ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 20 No. 3
May 2020
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2020; 20(3):15898-15918 DOI: 10.18697/ajfand.91.18055

PROXIMATE COMPOSITION AND SERVING SIZES OF SELECTED COMPOSITE GHANAIAN SOUPS

Appiah CA[1]*, Samwini AM[1], Brown PK[1], Hayford FEA[2,3] and O Asamoah-Boakye[1]

Collins A Appiah

Corresponding author email: caappiah.cos@knust.edu.gh; cappiahresearch@gmail.com

[1]Department of Biochemistry and Biotechnology (Human Nutrition and Dietetics Unit), Faculty of Biosciences, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

[2]Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, College of Health Sciences, University of Ghana, Accra, Ghana

[3]Centre of Excellence for Nutrition, Faculty of Health Sciences, North West University, Potchefstroom Campus, Potchefstroom, South Africa

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

ABSTRACT

Soups are major components of Ghanaian dishes. The composite nature of Ghanaian soups, in general, tend to make the calorie and macronutrient composition highly variable. This study sought to determine the proximate composition of selected Ghanaian soups from defined recipes and to photographically present quantities of the soups, measured with common Ghanaian household food measures, equivalent to servings of protein and carbohydrates. Two types of each conveniently selected soup (light soup, groundnut soup, kontomire (cocoyam leaves) soup and palm nut soup) were prepared; one with animal protein and the other without. The soups prepared include; **LS1**- light soup with garden eggplant (African eggplant); **LS2**- light soup with garden eggplant and chicken **GS1**- groundnut (peanut butter) soup without animal protein; **GS2**- groundnut soup with chicken; **PS1**- palm nut soup without animal protein; **PS2**- palm nut soup with smoked catfish and herrings. Proximate analysis was done to determine macronutrient content of all the soups. Each soup was measured using a household food measure (150 ml soup ladle) to obtain a 15 g carbohydrate and 7 g protein equivalent and then photographed. Carbohydrate content of the soups ranged between 1.18 g-8.43 g, protein was between 0.34 g-4.31 g and 0.14 g-7.78 g for fat per 100 g of edible portion. Palm nut soup with animal source protein had the highest carbohydrate (8.43 ± 0.86 g) and fibre (1.99 ±0.22 g) content. Soups with the highest protein and fat content were GS2 (4.29 ± 0.14 g) and PS1 (20.39 ± 3.54 g) respectively. Serving sizes of the soups prepared ranged approximately between 1-8½ soup ladles (using 150 ml soup ladle) per 15 g carbohydrate equivalence and 1-13 soup ladles (using 150 ml soup ladle) per 7 g protein equivalence. It took variable quantities of the prepared soups to obtain the target serving sizes with PS2 having the least quantity (~1 soup ladle) for 15 g carbohydrate serving and PS1 having the least amount (~1 soup ladle) for 7 g protein serving. The large serving size of most of the soups required to meet a serving of protein implied that those soups should be eaten together with food sources rich in protein, in order to appreciably enhance the protein intake of individuals.

Key words: Composite Ghanaian soups, serving size, protein, carbohydrates, fats, proximate composition

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

INTRODUCTION

In recent times, globally, and in developing countries like Ghana, changes in both diet and lifestyle have resulted in significant changes in nutritional status of individuals [1-3]. The implication is the increase in diet-related chronic conditions such as obesity, coronary heart disease, cancers, and diabetes [4], in addition to the existing problem of under nutrition, which is reflective of the double burden of disease seen in most developing countries [5]. Information on the nutrient intake of a population over a period can be used to study their diet-related disease epidemiology. Relevant up-to-date data on the nutrient composition of foods consumed by the population is needed for effective dietary assessment, nutrition education, targeted nutrition policy and interventions against the occurrence of diet-related diseases in the population. This is crucial in developing countries, including Ghana, where there has been an upsurge in diet-related chronic diseases in recent years [1-3].

Generally, people find it difficult to estimate the calorie contents of foods they eat [6]. It has been suggested that an individual's inability to estimate nutrient content of foods consumed, due to lack of appropriate tools for portion size estimation, could make portion and calorie control difficult [6,7]. In practice, dietitians estimate calories and macronutrient content of food consumed using the concept of servings [8-9]. A serving is a standard measure of food with known calorie and macronutrient content whilst a serving size is the measure of food equivalent to a serving. For instance, a serving of cooked rice has approximately 15 g carbohydrate, 3 g protein and 1 g fat, equivalent to 80 calories; half cup is the measure of cooked rice (serving size) equivalent to a serving [9-10]. In Ghana, dietitians use household food models popularly referred to 'handy measures' (food measuring tools used to quantify portion sizes of food) to represent food portions [6, 11]. Even though most Ghanaians would easily understand portion size estimation using household food measuring tools, their bulky nature make their use cumbersome [6]. Food photographs have been shown to be a simple and reliable tool for nutrient estimation [12].

Many nutrition stakeholders, especially dietitians, in Ghana identify the composite nature of Ghanaian foods as a major challenge in practically estimating their nutrient composition. Ghanaian soups are mostly composite with diverse recipes and as such, estimating calorie and nutrient content of the soups would depend on the specific recipe. Recipes of existing composition data on composite Ghanaian foods are not known, which limits the use of the data in estimating/recommending intakes for individuals. There is, therefore, the need for current data and a tool to aid estimation of servings, based on macronutrient and calorie content, of commonly consumed composite Ghanaian soups with defined recipes.

Presentation of serving sizes of commonly consumed foods in a less cumbersome form could help nutrition and dietetic professionals and the public to practically estimate the total calories and macronutrients in foods consumed. It is inconvenient and impractical to weigh foods at meals before consumption. Therefore, it has become imperative to have nutrient information on commonly consumed composite Ghanaian foods with defined recipes and an appropriate and reliable tool to assess and quantify their servings as seen

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

in countries like South Africa, where photographs are available of food portion sizes [13]. In 2014, a photographic food atlas was developed to represent portion sizes of commonly consumed carbohydrate-based foods in Accra, Ghana's capital city [14]. However, the composite nature of many Ghanaian foods, especially soups, and the variations in recipes make the calorie and macronutrient composition highly variable. Most Ghanaian dishes including soups, tend to vary by recipe between individuals, households and ethnicity. These soups do not have standard serving sizes due to their variable calorie and macronutrient content from their composite nature. There is limited data on the composition and recipes of composite Ghanaian foods [15-16]. Although the West Africa food composition table provides proximate compositions of some raw and cooked foods [17], it is limited to relevant information on the recipes of the composite indigenous dishes it contains. This research sought to determine the proximate composition of selected composite Ghanaian soups with defined recipes, and is the first to photographically present quantities of the soups, measured with common Ghanaian household food measures, equivalent to servings of protein and carbohydrates. Secondly, this study could provide insight for larger research in generating data on proximate composition and serving sizes of composite indigenous dishes in Ghana and other African countries, to aid nutrient estimations and recommendations.

MATERIALS AND METHODS

Sampling Sites

Sampling of ingredients for the preparation of the samples was conveniently done at the Ayigya market in the Ayigya community, a suburb in Kumasi, near the Kwame Nkrumah University of Science and Technology Campus. The ingredients were randomly selected from at least two different vendors in the market.

Recipe of soups

The soup recipes were conveniently obtained from women selling at a local market, as usually followed during soup preparation in households within the local communities in Kumasi, Ghana. The soups were prepared by the researchers, following the recipes obtained, at the Food kitchen of the Science Department. Prior to cooking, the quantity of each ingredient, described in the recipes obtained, was measured using a digital kitchen scale (Mark and Spencer, UK) and a measuring cup. The weight of each ingredient sourced from the local market, based on the description of size and quantities in the collected menu, were measured using the digital kitchen scale and documented. Two types of each conveniently selected soup (light soup with and without eggplant, groundnut (peanut butter) soup, kontomire (cocoyam leaves) soup and palm nut soup) were prepared using the same recipe; one with animal protein and the other without. The prepared soups were; **LS1**- light soup with garden eggplant (African garden eggplant); **LS2**- light soup with garden eggplant and chicken; **LS3**- light soup without garden eggplant, **LS4**- light soup without garden eggplant but with chicken; **GS1**-groundnut soup without animal protein; **GS2**- groundnut soup with chicken; **KS1**- kontomire soup without animal protein; KS2**-** kontomire soup with smoked catfish; **PS1**- palm nut soup without animal protein; **PS2** -palm nut soup with smoked catfish and herrings.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Preparation of light soup with garden eggplant

The light soup with garden eggplant (African garden eggplant), known locally as garden eggs, (LS1) was prepared using ingredients indicated in Table 1. To 1 litre of boiling water, 5 g of red chili powder, 15g of salt, 317 g of tomatoes and 229 g of onions were added and allowed to continue boiling until the onions and tomatoes were soft. Garden eggplant (354g) were simultaneously cooked in 750 ml of water for 20 minutes in another saucepan. When soft, the garden eggplant was removed, blended with 500 ml of water and sieved to obtain full soup. The soup was left to boil for 8 minutes after which the tomatoes and onions were removed, blended and sieved into the soup. The soup (LS1) was left to boil for 15 minutes and taken off the heat source. The same recipe was used to prepare light soup of garden eggplant with the addition of 268 g broiler chicken thigh as animal source protein (LS2).

Preparation of light soup without garden eggplant

A light soup base without garden eggplant (LS3) was prepared as follows; in a saucepan, 1 litre of water together with 15 g of salt and 5 g of pepper was placed on high heat for two minutes. To this mixture, 331 g of tomatoes and 209 g of onions was added and left to boil to soften tomatoes and onions. When soft, the onions and tomatoes were blended with 500ml of water and sieved into the soup. The soup (LS3) was left to boil for 15 minutes and then taken off the heat source. A light soup without garden eggplant was prepared, same as described for LS3. LS4 included 264 g of broiler chicken thigh as animal protein source (LS4).

Preparation of groundnut (peanut butter) soup

A baseline groundnut (peanut butter) soup (GS1) was prepared using the following procedure. In a plastic bowl, 157 g of groundnut paste was mashed with a 55 g tomato. When uniformly mixed, 1000 ml of water was added to dissolve the groundnut paste. Meanwhile, in another saucepan, 500 ml of water together with 7 g of powdered pepper and 18 g of salt were placed on high heat and allowed to cook for 10 minutes. The dissolved groundnut paste was added together with 250 g of fresh tomatoes and 246 g of onions and left to boil until tomatoes and onions were soft. The onions and tomatoes were removed, blended with 100 ml of water and sieved back into the soup. The soup (GS1) was left to boil until the accumulation of oil on the surface of the soup after which the soup was taken off the heat source. A similar groundnut soup was prepared from same recipe as GS1 but it contained broiler chicken thigh (267 g) as a source of protein (GS2).

Preparation of Kontomire (cocoyam leaves) soup

A baseline kontomire (cocoyam leaves) soup (KS1) was prepared using the following procedure. Fresh cocoyam leaves of 320 g were washed and boiled in 1000 ml of water for 20 minutes. The cocoyam leaves were drained, the filtrate stored and blended. In another saucepan, 500 ml of water together with 13 g of iodized salt and 5 g of powdered pepper was placed on high heat for two minutes. Tomatoes of 235 g and 190 g of onions were added and allowed to boil for 5 minutes. The ground cocoyam leaves together with the water used in boiling it as well as an extra 500 ml of water was added and allowed to boil for 20 minutes. The softened tomatoes and onions were then removed, blended with

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

250 ml of water, sieved and the filtrate added to the boiling soup. The soup (KS1) was then allowed to boil for 15 minutes and then taken off the heat source.

Similar kontomire soup was prepared following same recipe with addition of 226 g of smoked cat fish as animal protein source (KS2).

Preparation of palm nut soup

A baseline palm nut soup (PS1) was prepared using the following procedure. Palm nuts of 1200 g was washed and boiled with 2000 ml of water until the nuts were soft. The palm nut was sieved out and pounded until the flesh was peeled off. The pounded nuts were dissolved in 2500 ml of warm water. The palm pulp juice was obtained by sieving the nuts and husks from the nuts. In another saucepan, 500 ml of water together with 7 g of powdered pepper and 20 g of salt were put together with 265 g of onions and 317 g of tomatoes and allowed to heat for 10 minutes. The palm pulp juice of 3000 ml was added and allowed to boil for 25 minutes, after which, the softened onions and tomatoes were removed, blended with 250 ml of water, sieved and the filtrate poured into the soup. The soup was left to boil until there was accumulation of oil on the surface after which the soup (PS1) was taken off the heat source. Palm nut soup with addition of smoked catfish (135 g) and herrings (38 g) were added to PS2 as animal protein source (PS2) was prepared from same recipe as PS1.

Table 1 shows the recipes of various soup with and without animal protein.

Chemical analysis

Proximate analysis was done according to AOAC [18] to determine moisture, fat, protein and ash contents, while the carbohydrate content of the samples was determined by difference of the moisture, protein, fat and ash contents from 100 [18].

Quality Control

Canned milk was analysed as a standard sample of known nutrient content for quality control. The values obtained in the laboratory were compared to the published values on the milk label. The protein and calorie values obtained after the analysis were similar to the values stated on the milk label. The calorie content obtained in this analysis was 138.76 kcal per 100 g whereas the data on the milk product was 137 kcal per a 100 g of the milk. This gives an indication of the accuracy of the nutrient analysis process in this study.

Energy determination

Energy value for each sample was determined by multiplying the corresponding energy value of each macronutrient per gram. Carbohydrate content was multiplied by 4 kcal per gram, protein by 4 kcal per gram and fat, 9 kcal per grams estimated by the bomb calorimeter [9].

Determination of servings and serving sizes

From the results obtained after proximate analysis of each soup sample, quantities of each soup equivalent to per 15 g carbohydrates and 7 g protein servings [9] and their corresponding serving sizes per 150 ml soup ladle (Figure 1) were determined by calculation using Microsoft Excel.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Photographic representation of serving sizes
Serving sizes of soups containing 15 g carbohydrate and 7 g protein respectively, was measured using a 150 ml soup ladle and photographed. Photographs of the soups were taken at a height of 0.54 metre from the sample, a distance of 1.1 metre from the food and an angle of 45^0. A Nikon D5300 camera was used with a camera quality of 24 megapixels [19, 20]. The weights of the soups were presented in the respective tables.

Data analysis
Means and standard deviations of each sample type was calculated using Microsoft Excel (Microsoft Office, 2016) since each soup sample was analysed in duplicates, and this was presented as mean ± SD.

RESULTS AND DISCUSSION

Commonly consumed Ghanaian soups prepared and analysed were chicken light soup with garden eggplant (LS2), chicken light soup without garden eggplant (LS4), chicken peanut butter soup (GS2), kontomire (cocoyam leaves) soup with smoked catfish (KS2) and palm nut soup with smoked catfish and herrings (PS2). Animal protein (lean meat, fish and chicken) served as the varying factor for this analysis in that two forms of each soup were prepared, one with animal protein (meat, fish and chicken) and the other without. Soups prepared without animal protein source were described as baseline soups, labeled; LS1, LS3, GS1, KS1 and PS1 respectively. Sample PS1 contained the highest protein and fat percent, while sample PS2 contained the highest carbohydrate percent (Table 2). Industrially manufactured evaporated canned milk was analysed as a standard sample (Table 3). Per 15 g carbohydrate serving of the samples, sample PS1 contained the highest protein, fat and calories content, followed by sample GS2 and PS2 (Table 4). Per 7 g protein serving, sample LS1 contained highest carbohydrate content, while sample PS1 had the highest fat content and calories (Table 5).

Moisture content of soups
The moisture contents of the soups were high. This is because their preparation process, in the local Ghanaian communities required the addition of a lot of water especially for the precooking of vegetables and blending. It was observed that the moisture contents of baseline soups (soups without animal protein source) were relatively higher than the soups with animal protein source. The highest moisture value was recorded for Kontomire (cocoyam leaves) soup without animal source protein (KS1). The animal source protein could have absorbed some water for softening, resulting in lower moisture value for the soups with animal source protein. Another possible reason for high moisture content could be due to variations in composition of vegetables which depended on harvesting time, maturation period, storage conditions, humidity and temperature of growing period [21]. A similar study by Obiakor–Okeke *et al.* [22] found moisture content of kontomire (cocoyam leaves) soup to be 56.7% whereas in this study moisture content of kontomire soup was 96.8% (KS1) and 92.8% (KS2), which are higher than that reported by Obiakor-Okeke *et al.* [22]. Variation in recipes used for soup preparation due to cultural differences could also account for these observed differences.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Fat content of soups

The highest fat contents were recorded in palm nut soups without animal source protein (PS1), palm nut with smoked catfish and herrings (PS2), chicken groundnut soup (GS2) and groundnut soup without animal source protein (GS1). Palm nut and groundnut are known to be rich sources of fat. Specifically, groundnut (peanut) is a rich source of oleic acid [23]. The lowest fat contents were obtained in light soup without garden eggplant and animal source protein (LS3) and the other soups without animal source protein. It was observed that the soup samples with animal source protein had relatively high fat content compared to their corresponding baseline soups. The relative increase could be contributed by the fat portions in animal source protein. Also, a relatively higher fat content was observed in the soups whose animal protein source was chicken; as found in chicken light soup and chicken groundnut soup compared to that of the soups whose animal source protein were smoked catfish, herrings and lean meat. The possible explanation is the amounts of fat present in chicken skin as samples used were not de-skinned. Tayie and Lartey [16] reported fat content of groundnut soup of about twice the value found in this study. This difference in fat contents may be due to the variations in recipes which was not specified in their study. This suggests that groundnut soup and palm nut soup could contribute to high overall calorie intake in the Ghanaian diet. The amount of fat consumed may be relatively less for homes where the oil accumulated on the surface of soups are decanted before consumption. In recent times, decanting of excess oil from surface of oily soup such as palm nut soup and groundnut soup has become a common practice among Ghanaians due to increasing awareness of health risks of excess fat/oil consumption.

Protein content of soups

The protein contents of the soups were not high in this study, especially the baseline soups. This is because vegetables were used in the preparation of the soups, and they do not contain significant amount of protein. From the study, the highest protein contents were found in chicken groundnut soup (GS2) and the two palm nut soups. Similarly, it was observed that the protein contents of the soups with animal source protein were relatively higher compared to the baseline soups. This may probably be the dissolution of the animal protein into the soup during the boiling process. Tayie and Lartey [16] also reported relatively similar protein contents for the soups, except palm nut soup with animal source protein which had about twice the value reported by Tayie and Lartey [16] for palm nut soup. The low protein contents of the soups suggest the need to incorporate high protein foods such as animal source protein and legumes in their preparation to help meet protein needs of individuals whose diet are soup based. Ghanaian children fed mostly on soups without addition of protein-rich food could be prone to protein malnutrition.

Carbohydrate content of soups

The carbohydrate contents were generally low in all the soups (Table 2). This could be because the ingredients used in the preparation of the soups were not carbohydrate-rich foods. Notwithstanding, palm nut soup with smoked catfish and herrings had the highest carbohydrate content. This may have been contributed to by the palm fruits which are known to contain 30.5% carbohydrate [16]. Carbohydrate is an essential macronutrient

and required by the body for energy metabolism as such these soups need to be accompanied with foods rich in carbohydrates.

Servings of the Soups

Photographs of servings presented in this study were to provide individuals with an easy measure for identification of serving sizes to ensure good estimation and management of nutrient intake. Inability to determine serving size has been linked to excess calorie intake in previous studies [24-26]. In the determination of serving sizes, servings of 15 g carbohydrate and 7 g protein were used. These were used because in practice, a serving of a carbohydrate-rich food is 15g whereas a serving of a protein-rich food is 7 g of protein [9, 10]. Due to the composite nature of the soups, both servings were determined for each soup. The energy content of each of these servings were also determined as well as the weight of soup and serving sizes (using150 ml soup ladle) equivalent to the servings (Table 4-5).

Serving per 15 g Carbohydrate

It was observed after the determination of the serving sizes that a relatively high quantity (up to 8½ of 150 ml soup ladles) of the baseline soups was needed to obtain the 15 g carbohydrate serving (Table 4). This is because, the initial carbohydrate content of these soups was low and hence to obtain 15 g carbohydrate, high quantities of the soup were needed. The soups which contained animal source protein had relatively higher carbohydrate content and hence relatively smaller quantities were needed to obtain the 15 g carbohydrate serving. In Ghana, people generally do not prepare soups without animal source protein; hence the serving sizes may be similar to that of the soups with animal source protein in this study.

Serving per 7 g Protein

It was observed after the determination of the serving sizes that relatively high quantities (up to thirteen 150 ml soup ladles) of the baseline soups were needed to obtain 7 g protein serving (Table 5). This is because vegetables which were mainly used in preparation are low protein sources. Hence to obtain 7 g protein, high quantities of the soup was needed. The soups which contained animal source protein had relatively higher protein content than the baseline soups. Therefore, relatively smaller quantities of such soups were needed to obtain the 7 g protein serving. However, in Ghana people generally tend to prepare soups with animal source protein, hence the serving sizes (amount needed to obtain 7 g protein serving) may likely be lower, than what was observed in the baseline soups (without animal source protein) in this study

Photographic representation of serving sizes

Serving sizes corresponding to a common Ghanaian household food measure (a 150 ml soup ladle) for soups per 15 g carbohydrate and per 7 g protein were measured, served out and photographed. Figure 1-5 shows the pictorial images of the various serving sizes (using a 150 ml soup ladle) per 15 g carbohydrate and 7 g servings. Serving sizes per 15 g carbohydrate for the soups were as follows: LS1 (4.80 soup ladles), GS1 (3.07 soup ladles), LS2 (4.47 soup ladles), KS1 (3.50 soup ladles), and PS1 (1.19 soup ladles). Serving sizes per 7 g protein for the soups were: LS1 (3.62 soup ladles), GS1 (1.12 soup ladles), LS2 (5.66 soup ladles), KS1 (2.26 soup ladles) and PS1 (1.19 soup ladles). It is

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 20 No. 3
May 2020
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

expected that the photographs will help individuals estimate the calorie and macronutrient content of the soups, and also aid estimation of quantities of these soups as simpler alternative to weighing foods. Individuals will also be able make informed decisions based on serving sizes of the soups. Finally, the photographs can be used to assess and control macronutrient and calorie intake as well as aid dietitians in planning diet in therapeutic management of disease conditions.

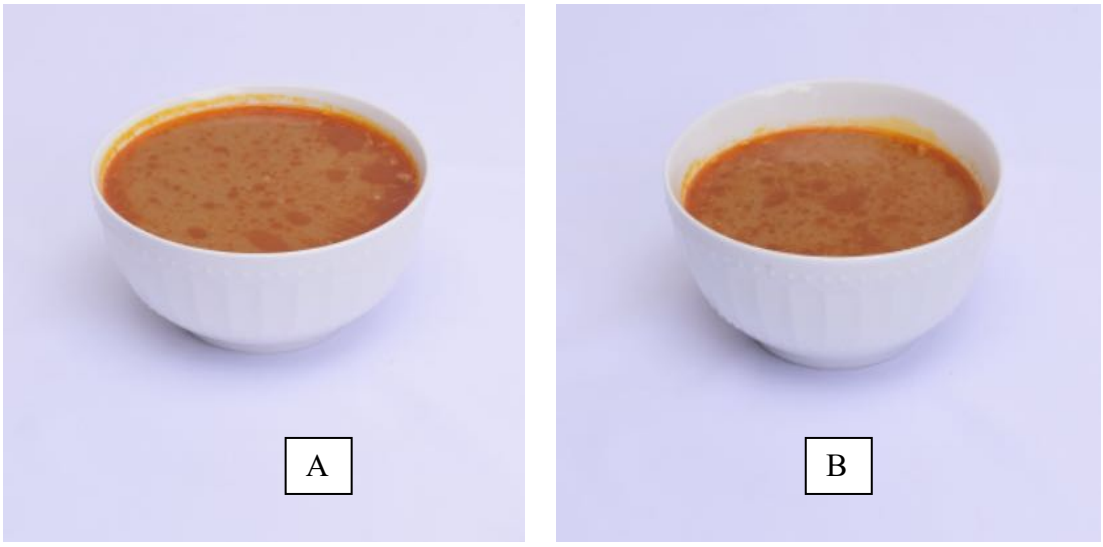

Figure 1:
A: Serving size for 15g carbohydrate of light soup with garden eggplant (LS1)
B: Serving size of 7g protein of light soup with garden eggplant (LS1)

Figure 2:
A: Serving size for 15g carbohydrate chicken light soup with garden eggplant (LS2)
B: Serving size of 7g chicken light soup without garden eggplant (LS2)

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 20 No. 3
May 2020
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Figure 3:
A: Serving size for 15g carbohydrate of kontomire soup with smoked catfish (KS1)
B: Serving size 7g protein of kontomire soup with smoked catfish (KS1)

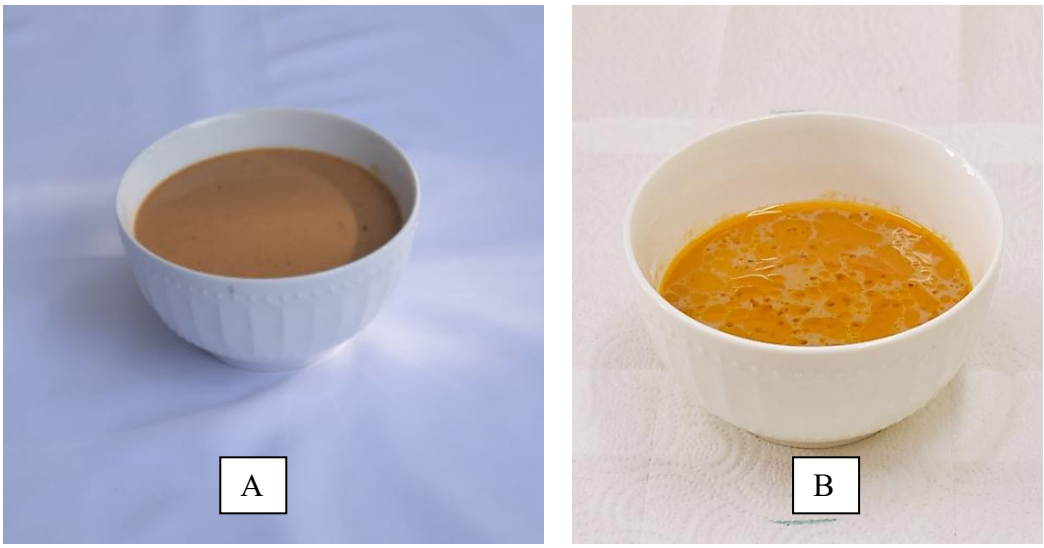

Figure 4:
A: Serving size for 15g carbohydrate of chicken groundnut soup (GS2)
B: Serving size for 7g protein of chicken groundnut soup (GS2)

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 20 No. 3
May 2020
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

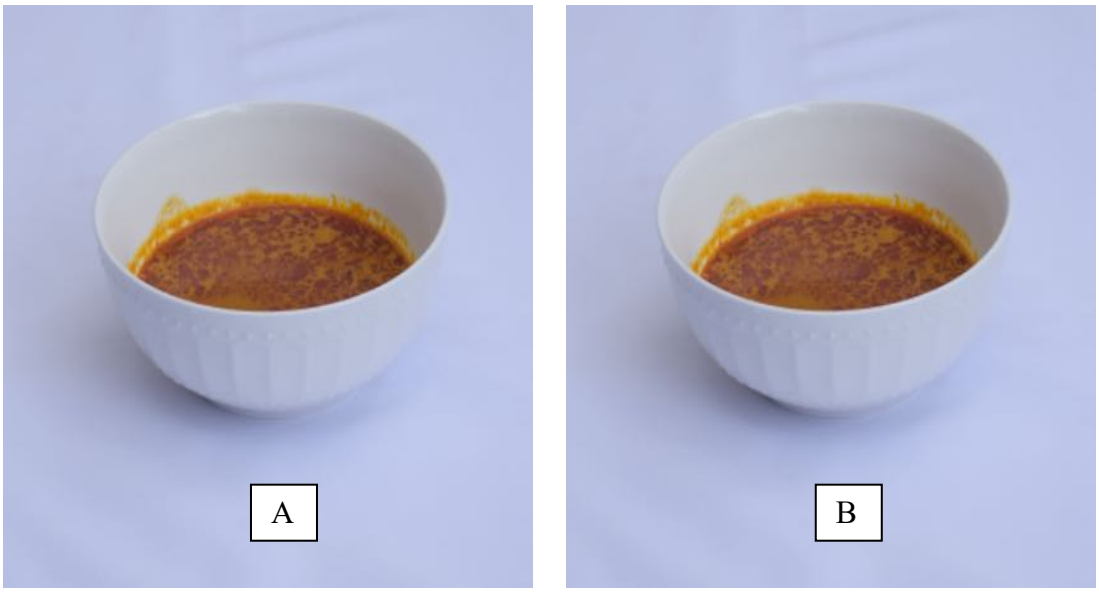

Figure 5:
A: Serving size for 15g carbohydrate of palm soup with smoked catfish and herrings (PS2)
B: Serving size for 7g protein of palm soup with smoked catfish and herrings (PS2)

LIMITATIONS

The soups were prepared by student volunteers and not community women which could have introduced bias in the preparation. However, the soup recipes and preparation methods were obtained from the local community market women. Due to limited funds, only one sample of each of the composite soups was prepared. Nonetheless, this study provides insights for further studies on composition and serving sizes of composite indigenous African foods.

CONCLUSION

The proximate composition and serving sizes per 15 g carbohydrate and 7 g protein servings of some selected composite Ghanaian soups with defined recipes were determined and presented photographically. Chicken groundnut soup (GS2) had the highest protein content, followed by palm nut soup without animal source protein (PS1) and palm nut soup with smoked catfish and herrings (PS2). Serving sizes of the soups prepared ranged approximately between 1-8½ soup ladles (using 150 ml soup ladle) per 15 g carbohydrate equivalence and 1-13 soup ladles (using 150 ml soup ladle) per 7 g protein equivalence. The large serving sizes of most of the soups required to meet the servings of carbohydrate and proteins implied that they should be eaten with foods rich in carbohydrate and protein to appreciably enhance the energy and protein intake of individuals, especially in children among whom undernutrition due to low protein intake is still a public health concern in Ghana. However, dietitians/nutritionists could recommend frequent intake of the soups to substitute high carbohydrate and high fat foods to help combat the increasing burden of overnutrition-related diseases. Pictorial images of the servings of Ghanaian soups would aid dietitians/nutritionists and the public

in estimating macronutrient intakes from the soups which is often difficult to determine due to limited documented information on recipes and nutrient content of composite Ghanaian soups. This study will provide insight for large research to generate data on recipes, proximate composition and serving sizes of composite indigenous dishes, in order to improve quality of nutrient estimations and recommendations in Ghana and other African countries. This was a small study with limited funds for large sampling from within the community. Larger studies involving sampling composite foods from within the community to reflect more representative recipes and dishes are needed.

Authors' contribution

All authors contributed to the preparation and final writing of this manuscript. Author CAA, PKB and AMS wrote the original concept, protocol, designed the study and performed data analysis. Authors CAA, AMS, FEAH and OAB contributed to literature search, data analysis and writing of manuscript. All authors read and approved the final manuscript.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 1: Recipes of soups with and without animal protein

Ingredients	Weight (g)	
	Without animal protein	With animal protein
	Light soup with garden eggplant	
	LS1	**LS2**
Red chili powder	5	5
Salt,	15	15
Tomatoes	317	317
Onions	229	229
Egg plant	354	354
broiler chicken thigh	-	268
	Light soup without garden eggplant	
	LS3	**LS4**
Salt	15	15
Pepper	5	5
Fresh tomatoes	331	331
Onions	209	209
Broiler chicken thigh		264
	Groundnut soup (g)	
	GS1	**GS2**
Groundnut paste	157	157
Fresh tomato	305	305
Powdered pepper	7	7
Salt	18	18
Onion	246	246
Chicken thigh		267

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Ingredients	Weight (g)	
	Without animal protein	With animal protein
	Kontomire Soup (g)	
	KS1	**KS2**
Cocoyam leaves	320	320
Salt	13	13
Powdered pepper	5	5
Fresh tomatoes	235	235
Onion	190	190
Smoked cat fish		226
	Palm nut soup (g)	
	PS1	**PS2**
African oil palm nut	1200	1200
Salt	20	20
Powdered pepper	7	7
Onion	265	265
Fresh tomatoes	317	317
Smoked cat fish		135
Herrings		38

LS1- Light soup with garden eggplant; **LS2**- Light soup with garden eggplant and chicken; **LS3**- Light soup without garden eggplant, **LS4**- Light soup with chicken without garden eggplant; **GS1**-Groundnut (peanut butter) soup without animal source protein; **GS2**- Groundnut (peanut butter) soup with chicken; **KS1**- Kontomire (cocoyam leaves) soup without animal source protein; KS2-Kontomire (cocoyam leaves) soup with smoked catfish; **PS1**- Palm nut soup without animal source protein; **PS2**- Palm nut soup with smoked catfish and herrings

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 2: Proximate composition of soups

Soup	Moisture (%) Mean ± SD	Fat (%) Mean ± SD	Fibre content (%) Mean ± SD	Protein (%) Mean ± SD	Ash (%) Mean ± SD	Carbohydrate (%) Mean ± SD
LS1	95.90 ±0.14	0.32 ± 0.02	0.63 ±0.04	0.34 ± 0.01	0.91 ± 0.02	2.38 ± 0.14
LS2	93.00 ±0.00	1.51 ± 0.00	0.80 ±0.28	1.28 ± 0.02	1.84 ±0.02	2.09 ± 0.13
LS3	95.70 ±0.14	0.14 ± 0.02	0.71 ±0.19	0.41 ± 0.01	1.48 ± 0.05	2.24 ± 0.04
LS4	94.70 ±0.14	0.93 ± 0.02	0.45 ±0.00	0.81 ± 0.02	1.15 ± 0.05	2.24 ± 0.06
GS1	89.70 ±0.42	3.86 ± 0.16	0.89 ±0.20	2.19 ± 0.09	1.03 ± 0.04	2.39 ± 0.05
GS2	82.30 ±0.71	7.78 ± 0.06	0.70 ±0.15	4.29 ± 0.14	2.17 ± 0.15	3.29 ± 0.47
KS1	96.80 ±0.00	0.22 ± 0.01	0.48 ±0.01	0.45 ± 0.00	0.78 ± 0.00	1.69 ± 0.00
KS2	92.80 ±0.00	0.85 ± 0.03	1.24 ±0.53	2.07 ± 0.01	1.21 ±0.03	2.86 ± 0.01
PS1	71.50±4.67	20.39 ± 3.54	1.94 ±0.31	4.08 ± 0.67	2.22 ± 0.46	1.18 ± 0.01
PS2	65.30 ±3.54	17.00 ± 1.73	1.99 ±0.22	4.23 ± 0.43	3.64 ± 0.37	8.43 ± 0.86

LS1- Light soup with garden eggplant;**LS2**- Light soup with garden eggplant and chicken;**LS3**-Light soup without garden eggplant, **LS4**-Light soup with chicken without garden eggplant; **GS1**-Groundnut (peanut butter) soup without animal source protein; **GS2**-Groundnut (peanut butter) soup with chicken; **KS1**- Kontomire (cocoyam leaves) soup without animal source protein; KS2-Kontomire (cocoyam leaves) soup with smoked catfish; **PS1**- Palm nut soup without animal source protein; **PS2**- Palm nut soup with smoked catfish and herrings. Data are based on dry weight of sample and presented as means ± SD (standard deviation) using Microsoft Excel

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 3: Carbohydrate, protein, fat and calorie content per 100 g of milk sample

Sample	Carbohydrate (g)	Protein(g)	Fat(g)	Calories(kcal)
Analysed evaporated tinned milk	8.2 ± 0.1	4.3 ± 0.0	9.8 ± 0.1	138.7 ± 0.5
Content specified on milk label	11.6	4.9	7.9	137

Data are based on dry weight of sample and presented as means ± SD (standard deviation) using Microsoft Excel

Table 4: Protein, fat, calorie and serving size per 15g carbohydrate of the soups

Soup	15 g Carbohydrate serving	Protein (g)	Fat(g)	Calories (kcal)	Serving size (per 150 ml soup ladle)	Weight of soup (g)
LS1	15 ± 0.00	2.16 ± 0.05	2.00 ± 0.01	86.64 ± 1.47	4.20	630.09±37.04
LS2	15 ± 0.00	9.17 ± 0.42	10.83 ± 0.65	194.15 ± 7.53	4.80	719.51±43.12
LS3	15 ± 0.00	2.73 ± 0.04	0.94 ± 0.11	79.35 ± 1.18	4.47	670.60±12.95
LS4	15 ± 0.00	5.40 ± 0.03	6.21 ± 0.01	137.51 ± 0.18	4.47	669.78±16.97
GS1	15 ± 0.00	13.71 ± 0.83	24.22 ± 1.47	332.80 ± 16.58	4.18	626.74±12.28
GS2	15 ± 0.00	19.71 ± 2.18	35.89 ± 5.45	461.87 ± 57.83	3.07	461.04±66.30
KS1	15 ± 0.00	4.03 ± 0.00	1.92 ± 0.10	93.39 ± 0.92	5.92	887.70±0.12
KS2	15 ± 0.00	10.87 ± 0.05	4.44 ± 0.12	143.39 ± 0.92	3.50	524.44±1.03
PS1	15 ± 0.00	52.07 ± 8.91	260.28 ± 46.95	2610.78 ± 458.21	8.50	1275.48±8.93
PS2	15 ± 0.00	7.53 ± 0.01	30.24 ± 0.01	362.27 ± 0.11	1.19	178.79±18.27

LS1- Light soup with garden eggplant; **LS2**- Light soup with garden eggplant and chicken; **LS3**-Light soup without garden eggplant, **LS4**-Light soup with chicken without garden eggplant; **GS1**-Groundnut (peanut butter) soup without animal source protein; **GS2**-Groundnut (peanut butter) soup with chicken; **KS1**- Kontomire (cocoyam leaves) soup without animal source protein; KS2-Kontomire (cocoyam leaves) soup with smoked catfish; **PS1**- Palm nut soup without animal source protein; **PS2**- Palm nut soup with smoked catfish and herrings. Data are based on dry weight of sample and presented as means ± SD (standard deviation) using Microsoft Excel

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 20 No. 3 May 2020 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 5: Carbohydrate, fat, calorie contents of the soups and serving size per 7g protein of the soups

Soup	7 g protein serving	Carbohydrate (g)	Fat (g)	Calories (kcal)	Serving size (per 150 ml soup ladle)	Weight of soup (g)
LS1	7 ± 0.00	48.68 ± 1.18	6.49 ± 0.30	281.13 ± 2.07	13.29	2043.46 ± 70.49
LS2	7 ± 0.00	11.46 ± 0.53	8.26 ± 0.12	148.18 ± 1.07	3.62	548.90 ± 7.67
LS3	7 ± 0.00	38.51 ± 0.52	2.40 ± 0.26	203.67 ± 0.26	11.21	1721.76 ± 0.91
LS4	7 ± 0.00	19.43 ± 0.10	8.04 ± 0.03	178.10 ± 0.66	5.66	867.56 ± 26.37
GS1	7 ± 0.00	7.67 ± 0.47	12.36 ± 0.00	169.97 ± 1.87	2.20	320.39 ± 13.20
GS2	7 ± 0.00	5.36 ± 0.59	12.72 ± 0.53	163.90 ± 2.37	1.12	163.43 ± 5.43
KS1	7 ± 0.00	26.04 ± 0.02	3.33 ± 0.17	162.11 ± 1.49	10.27	1541.04 ± 0.77
KS2	7 ± 0.00	9.66 ± 0.05	2.86 ± 0.09	92.38 ± 1.02	2.257	337.87 ± 0.91
PS1	7 ± 0.00	2.05 ± 0.35	34.96 ± 0.33	350.86 ± 1.56	1.02	173.92 ± 28.56
PS2	7 ± 0.00	13.95 ± 0.01	28.13 ± 0.02	336.94 ± 0.20	1.19	166.28 ± 16.85

LS1- Light soup with garden eggplant; **LS2**- Light soup with garden eggplant and chicken; **LS3**-Light soup without garden eggplant, **LS4**-Light soup with chicken without garden eggplant; **GS1**-Groundnut (peanut butter) soup without animal source protein; **GS2**-Groundnut (peanut butter) soup with chicken; **KS1**- Kontomire (cocoyam leaves) soup without animal source protein; KS2-Kontomire (cocoyam leaves) soup with smoked catfish; **PS1**- Palm nut soup without animal source protein; **PS2**- Palm nut soup with smoked catfish and herrings. Data are based on dry weight of sample and presented as means ± SD (standard deviation) using Microsoft Excel

REFERENCES

1. **Popkin BM and P Gordon-Larsen** The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obesity.* 2004;**28**: S2-S9.

2. **Prentice AM** The emerging epidemic of obesity in developing countries. *Int J Epidemiol*.2006; **35**: 93-99.

3. **Ministry of Health**. Strategy for the management, prevention and control of chronic non-communicable diseases in Ghana 2012-2016. 2012; pp. 7, 13 and 19.

4. **World Cancer Research Fund International**. The link between food, nutrition, diet and non-communicable diseases. World Cancer Research Fund International and the NCD Alliance, 2014. Available online at www.wrcf.org. Accessed 15th October, 2018.

5. **Semba RD** The rise and fall of protein malnutrition in global health. *Ann Nutr Metab*. 2016; **69(2)**: 79-88.

6. **Peprah GB** A Photographic Food Atlas of Commonly Consumed Carbohydrate Based Food with Portion Sizes in Accra Ghana (PhD Thesis). University of Ghana. 2014.

7. **Byrd-Bredbenner C and J Schwartz** The effect of practical portion size measurement aids on the accuracy of portion size estimates made by young adults. *Journal of Human Nutrition and Dietetics*. 2004;**17**: 351–357.

8. **Hannum SM, Carson LA, Evans EM, Canene KA, Petr EL, Bui L and JW Erdman** Use of portion-controlled entrees enhances weight loss in women. *Obesity Research*. 2004; **12**: 538-546.Available at www.fao.org/fileadmin/templates/food_composition/images/FCD.pdf. Accessed 15th February, 2018

9. **Herman IP** Metabolism: Energy, Heat, Work, and Power of the Body. InPhysics of the Human Body 2016 (pp. 393-489). Springer, Cham.

10. **Wardlaw MG** Contemporary Nutrition, Fourth Edition, McGraw Hill Higher Education, New York. 2003; pg. 208.

11. **Owusu AA, Ankrah M, Boateng PG and G Anteh** Food weights/food measures tables. Accra: The Dreyfus Health Foundation of New York. 1995.

12. **Small L, Sidora-Arcoleo K, Vaughan L, Creed-Capsel J, Chung K and C Stevens** Validity and reliability of photographic diet diaries for assessing dietary intake among young. *ICAN: Infant, Child, & Adolescent Nutrition.* 2009;**1(1)**: 27-36.

13. **Lombard M, Steyn N, Burger HM, Charlton K and M Senekal** A food photograph series for identifying portion sizes of culturally specific dishes in rural areas with high incidence of oesophageal cancer. *Nutrients*. 2013; **5(8)**: 3118–3130. http://doi.org/10.3390/nu5083118

14. **Boateng G** The development of a photographic food atlas with portion sizes of commonly consumed carbohydrate foods in Accra, Ghana. 2014; PhD Thesis, University of Ghana.

15. **Eyeson KK, Ankrah EK, Sundararajan AR, Karinpaa A and MJ Rudzka** Composition of Foods Commonly Used in Ghana. Accra: Secretariat of the council for Scientific and Industrial Research. 1975.

16. **Tayie FAK and A Lartey** Nutrient contents of some typical Ghanaian foods. University of Ghana. 1999; 1-5.

17. **Stadlmayr B, Charrondiere UR, Enujiugha VN, Bayili RG, Fagbohoun EG, Samb B, Addy P, Barikmo I, Outtara F, Oshaug A, Akinyele I, Annor GA, Bomfeh K, Ene-Obong H, Smith IF, Thiam I and B Burlingame** West African Food Table. FAO of the United Nations, Rome, 2012. Available online at (http://www.fao.org/3/a-i2698b.pdf). Accessed 15th February, 2018.

18. **Association of Official Analytical Chemistry (AOAC).** Official Methods of Analysis, 20th Edition, AOAC International, Washington DC. 1990;p.1230. https://law.resource.org/pub/us/cfr/ibr/002/aoac.methods.1.1990.pdf. Accessed 10th March, 2017.

19. **Bouchoucha M, Akrout M, Bellali H, Bouchoucha R, Tarhouni F, Mansour AB and B Zouari** Development and validation of a food photography manual, as a tool for estimation of food portion size in epidemiological dietary surveys in Tunisia. *Libyan Journal of Medicine*. 2016 **11(1)**:32676.

20. **Harris-Fry H, Paudel P, Karn M, Mishra N, Thakur J, Paudel V, Harrisson T, Shrestha B, Manandhar DS, Costello A and M Cortina-Borja** Development and validation of a photographic food atlas for portion size assessment in the southern plains of Nepal. *Public health nutrition*. 2016;**19(14)**:2495-507.

21. **Kader AA** Pre- and postharvest factors affecting fresh produce quality, nutritional value and implications for human health, Proceedings of the international congress food production and the quality of life, Sassari (Italy). 2002; Volume **1**: 109-119.

22. **Obiakor–Okeke PN, Obioha BC and EN Onyeneke** Nutrient and sensory evaluation of traditional soups consumed in Igbere Community in Bende local government area, Abia State, Nigeria. *International Journal of Nutrition and Food Science*. 2014; **3(5)**: 370-379.

23. **Atasie VN, Akinhanmi TF and CC Ojiodu** Proximate analysis and physico-chemical properties of groundnut (*Arachis hypogeae L.*). *Pakistan Journal of Nutrition*.2009; **8(2)**: 194-197.

24. **Ello-Martin JA, Ledikwe JH and BJ Rolls** The influence of food portion size and energy density on energy intake: implications for weight management. *The American Journal of Clinical Nutrition*.2005; **82(1)**: 236–241.

25. **Rolls BJ, Drewnowski A and JH Ledikwe** Changing the energy density of the diet as a strategy for weight management. *Journal of American Dietetic Association*. 2005;**105(52)**: 98–103.

26. **Kral TV, Roe LS and BJ Rolls** Combined effects of energy density and portion size on energy intake in women. *Journal of Clinical Nutrition*. 2004;**79(8)**: 962–968.