

# The Use of Indigenous Green Leafy Vegetables in the Preparation of Ghanaian Dishes

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## Abstract

**Background:** The study assessed uses of Indigenous Green Leafy Vegetables (IGLV's) in the preparation of Ghanaian dishes. Expensive exotic vegetables are patronized more than cheaper indigenous ones. Providing adequate nutritional information on IGLV's together with recipe formulation could encourage consumption. The objectives were to highlight health benefits of IGLV's, develop recipes from selected IGLV's and determine their acceptability.

**Materials and methods:** A self-developed questionnaire was administered to 40 randomly selected individuals to assess uses of IGLV's in food preparation. Fifteen individuals (10 males and 5 females) out of the 40 were purposively selected to sensorily evaluate 10 recipes developed from 4 selected (IGLV's) to ascertain their overall acceptability. Panelists' scores were subjected to ANOVA and Tukey's test at  $\alpha \leq 0.05$ .

**Results:** Out of 10 (IGLV's) identified by participants, only 4 were often used. Among the 4, *Corchorusalitorius L.* commonly called "Bush okra" was the most used and Dandelion was the least used. Recipes prepared with vegetables included stews, soups, salads and drinks and the soups were the most accepted by panel members who tasted. For overall acceptability, Ayoyo soup was judged the best followed by Dandefam and Dande pine swizzle the least. Flavor of the products differed significantly at  $\alpha \leq 0.05$ .

**Conclusions:** IGLV's could augment exotic vegetables in Ghanaian dishes if new tasty recipes are developed from hygienic vegetables and accepted by consumers. This will help keep the health value of the vegetables and promote the associated good health when eaten.

**Keywords:** Green leafy vegetables; Vitamins; Health; (IGLV's) Recipes

## Introduction

Vegetables are highly beneficial for maintaining health and preventing diseases. Dark green leafy vegetables provide high amounts of micro-minerals which play vital roles in nutrient metabolism and retard degenerative diseases [1]. In Ghana, both wild and cultivated green leafy vegetables are used in food preparation. However, more people tend to patronize cultivated exotic vegetables which are often more expensive than indigenous ones that are cultivated or grow in the wild. In a study [2], non-appreciation of African traditional vegetables and urbanization were identified as some leading factors that contribute to peoples' preference for exotic vegetables as against indigenous ones. [3] Reports show that vegetables are a vital constituent of West African diet especially traditional vegetable species but inadequate documented scientific information on indigenous African vegetable species is a major factor that influences people to choose exotic vegetables over indigenous ones. An earlier study [4], reported that the nutrient contents of some local Ghanaian and other African vegetables are superior to some exotic types. Thus promoting consumption of indigenous green leafy vegetables among Ghanaians is a key to improving the health of many.

Some authors [5] suggest the need to consume high vegetable meals to prevent colon and stomach cancers. Others [6] report on high vitamin, dietary fiber and mineral contents of vegetables and the role they play in maintaining alkalinity in the body. Most green vegetables, legume seeds, peas, beans, and nuts are rich in magnesium, as are some shellfish, spices, and soya flour, all of which usually contain more than 500 mg/kg fresh weight [7]. The high dietary fiber in green leafy vegetables helps regulate the digestive system aiding bowel health and

weight management. Several studies have shown that high folate intake from green leafy vegetables may lower the risk of colon polyps by 30 to 40 percent compared to low intake of this vitamin suggesting that diets low in folate may increase the risk of colon cancer [8,9]. Low folate intake has also been associated with cancers of the breast, cervix and lung.

Copious consumption of vegetables treat hemorrhoids, gallstones, obesity and constipation; the antioxidants in vegetables decrease the risk of heart disease and vitamin K contents of dark green leafy vegetables provide a number of health benefits including: protecting bones from osteoporosis and helping to fight against inflammatory diseases [10]. Green leafy vegetables are known to be low in calorie, contain low carbohydrate contents and have low glycemic index. These characteristics make them ideal for promoting and maintaining healthy body weight and coupled with the high fiber content, these vegetables particularly help with reducing type II diabetes. Also, the consumption of green leafy vegetables which have the highest nutritional value will enhance the nutritional status of both poor rural and urban households

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[11] who may not be in a position to consume enough vegetables because of affordability.

Hunger and malnutrition have been reported [2] to threaten millions of people in Sub-Saharan Africa, and an increased consumption of African leafy vegetables (ALVs) can have a positive effect on nutrition, health and economic wellbeing of both rural and urban populations. Apart from promoting good health when indigenous green leafy vegetables are consumed, increased consumption of African indigenous vegetables will help to enhance crop diversity, alleviate poverty and promote food security [12]. Despite the great value of these traditional leafy vegetables, not much research has been carried out on them especially in the area of nutrition specifically product or recipe development. The *Xanthosoma spp.* locally known as “kontomire” is often the only indigenous green leafy vegetable widely eaten in Ghana. To help promote the use of the many other indigenous green leafy vegetables which are under exploited and underutilized, it is important to develop recipes using these vegetables which will be accepted and used by others. The main objective of this study was to promote the use of indigenous green leafy vegetables in the preparation of dishes. Specifically, recipes were developed from selected indigenous green leafy vegetables and their characteristics evaluated using a sensory panel.

## Materials and Methods

### Survey

The study was in two parts. For the first part, the study looked at the use of indigenous green leafy vegetables in the preparation of dishes. For this, the probability sample procedure was employed to obtain a population of 40 males and females (20 each). A self-developed questionnaire made up of both closed ended and open-ended questions was used to gather information on the demographics of the participants, known types of indigenous green leafy vegetables, uses of indigenous green leafy vegetables, dishes prepared out of these vegetables, health benefits and sources of these vegetables, and problems associated with their utilization among others. Four indigenous green leafy vegetables (IGLV's): *Amaranthus spp.*, *Corchorus olitorius L.*, *Talinum triangulare* and *Launaea taraxacifolia* were selected out of ten (10) by survey participants as the most common IGLV's known and eaten. These IGLV's were obtained from the University of Cape Coast farm and its surroundings and used in developing recipes. Ten (10) recipes were developed in total and presented to a panel for sensory evaluation.

### Knowledge about indigenous green leafy vegetables

Table 1 shows the types of Indigenous Green Leafy Vegetables (IGLV's) presented to survey participants for identification. Out of the 10 vegetables presented, only 4 were selected by the participants as vegetables that they commonly eat. These 4 vegetables were then selected, gathered and used in developing different recipes for the sensory evaluation.

Cassava leaves topped the list of IGLV's identified by survey respondents with about 73% of respondents selecting it. This was followed by *Corchorus olitorius L.* (65%), *Talinum triangulare* (about 58%) and *Amaranthus cruentus* (55%) with the least selected vegetable being *Solanum* species (about 3%) and Silk cotton leaves (about 3%). Development of recipes from indigenous green leafy vegetables was followed by sensory evaluation of developed recipes. Recipes are presented later in the manuscript.

Indigenous Green Leafy Vegetables	Frequency N=40		Percentage %		Total	
	Yes	No	Yes	No	N	%
Cassava leaves	29.0	11	72.5	27.5	40	100
<i>Corchorus olitorius L.</i>	26.0	14	65.0	35.0	40	100
<i>Talinum triangulare</i>	23.0	17	57.5	42.5	40	100
<i>Amaranthus species</i>	22.0	18	55.0	45.0	40	100
<i>Xanthosoma species</i>	12.0	28	30.0	70.0	40	100
<i>Launaea taraxacifolia</i>	3.0	37	7.5	92.5	40	100
Fiber leaves	2.0	38	5.0	95.0	40	100
Bean leaves	2.0	38	5.0	95.0	40	100
<i>Solanum species</i>	1.0	39	2.5	97.5	40	100
Silk cotton leaves	1.0	39	2.5	97.7	40	100

\*Results are based on responses from 40 participants used for the survey Botanical information on these vegetables was obtained from PROTA (2004) [13]

Table 1: Knowledge about Indigenous Green Leafy Vegetables.

### Sensory evaluation of (IGLV's) recipes

For this part of the study, the Affective method was used to determine consumer acceptance of the products.

### Panel

10 males and 5 females totaling 15 panel members were selected out of the initial 40 used for the survey on the basis that they eat these vegetables and are knowledgeable about them.

- The purposive sampling technique was used to select panel members and an informed consent statement provided to them.
- Panel members were dubbed as “trained” or “schooled”. “Trained” or “Schooled” here means panel members were taken through the process of scoring and the score sheet verbally explained to them before they were handed over.
- A structured questionnaire consisting of only closed ended questions arranged in a tabular form was designed and presented to the panel
- The attribute rating was based on appearance, taste, color, texture, flavor and overall acceptability.
- Hedonic test (5-point hedonic scale-5- excellent; 4- very good; 3-good; 2- fair; and 1- poor) was used.

Some other steps the panel members were taken through included:

- Individual assessment of products to prevent interaction or communication among members and any possible influence from each other that could lead to bias in scoring
- Washing of mouth after tasting and swallowing each sample to avoid overlap of taste and other properties from tasting earlier samples
- Giving sometime in between tasting of samples

### Selection criteria

To participate, the individual has to be either an employee or nonemployee specifically a staff or student of the University ofCape Coast (UCC).

### Demographics

Participants had to be at least 18 years of age or more. The ideal

would have been to use equal numbers of males and females but in this study, it was difficult to get the females to participate so more males than females were selected to help bring out differences in taste and smell characteristics of these two groups of people, for example men are known to tolerate more bitter taste than females. Participants should be familiar with product and be able to know what organoleptic characteristics to expect of IGLV's products. They should be frequent users/eaters of the product as well.

### Test conditions

Test area for the sensory evaluation was the Vocational and Technical Education Department's food laboratory.

**Sample description:** Ten recipes were developed using the following four indigenous green leafy vegetables: *Amaranthus* spp., *Corchorus olitorius* L., *Talinum triangulare* and *Launaea taraxacifolia* and subsequently code named as "A" (Dande salad), "B" (Taagu balls), "C" (Talspaghetti), "D" (Ayoyo soup), "E" (Tali savory tidbits), "F" (Dande pine swizzle), "A1" (Aleefu soup), "B2" (Dandefam), "C3" (Ale sauce) and "D4" (Ale drink). All recipes developed were based on 4 servings or portions [14].

**Sample preparation and presentation:** Samples were prepared, blind labeled using random codes with minimum conceptual information. Two sessions were organized with 5 samples at each session. For the first session, the following five (5) samples were presented to the panel for tasting: "A" (Dande salad), "C" (Talspaghetti), "D" (Ayoyo soup), and "E" (Tali savory tidbits), and "F" (Dandepine swizzle). The remaining five samples: "B" (Taagu balls), "A1" (Aleefu soup), "B2" (Dandefam), "C3" (Ale sauce) and "D4" (Ale drink) were presented to the panel for tasting at the second session. Most samples were presented along with food accompaniments in either small glass plates or bowls.

### Data analysis

Data obtained from the survey were presented in frequencies and that obtained from the sensory evaluation were subjected to analysis of variance (ANOVA) to determine any significant differences. Tukey's test was subsequently used to identify specific differences between individual products which were significantly different from the ANOVA at (P= .05).

### Development of recipes from indigenous green leafy vegetables

All recipes developed were based on 4 servings or portions [14] and

distributed as small samples in small glass plates to panel members for tasting. For each recipe, 250g of the IGLV was used (Tables 2-11).

## Results and Discussion

Although cassava leaves were selected by survey participants as the most common indigenous green leafy vegetable known, the leaves were not used much in cooking or were not eaten much by participants. Rather the 4 vegetables selected (Table 12) by the participants as the most eaten were *Launaea taraxacifolia*, *Talinum triangulare*, *Corchorus olitorius* L. and *Amaranthu scruentus*. Participants mentioned that they patronized these 4 vegetables because they could be bought from markets, grown in homestead gardens as well as easily obtained from the wild. Common names and local names for these vegetables were obtained from both literature [13] and sellers of these vegetables and documented (Table 12). In an earlier similar study, 5 green leafy vegetables identified as the most common vegetables consumed in Nigeria-West Africa were *Talinum triangulare*, *Corchorus olitorius* L., *Celosia argentea*, *Amaranthus hybridus* and *Vernonia amygdalina*. *Talinum triangulare*, *Corchorus olitorius* L. and *Amaranthus* species are commonly consumed in both Ghana and Nigeria [15].

### Uses of indigenous green leafy vegetables

Participants mentioned that they used the vegetables in different ways. These included the preparation of stews, soups, salads, drinks/beverages, pastries and in stir fry (Table 13). Majority of the participants (42.5%) used the vegetables to prepare stews and very few (about 5%) used them to prepare drinks/beverages, pastries and stir fry. Based on this information, equal amounts of the 4 selected vegetables were used in developing similar recipes and presented to 15 panel members purposively selected from the 40 participants to taste and score according to certain sensory attributes.

### Sensory analysis

Sensory evaluation scores were obtained from 15 panel members for the two sessions and subjected to analysis of variance (ANOVA) and Tukey's test to determine any significant difference at 5% significance level. The mean scores for quality and overall acceptability as produced from ANOVA results for both the male and female panelists for the first session of the sensory evaluation are presented in (Table 14) and that for the second session in Table 15. Generally, all the samples obtained high mean scores for all the qualities considered in the sensory analysis.

Only distinct differences between samples and similarities among samples in Table 14 and 15 have been highlighted. From Table 14, mean scores across columns showed that all products carried significant different flavors and taste but their individual colors, textures and

Ingredients	Instructions for preparation/Action
1 large potato (sweet/ Irish)	Season and steam shredded chicken for 7 minutes and set aside
2 shallots or small onions	Peel, dice and boil potato for 6 minutes and set aside to cool
2oz shredded chicken	Heat oil in frying pan over medium heat, add onions & chicken
½ teaspoon sugar	Sauté for 4-5minutes until chicken browns
2 tablespoon vinegar	Add diced potatoes and continue with sautéing till potatoes brown
4 tablespoons chicken stock	Stir in vinegar, chicken stock, sugar, salt and black pepper
1 tablespoon vegetable oil	Stir mixture and leave it to simmer till liquid reduces by half
¼ teaspoon dried black pepper	Cool mixture slightly and pour over dandelion leaves & toss well
8oz (250g) dandelion green leaves	Serve salad immediately

Table 2: Recipe for preparing "A"- Dande salad.

Ingredients	Instructions for preparation/ Action
½ lb ground melon seeds (agushie)	Chop Talinum leaves, blanch for 5 minutes and set aside
8oz Talinum leaves (bokorbokor)	Add chopped onions, garlic and seasonings to agushie and add Talinum leaves
1 small size onion	Take out the egg yolk and use it to bind the mixture
2 eggs	Roll mixture into balls and dip in egg white
4oz breadcrumbs	Coat balls with breadcrumbs
1 clove garlic	Deep fry until golden brown
2 tablespoons vegetable oil	Serve hot
Pepper and salt to taste	

**Table 3:** Recipe for preparing "B"- Taagu balls.

Ingredients	Instructions for preparation/Action
1 cup wheat flour	Add a pinch of salt to flour
1 egg	Grind Talinum leaves into paste and set aside
8oz Talinum leaves (bokorbokor)	Break egg and beat it
Salt to taste	Add Talinum paste and beaten egg to flour, knead into hard dough
2 tablespoons of vegetable oil	Roll dough into rolls of 1.6 inch & pass through a pasta maker to slice
	Par boiled spaghetti in salted boiling water, drain in colander and leave under running water to cool.
	Toss in 2 tablespoons of vegetable oil to prevent sticking and serve with sauce

**Table 4:** Recipe for preparing "C"- Tal spaghetti.

Ingredients	Instructions for preparation/Action
1/2oz washed & chopped Ayoyo	Season chicken with cut onions and steam for 12 minutes
8 fingers of fresh okra	Add pepper to taste followed by chopped okra & a little water
Seasonings	Bring to boil and add leaves
4 tablespoons of palm oil	Leave to cook for 5 minutes
½ oz chicken or fish	Add oil and allow soup to simmer
3 medium sized onions	Serve hot with maize pap or banku

**Table 5:** Recipe for preparing "D"- Ayoyo soup.

Ingredients	Instructions for preparation/Action
½ lb wheat flour	Add salt to flour and rub in fat
150g baking fat	Rub in other condiments
2 medium size onions	Add talinum paste with enough water to bind dough
1 root ginger	Roll the pastry into thin layer
2 cloves of garlic	Cut rolled pastry into desired shapes
Ground Talinum leaves	Deep fry in hot vegetable oil till golden brown
Salt to taste	Remove and cool
Oil to fry titbits	Serve with drinks or beverages

**Table 6:** Recipe for preparing "E"- Tali savory titbits.

Ingredients	Instructions for preparation/Action
1 large size pineapple	Place the sugar, crushed ginger and peppercorn in a saucepan
1 small lemon	Add enough water to cover ingredients and cook over medium heat stirring continuously until sugar dissolves
1 small size root ginger	Increase heat and bring syrup to boil for 3 minutes
½ lb sugar	Remove syrup from fire and cool
Dandelion (enough)	Cut dandelion leaves and pineapple and blend together in a food processor, strain mixture, add to syrup & add a little lemon juice
Peppercorn	Chill mixture and serve with snacks of your choice

**Table 7:** Recipe for preparing "F"- Dande pine swizzle.

Ingredients	Instructions for preparation/Action
½ lb smoked fish	Clean, cut & steam fish with tomatoes, chopped onions and salt
1 bundle aleefu leaves	Take out snails/squid & clean with lime in water
4 medium size tomatoes	Add snails/squid to fish and simmer till snails/squid are tender
A piece of salted fish	Remove steamed tomatoes and onions and blend together with steamed aleefu leaves
2 small size onions	Add to soup and add piece of salted fish
4 medium size snails/squid	Leave soup to simmer for 10 minutes and take off fire
Salt & pepper to taste	Serve with fufu, rice or any food of your choice

**Table 8:** Recipe for preparing "A1"- Aleefu soup.

Ingredients	Instructions for preparation/Action
1 lb corn flour	Peel & mash plantain into smooth paste
3 well ripe plantain	Grind garlic & ginger & add to mashed plantain & mix together
1 pint palm oil, little pepper	Add corn flour & salt to the mixture and stir
1 small size onion& ginger	Shred dandelion and mix with mixture
2 cloves garlic, salt to taste	Add palm oil & bake in a greased baking tin for 30 minutes
8oz dandelion greens	Serve hot or cold

**Table 9:** Recipe for preparing "B2"- Dandefam.

Ingredients	Instructions for preparation/Action
½ lb smoked salmon	Fry onion, ground pepper and tomatoes together for 5 minutes
2 bundles of aleefu leaves	Add smoked and salted fish
¼ pint oil (palm/vegetable)	Leave to simmer for 3 minutes
¼ lb melon seeds (agushie)	Add ground melon seeds and continue simmering
2 medium size onions	Add aleefu leaves and leave to simmer for 10 minutes
4 small size tomatoes	Serve with yam, plantain and rice
A piece of salted fish	
Seasoning/pepper to taste	

**Table 10:** Recipe for preparing "C3"- Ale sauce.

½ lb sugar	Put in a saucepan crushed ginger, peppercorn, sugar and water
1 small size root ginger	Boil over medium heat while stirring continuously till sugar dissolves to form syrup
1 peppercorn	In a separate saucepan, boil aleefu leaves in 1 pint of water for 5 minutes
1 pint of water	Add syrup to cooled leaf extract and stir to mix
Aleefu leaves	Chill and serve

**Table 11:** Recipe for preparing "D4"- Ale drink.

Common name	Scientific name	Local name (Ghanaian)
Dandelion/Wild lettuce	<i>Launaeataraxacifolia</i>	Twii/Akan: Mmrobo, Dadeduru, Nnenoa Ga: Agloke, Fie, Dan Krobo/GaAdangbe: Kusii, Kusa Ewe: Bebletama, Anloto, Anoto
Water leaf	<i>Talinumtriangulare</i>	Twii/Akan: Busummuruadwere, Nkokodwe Efan, Borkorborkor, Kotubetsew Ga: Shee, Bleefoshee Krobo/GaAdangbe: Ablotsipui, Ngmlongmloo Ewe: Yevugboma, Senuma, Dentefla
Bush okra, Jute mallow	<i>Corchorusalitorius L.</i>	Twii/Akan: Ofaro Ga: Ayoyo Krobo/GaAdangbe: Ayoyo Ewe: Sigli, Ademe, Ademademe ***Kasem: Ayoyo
African spinach, Amaranthus	<i>Amaranthuscruentus L.</i>	Twii/Akan: Srahansoe, Nantwibin, Nantwinkasee, Asantewa, Asibe Ga: Awsaumei, Dan, Anago mio Krobo/Ga Adangbe: Aleefu Ewe: Matonui, Moxeti, Senutsoe, Fotete, Awusagbe ***Kasem: Aleefu

**Table 12:** The most common indigenous green leafy vegetables eaten by participants.

appearances did not seem to be much different from each other. Also mean scores across rows showed that the individual characteristics scored for each product did not show many differences and thus were not significantly different. For example, the mean scores for the flavor, color, taste and appearance of sample “A” all carried the letter “a” showing that these characteristics were not significantly different unlike the flavor of the different products A, B, C, D and F in the column where all the mean scores were assigned different letters meaning the flavor of the different products were significantly different. Also, for sample “C”, there was no significant difference between the flavor and taste since they both carried the same letter. Also, there was no significant difference between the color and appearance but these were significantly different from the flavor and taste. The flavor and taste of sample “F” Dande pine swizzle drink across the row were similar but not significantly different from the color and appearance.

From (Table 15), mean scores across columns showed that all products carried significant different flavors but were similar in color, texture, taste and overall acceptability except for the taste and appearance of sample “E” Tali savory tit-bits pastry which was significantly different. The flavor and taste of sample “E” were similar but not significantly different from the color and appearance.

The Ayoyo soup (“D”) was selected by the panel as the most acceptable product in terms of all the characteristics scored for followed by Dandefam (“B2”). These results reflect that provided by participants in the earlier survey where about 33% stated that IGLV’s

are commonly used in preparing soup. Also, Ayoyo soup is well known and taken by lots of people so probably panel members were already conversant with it and thus scored it high. Dande pine swizzle (“F”) was the least accepted which is consistent with results obtained from the earlier survey where only 1 participant stated that IGLV’s are used for preparing drinks. Drinks often come in colors such as red, pink or orange not often green. This perception could influence panelists’ acceptability of the product.

Although “sex” is usually an important factor to consider in sensory analysis of food products to help bring out differences in certain characteristics like taste, scores for males were not analyzed differently from that of females for the simple reason that there were twice as many males as females on the panel. Probably, if equal numbers of males and females had been used for the evaluation, then analyzing the scores for males and females separately could have produced some significant results or differences. Also, another important limitation in this study was the small number of participants (40) used. This averted any deeper analysis on the sex ratio, age, or rural-urban influence which would have enriched the study and provided more applied outcomes for improving ALGV consumption in Ghana.

Equal amounts of the vegetables were used in order to compare how well the different IGLV’s did or performed in the different products yet, the flavor and taste of Ayoyo soup “D”, Dande pine swizzle drink “F”, and Tali savory tit-bits pastry “E” were significantly different from that of the other products at 5% significance. This indicates that adding vegetables to recipes could affect or change the flavor and taste of the recipe. Findings from a study on the effect of food color on perceived flavor indicate that beverage color has a significant effect on liking and consumers’ capability to correctly recognize fruit flavor of beverages indicating that food color affects the favorable evaluation of foods [16]. Further, food color tends to affect consumers’ ability to: (i) correctly form food preferences, (ii) take over taste of food and (iii) make selection of uncharacteristic food color [16]. Such information is important when developing products using IGLV’s to help increase consumers acceptance.

Product	Frequency N=40	Percentage (%)
Stews	17.0	42.5
Soups	13.0	32.5
Salads	7.0	17.5
Drinks/Beverages	1.0	2.5
Pastries (Tit bits)	1.0	2.5
Stir fry	1.0	2.5
Total	40.0	100.0

\*Results are based on responses obtained from 40 participants used for the survey

Table 13: Uses of Indigenous green leafy vegetables.

Most of the products presented to the panel for tasting or evaluation

Products	Flavor	Color	Texture	Taste	Appearance	Overall Acceptability
A	4.0 <sup>a</sup>	4.1 <sup>a</sup>	3.5	4.4 <sup>a</sup>	4.2 <sup>a</sup>	4.0
B	3.9 <sup>b</sup>	3.8 <sup>ab</sup>	4.1	4.1 <sup>b</sup>	3.8	3.9
C	3.7 <sup>c</sup>	4.0 <sup>a</sup>	3.4	4.1 <sup>c</sup>	4.1 <sup>a</sup>	4.0
D	4.1 <sup>d</sup>	3.9 <sup>ab</sup>	4.1	4.4 <sup>d</sup>	4.1 <sup>a</sup>	4.1
F	3.8 <sup>f</sup>	3.0 <sup>b</sup>	3.5	4.4 <sup>f</sup>	3.1 <sup>b</sup>	3.5

$\alpha \leq 0.05$  Values are means of 15 scores from 10 male and 5 female panelists on each characteristic. Means with similar letter(s) in the same column or row are not significantly different at 5% significance level

Table 14: Sensory analysis results (session 1).

Products	Flavor	Color	Texture	Taste	Appearance	Overall Acceptability
A1	3.9 <sup>a</sup>	3.5 <sup>b</sup>	3.5	4.4 <sup>ab</sup>	3.6	3.8 <sup>***</sup>
B2	3.8 <sup>b</sup>	4.1 <sup>ab</sup>	4.0	4.1 <sup>a</sup>	4.0	4.1 <sup>**</sup>
C3	3.8 <sup>c</sup>	4.7 <sup>a</sup>	4.1	4.3 <sup>ab</sup>	4.3	4.2 <sup>a</sup>
D4	3.4 <sup>d</sup>	4.0 <sup>ab</sup>	3.9	3.9 <sup>b</sup>	3.9	3.8 <sup>b</sup>
E	3.9 <sup>e</sup>	3.8 <sup>ab</sup>	4.0	4.5 <sup>c</sup>	4.0 <sup>ab</sup>	4.0

$\alpha \leq 0.05$  Values are means of 15 scores from 10 male and 5 female panelists on each characteristic. Means with similar letter(s) in the same column or row are not significantly different at 5% significance level

Table 15: Sensory analysis results (session 2).

came with food accompaniments which could also influence the way panelists scored. Studies have reported taste interactions between individual components of a meal stressing that such effects are smaller in more complex meal combinations [17]. Other studies have also looked at the effect of meal accompaniments on the acceptability and sensory attribute liking for certain foods [18]. Positive sensory changes have been achieved in vegetables like cauliflower and broccoli which have strong sulfur flavor when served with gravy as a food accompaniment [19]. In this study, gravy with different fat concentrations was poured over cauliflower, broccoli, and potatoes, and the flavors of these vegetables were reduced significantly but that of the meat increased thus enhancing the acceptability of the meals. Findings showed that only 5% fat was actually required in the gravy to obtain a reduction in vegetable flavor [19].

Certain food borne outbreaks have been associated with vegetables and fruits. For example *Escherichia coli* have been associated with eating contaminated lettuce and sprouts, *Cryptosporidium* (onions and cider), and Hepatitis A (green onions) [20]. Food borne illnesses have become an important public health issue in the wake of more complex food system, coupled with factors such as increased chronic ailment or compromised immunities, more focus on hygiene and its related risks, and the emergence of more virulent strains of microorganisms. These illnesses cause individual distress and deaths which could easily be prevented, and the economic implications associated with treatment are huge. Common practices in vegetable production in Ghana that have huge health implications are the use of contaminated water for watering plants and the application of non-composted manure to plants. During harvesting, infected workers do contaminate the vegetables and even after harvesting, some vegetables are still washed with contaminated water. Risks still persists after purchasing these vegetables, bringing them home and storing them prior to use. It is necessary to step up teaching growers and vendors about these risks, and also develop a food safety plan with the goal of reducing microbial risk and assuring food safety. These food safety issues are important to address in order to keep the health value of the vegetables and encourage more consumption.

## Conclusions

In conclusion, IGLV's do possess great levels of vitamins, minerals and fiber as confirmed in literature and the fact that they are comparatively cheaper than exotic vegetables, promoting IGLV food products is important in enhancing nutrition of the Ghanaian population. With the great health promoting effects of these vegetables, it would be of great advantage to incorporate them into as many recipes as possible for human benefit. Results from the survey showed that respondents used IGLV's mostly for preparing soups and stews. Developing new tasty recipes from these vegetables that would be accepted by consumers could help promote their consumption. Also, ensuring that vegetables used in preparing these recipes are hygienic and safe to eat is critical in order to keep the health value of the vegetables. In addition to soups and stews, other products like pastries, drinks, sauces and salads could be prepared using these vegetables and served with food accompaniments that would enhance their acceptability by consumers. Having a wide variety of products to choose from could attract people to eat more of these vegetables and obtain all the health benefits associated with consuming these vegetables.

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