total energy should come from a variety of carbohydrate sources. WHO (1985) reported that an adult male requires 2944 Kcal of energy/day. Linking these values in soups to the recommended daily intake of an adult Nigerian man, consumption of a large quantity of the soup with a combination of the food like garri or fufu can supply an appreciable amount of the recommended daily intake (Owuamanam *et al.,* 2010).

Protein is a macronutrient crucial for growth and maintenance of the body (Falade *et al.,* 2012). The crude protein content in the soups was high. GSUB and GSBD were the same and they showed a significantly ($p<0.05$) higher crude protein content to GS. Indeed, the crude protein value compares favourably with other high crude protein containing soups like beniseed soup (22.75 to 19.40%) (Agiang *et al.,* 2010). The meat and fish added to the soups could contribute to their high protein value. The crude protein value in these soups is higher than that of melon soup (4.21%) (Kolawale and Obueh, 2012), and egusi with ugu (6.44%) (kayode *et al.,* 2008). This indicates that the soups are relatively a better source of protein. WHO (1985) stated that protein requirement is 0.8 g per kg of body weight, an adult male requires 49 grammes of protein/day and a ten-year-old child weighing 22 kg would require 18 grammes protein per day. The soups are good sources of protein especially GS, GSUB and GSBF and can contribute to the recommended daily protein requirement of human which is 23 to 56% as specified by National Research Council (NRC, 1980). The variation in the protein content amongst the soups might be due to protein denaturation as a result of heat treatment. This might reduce the availability of amino acids and hence decreased the protein value of the soups (FAO, 1997). There were variations in all the proximate nutrient contents amongst the studied soups and also from other soups reported in other studies. This could be caused by the extent of nutrient loss which depends on the cooking process, the treatment the food received before it was cooked, the cooking time, the amount of liquid used, the time which the food was kept hot before consumption and the physical state of the food (Agiang *et al.,* 2010).

The concentration of anti- nutrients obtainable in a soup affects the nutritive value of the soup. Oxalates and phytate chelate di- and tri- valent metallic ions like iron, zinc, magnesium and calcium to form insoluble or poorly soluble complexes that cannot be absorbed by the gastrointestinal tract, as a result, decreasing the nutrient bioavailability and utilization by the body (Adegunwa *et al*., 2011). Blanching and cooking have been shown to be the likely means of decreasing the anti-nutrient content in plant food to harmless level that can be tolerated by monogastric animal as well as man (Oguche, 2012). The phytate content of the soups ranged from 3.041 to 6.426 mg/100 g ; these values are higher than what was reported for beniseed soups by Agiang *et al.,* (2010). The results in this study (Table 5) revealed that the phytic acid and oxalate in the soups were below the toxic level for human consumption. Tannin is known to be bitter and form high polyphenol complex with protein thereby making it unavailable in foods (Ajala, 2009). The decreased quantity of tannin in the soups must have been due to the cooking process.

TABLE 5: Anti-nutrient composition of groundnut soups containing processed and unprocessed *F.* glumosa Soups (miligramme per 100 gramme)

Samples	GS	GSUB	GSBF	GSBD
Tannin (%)	0.57 ± 0.01	0.56± 0.01 ^{NS}	0.58 ± 0.20 ^{NS}	0.59 ± 0.41 ^{NS}
Total Oxalate	0.02± 0.03	0.02 ± 0.21 ^{NS}	0.01 ± 0.01 ^{NS}	0.03±0.01 ^{NS}
Phytate	3.04± 0.05	7.43 ± 0.02 ^{c,f}	6.27 ± 0.02 ^{c}	3.42±0.02 ^{c,f,z}

Values are mean ± SEM, n = 3. NS = not significant vs GS; c = p<0.001 vs GS; f = p<0.001 vs GSUB; z = p<0.001 vs GSBD.
GSBD: groundnut soup with blanched dried *F. glumosa* leaves
GSBF: groundnut soup with blanched *F. glumosa* leaves
GSUB: groundnut soup with unblanched *F. glumosa* leaves
GS: groundnut soup without any leaf

CONCLUSION

From the results of this study, it is necessary to use vegetables in foods to enhance their nutritional value. This should be encouraged amongst rural and urban dwellers in order to reduce protein-energy malnutrition and micronutrient deficiency illnesses, thus encouraging proper food use and diversification.

Conflict of interest

The authors have no conflict of interest to declare

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