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Acceptability of Soup Powders Made from Selected Traditional Leafy Vegetables Grown in Lindi, Tanzania

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ABSTRACT
A study was conducted to assess the acceptability of soup formulated from traditional leafy vegetables (TLVs) grown in Lindi, Tanzania. Three TLVs, Amaranth hybrids known as amaranthus leaves (AML), Manihortesculenta known as cassava leaves (CAL) and Ipomeabatatas known as sweet potatoes leaves (SPL) which had been optimized for Iron content, were used to prepare 4 vegetable soup formulations (F1– 60.0:7.5:22.5); (F2 –70.0:5.0:15.0); (F3 –80.0:2.5:7.5) and (F4 –40.0:10.0:40.0) respectively. Descriptive sensory analysis was performed by10 trained panelists who used 5 descriptors to quantitatively describe the sensory characteristics of four soup formulations. Thirty consumers assessed the degree of liking of products' sensory attributes using a 7-point hedonic scale. External preference mapping was performed by relating sensory data with hedonic responses. Mean intensity ratings of descriptive attributes of the soup showed that F1, F2 and F3had significantly higher($p<0.05$) mean intensity scores in colour, aroma, and mouth feel than F4. The consumer study showed that, with exception of mouth feel, consumers showed significant differences ($p<0.05$) between samples in colour, aroma, taste and overall acceptability. It was thus concluded thatF1 was the most liked by consumers due to colour, aroma and mouth feel followed by F2 and then F3 and finally F4. Furthermore, the preference mapping results showed that colour, aroma and mouth feel attributes were the main drivers for positive consumer preference for vegetable soup. Thus, selection and processing of vegetables, which retain these attributes, is of greater importance for consumer acceptability and hence increased utilization for consumer's health and well-being.

Keywords: *Traditional Leafy vegetables, solar drying, sensory evaluation, acceptability.*

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INTRODUCTION

According to the global nutrition report 2016, two billion people are still suffering from micronutrient deficiencies and almost 800 million from caloric deficiencies on a global scale (Achadi *et al*., 2016). In Sub Sahara African Countries, people's diets rely heavily on rice, potato and cassava, which are high in calories but deficient in essential micronutrients. Deficiencies in iron, vitamin A and iodine are widespread, affecting about 300 million people every year, with many more at risk of experiencing these deficiencies (Atangana *et al.,* 2013). The use of traditional leafy vegetables in rural communities however has reached a low point, as many have labeled their dishes as 'poverty food' (Atangana *et al* 2013). These vegetables however contain a variety of bioactive, non-nutritive health enhancing factors such as phytochemicals including antioxidants, essential fatty acids and dietary fiber and are inexpensive sources of micronutrients (Gupta and Prakash, 2011). Unfortunately, however, they are not consumed in sufficient amounts by the households (Ochieng *et al.*, 2017). Promotion of production and consumption of micronutrient-rich foods will improve intakes, the overall diet, and health status (Mwanri *et al.*, 2011). Development of TLVs products with extended shelf life using locally processing techniques can help solve the problem of under consumption while making an important contribution to improve population income as well as availability (Habwe *et al.,* 2008: Smith and Eyzaguirre, 2007, Umuhozariho *et al*., 2014).Drying either by sun or solar, is one of the commonly used method for preservation of vegetables(Agiriga *et al*.,2015). However, drying at higher temperatures may cause nutritional loss and damage to sensory attributes such as colour, texture and flavor of the products (Kumar *et al.,* 2006). Sensory quality has a key influence on how consumers perceive the quality of a product and hence preferences (Green-Petersen, 2010). The sensory analysis is recognised as an important tool for determining the viability or acceptability of a food product (Carvalho *et al.*, 2013). New product development requires the integration of sensory attributes inclu7ding product taste, texture, and appearance with consumer attitudes and health biases. Acceptability of nutrient dense formulated powders will improve the nutritional status of the community. This research was thus done to develop iron rich soup powders using leafy of Amaranths (*Amaranthus hybridus* L.) (AHL), sweet potato (*Ipomoea batatas*) (IBL) and cassava (*Manihortesculenta*) and assess their acceptability.

MATERIALS AND METHODS

Materials

Materials used included Amaranths leaves (*Amaranthus hybridus* L.) (AML), sweet potato leaves (*Ipomoea batatas*) (SPL) and cassava leaves (*Manihotesculenta*) (CAL) from two villages Mtumbati and Mibure in Lindi Region, Tanzania. Samples were collected in freezer bags from two sites (home garden and low land) in each village and transported in a cool box containing ice maintained at 4°C to Sokoine University of Agricuture (SUA), Morogoro for sample preparation and solar drying.

Research Design

Complete randomized block design (CRBD) was used in the study and the principal factors were vegetable soup formulations representing AML: CAL: SPL respectively:

Formulation 1 – FI	60.0 :7.5:22.5.
Formulation 2 - F2	70.0 :5.0:15.0
Formulation 3 - F3	80.0 :2.5:7.5
Formulation 4 - F4	40.0 :10.0 :40.0

The effects of these factors on sensory attributes during drying were determined.

The following model was used

$y_{ij} = \mu + \tau_i + \beta_j + {ij}\varepsilon$

i = 1, 2, 3, 4

j = 1, 2, ….

where,

μ = the overall mean

τ_i= the ith treatment effect (Soup Formulation Samples)

β_j= the jth block effect (Assessors)

ij ε= the random effect

Methods

Sample preparation

The leafy edible parts of the vegetables were separated from the main plant .About 2.5 kg of each of the fresh TLVs samples were thoroughly washed with potable water to remove adhering dust and impurities,. They were then sliced, blanched at 80°C for 2 minutes.. Blanching cleans the raw material and reduces bacterial load, softens plant tissue and causes shrinkage which allowing greater volume of materials in the pack, helps fix colour for plants with carotenoid, improves the texture of dehydrated products, inhibits some micro-organisms and facilitates the removal of moisture during drying (Agiriga et al., 2015). The blanched vegetables were spread on trays for 10-15 minutes to drain. Solar drying was done at Sugeco (Sokoine University Graduate Entrepreneurs cooperative, Morogoro) Solar drying of TLVs was done according to Mongi (2013) with some modifications. Samples were loaded into the solar dryer. The temperature in the solar dryer ranged between 45-55°C and drying was completed in 3 days. About 1.5kgs of each dried TLVs were packed separately in a freezer bag and stored in a dark dry place at 25^0CAfter solar drying, the dried vegetables were ground separately by a grinder (Gaoxin 1250 gx-25, China) and passed through a fine 315-micron sieve to obtain fine powders. The fine powders were then packed in labeled food grade bags and stored at25^0Cin a dark dry place prior to product formulations and laboratory analysis.

Product formulation

Three types of TLVs samples were used to formulate iron rich powders. Various proportions of TLVs were used based on iron optimization to meet the 7mg/day iron RDA for children aged between 1-5 years(TZS 1657: 2014- EAS 797: 2013). **Table 1** shows the amount of iron in some selected solar dried TLV samples used to make formulation after pretesting. Quantities of solar dried TLVs and spices used were as shown on **Table 2.** Soup powders formulations were made by mixing 90 g of solar dried TLVs with 10 g of spices to make F1, F2, F3 and F4 as shown below.

Table 1: Iron content of selected traditional leafy vegetables

Type of dried vegetable	Amount of Iron in mg/100g
Amaranthushybridus L (AML)	80.21
Sweet potatoes (SPL)	39.80
Cassava (CAL)	10.74

Table 2: Soup formulations from 3 traditional leafy vegetables (90% of formulation)

Materials	(F1)	(F2)	(F3)	(F4)
		(Amount per g)		
Amaranthushybridus(AMI	60.0	70.0	80.0	40.0
Manihotesculenta(CAL)	7.50	5.00	2.50	10.0
Ipomeabatatas(SPL)	22.5	15.0	7.50	40.0
Total	90.0	90.0	90.0	90.0

Table 3: Spices added to soup formulations (10% of formulation)

Spices	Amount per g
Garlic	0.5
Ginger	0.5
Coriander	0.5
Cumin	0.5
Corn Flour	4.0
Salt	2.0
Sugar	2.0
Total	**10**

Cooking procedures of soup powders

For descriptive test, about125 g of soup formulation was used in which 1750 mls of water was added and boiled for 5 minutes (Farzana *et al*., 2017 with modification). Gas cooker was used for cooking the soup. This amount served 10 panelists. The same concentration was used to prepare for large groups of panelists.

Quantitative descriptive analysis (QDA)

A descriptive sensory profiling was conducted at the Department of Food Technology, Nutrition and Consumer Sciences, Sokoine University of Agriculture by trained sensory panel according to the method described in Lawless and Heyman (2003).Tenfemale assessors aged between 21 to 39 years, were purposively chosen because they are responsible to prepare food for their children (1-5 years).Thus they determine whether they accept or reject the food on behalf of their children. The assessors were selected and trained according to ISO Standard (2005). In a pre-testing session, the assessors were trained in developing sensory descriptors and the definition of the sensory attributes. They developed a test vocabulary describing differences between samples and agreed to a total number of attributes on colour, aroma, texture, taste and mouth feel **(Table 3).** An unstructured line scale was used for rating the intensity of each attribute where by assessors indicated appropriate number against each characteristic - colour, aroma, texture, taste and mouth feel. The left side of the scale corresponded to the lowest intensity of each attribute indicated by 1 and the right side corresponded to the highest intensity indicated by 9 as shown in the descriptive sensory form attached in **Appendix 1**. Descriptive analyses of four soup samples were carried in one session and each assessor evaluated four samples per session. The samples were coded with 3-digit random numbers and served to each panelist in a randomized order. Water was served alongside samples for rinsing mouth before evaluating other samples during the test. Form for QDA is attached in **Appendix 1.**

Table 3: Definitions of sensory attributes used in descriptive sensory analysis Parameter Attribute Definition

Attribute	Definition
Colour	Colourintensity Degree of greenish in the colour Clear, strong colour.
Aroma	Vegetable romatics associated with dried vegetables.
Texture	The degree of coarseness. It also includes the consistency, thickness, fragility, chewiness and the size and shape of particles in food (The force required to bite through the sample.
Taste	The taste associated with the intensity of bitterness.
Mouth feel	Feeling when the food is in the mouth is it good or bad.

(Sharif *et- al.*, 2017 with modification)

Consumer test

The test was carried out at Ipoipo area, Mazimbu road- Morogoro by 30 untrained female consumers aged between 21- 69 years, using a 7-point hedonic scale (where 1 = Dislike very much and 7 = 7-Like very much) as described by Lawless and Heyman (2010).Samples were poured into plastic bowl coded with 3-digit random numbers, in a randomized order and served to the panelists at 4 pm. Panelists were also given distilled water for rinsing the mouth. Panelists were instructed to rate the colour, aroma, taste, texture, mouth feel and overall acceptability of each sample indicating their degree of liking or disliking by putting a number as provided in the hedonic scale according to their preference. Testing was completed in one session and each consumer evaluated all the 4 formulations. This evaluation was conducted under the same conditions as for the sensory descriptive test. Sensory form for consumer test is attached in **Appendix 2**

Statistical data analysis

Data was analyzed using R software version 3.5.3 (Stats package) Data were subjected to one-way ANOVA to establish if there was significant ($p<0.05$) variation and interaction between means of four soup powder formulations at ($p<0.05$). Means were separated by Turkey's Honest Significant Difference at $p <0.05$. Principal component analysis (PCA) and Partial Least Squares Regression (PLSR) were also performed. The main sources of systematic variation in the average sensory descriptive results were determined by using Principal Component Analysis (PCA) while the relationship between descriptive data and hedonic liking from the consumers were determined by PLSR. The variables were standardized and full cross-validation was applied. Correlation loading plots were applied with circles indicating 50 and 100% explained variance, respectively.

RESULTS

Quantitative Descriptive analysis test (QDA)

Product effect

Mean intensity ratings of descriptive attributes of the vegetable soup are shown in **Table 4**. There were significant ($p<0.05$) differences in mean intensity scores between soup formulations. In terms of colour, F1 had the highest score which was statistically ($p<0.05$) different from the rest of the samples. The aroma scores for F1 and F2 were not statistically ($p>0.05$) different but signicantly differed from F3 and F4 which were similar. F3 and F4 scored the highest scores for taste and differed significantly ($p<0.05$) from F1 and F2 which did not differ. F1 scored the highest for mouth feel and was statistically different from F2 and F3. Texture scored highest in F4 and F3 which were not statistically different but differed from F1 and F2. F1 samples had higher mean intensity scores in colour, aroma, and mouth feel than F 4 samples, which had higher texture and taste scores.

Table 4: Mean attribute intensity descriptive scores of vegetables soup samples

Sample	Colour	Aroma	Taste	Mouth feel	Texture
F1	7.7±0.82^{a}	5.1±1.27^{a}	4.1±0.57^{b}	6.5±0.71^{a}	5.8±0.92^{b}
F2	7.1±1.60^{b}	5.1±1.27^{a}	4.1±2.00^{b}	5.9±1.20^{ab}	5.4±1.00^{b}
F3	6.0±0.94^{c}	4.5±1.43^{b}	4.7±0.48^{a}	5.3±0.67^{bc}	6.2±0.92^{a}
F4	6.3±1.16^{bc}	4.2±1.32^{b}	5.4±0.84^{a}	4.8±1.23^{c}	6.5±0.85^{a}

Values are expressed as mean ±SD (n=10). Mean values with different superscript letters along the column are significantly different at p<0.05

Hedonic test

Mean hedonic scores of the vegetable soup are shown in **Table 5**. Colour ranged from 4.3 to 5.9 whereby F4 had the lowest score which was statistically different (p<0.05) from the rest of the samples. Aroma score ranged between 4.00 and 5.40, and F4 had the least score and was significantly different (p<0.05) from the rest of the samples. For taste, values between 4.2 and 5.3 were recorded, whereby F3 and F4 had the lower scores which statistically differed (p<0.05) from both F1 and F2 which were not different (Table 5). No significant differences (p<0.05) were observed for mouth feel scores between the 4 formulations. In conclusion, the general acceptability for samples F1 and F2 were higher and statistically different (p<0.05) from F3 and F4 which had lower values.

Table 5: Mean hedonic scores for the vegetable soup formulations

Sample	Colour	Aroma	Taste	Mouth feel	Acceptability
F1	5.93±1.01^{a}	5.30±1.22^{a}	5.30±1.15^{a}	5.30±1.20^{a}	5.60±1.50^{a}
F2	5.63±1.71^{a}	5.10±1.68^{a}	4.90±2.00^{a}	5.00±1.63^{a}	5.00±1.55^{a}
F3	5.30±1.15^{a}	5.40±1.28^{a}	4.50±1.70^{b}	4.80±1.21^{a}	4.50±1.60^{b}
F4	4.30±2.22^{b}	4.00±1.81^{b}	4.20±2.08^{b}	4.80±1.36^{a}	4.40±1.81^{b}

Values are expressed as mean ±SD (n=30) where Mean values with different superscript letters along the column are significantly different at p<0.05.

Relationship between descriptive data and acceptability data by Partial Least Square Regression (Preference mapping)

Principal component of descriptive sensory data

Figure1. shows a bi-plot on average sensory attributes of the soup. where by the two first significant principal components from Principal Component Analysis (PCA) are indicated on Fig 1. The obtained results showed principal component (PC) 1 accounted for 96.6% of the systematic variation in the data while principal component (PC) 2 accounted for 2.96%. PC

1 was a contrast between formulation 1 and 2 which correlated positively with colour, mouth fell and aroma attributes on one side and formulation 3 and 4 which correlated positively with texture and taste attributes on the other side. PC 2 was contrast between F1 and F4 which correlated positively with mouth feel, colour and taste in one side and F2 and F3 which correlated positively with aroma and texture attributes on other side.

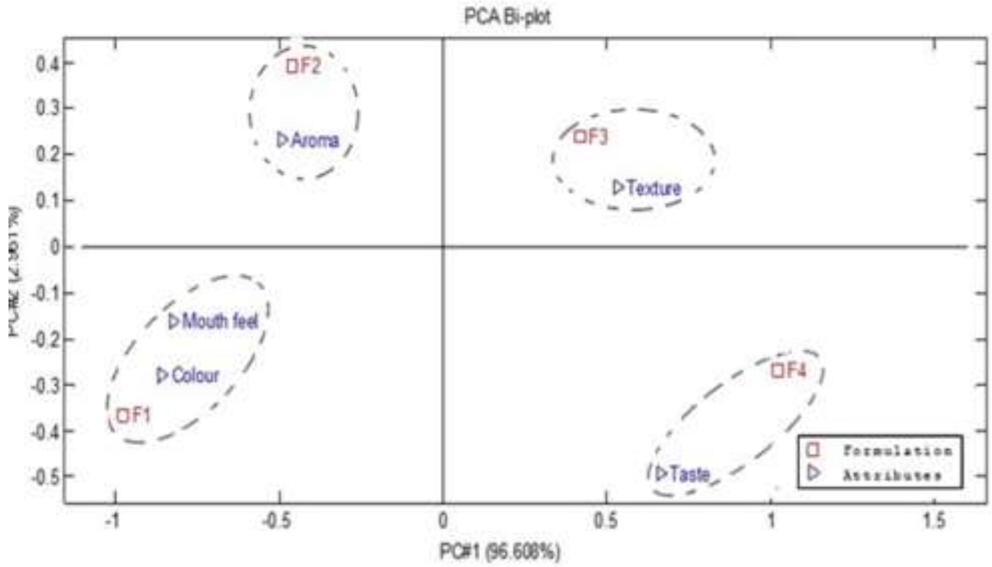

Figure 1 Bi-plot from PCA of descriptive sensory data for vegetable soup formulations

Relationship between descriptive data and hedonic liking by PLSR

The partial least square regression (PLSR) shows descriptive data as X-variables and liking rated by the consumers as *Y*-variables as indicated in **Figure 2**. Variance was relatively high; the two first significant components described 85% of the variation in X and 71% in *Y*. The figure shows that many consumers fall to the right of the vertical Y-axis, outside the 50% explained circle which means that, the acceptance values of these persons go in the direction of F1 sample associated with colour, mouth feel and aroma intensities. Taste and texture attributes correlated positively sample F4 very few consumers on that side. This implies that, colour, mouth feel and aroma were the main drivers for consumers liking of the vegetables soup formulations in this study as supported by regression coefficient **(Figure 3)**

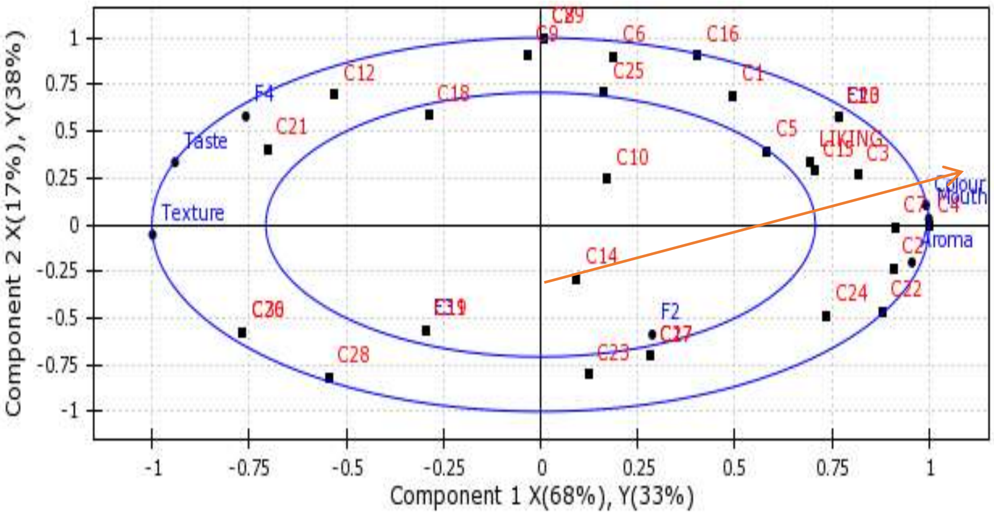

Figure 2: Correlation loadings from a partial least squares' regression of vegetable soup formulations with descriptive data as X variables and hedonic rating as Y variables.

Figure 3 shows the importance of each attribute in consumer liking of the vegetable soup formulations. It shows that colour, aroma and mouth feel are positively correlated with liking while texture and taste are negative correlated with liking. Most of the consumers liked the soup formulated due to its colour, aroma and mouthfeel and few consumers liked the vegetable formulated soup due to its taste and texture.

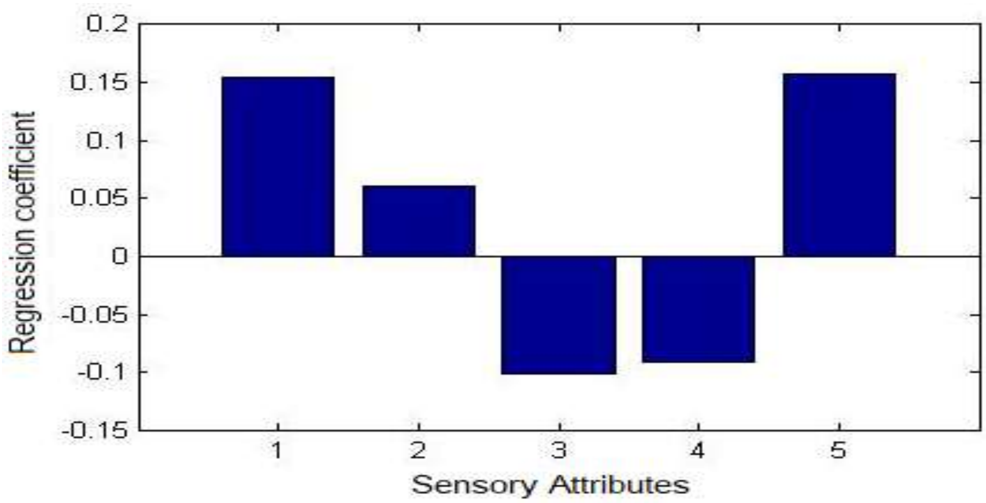

Figure 3. Regression coefficients of PLSR showing importance of each attributes on consumer liking of vegetables soup formulation/ 1= Colour, 2= Aroma, 3=Texture, 4=Taste and 5 =Mouth feel.

DISCUSSION

Quantitative descriptive analysis

The F1 formulation had high intensity scores for color, aroma and mouth feel as shown in **Table 4**. The high color, aroma and mouth feel score in F1 may be due to high proportional of sweet potatoes leaves which was an excellent source of chlorophylls and carotenes. This is also revealed by Dinu *et al*., 2018 who explained on the importance of sweet potatoes leaves as an excellent source of chlorophylls and carotenes which are primary photosynthetic pigment that determine the green colour of plants. The green colour is an aesthetic quality highly valued in vegetables. Moreover, the degree of greenness attributed to chlorophyll pigments is important in determining the final quality of these kinds of vegetables since colour is one of the major quality indicators for vegetable products (Nisha *et al*., 2004). The higher the concentration of this pigment the greater the color intensity. However, itis easily degraded during processing and is susceptible to chemical and physical changes during processing. It is less stable to heat due to conversion of chlorophyll to pheophytin. This occurs through the magnesium substitution of the chlorophyll by hydrogen which results in colour changes in green vegetables (Turkmen *et al*.,2006). The drastic irreversible changes, causes a change from bright green to olive brown (Kumar *et al*., 2013).

It is well-known that excessive heating of food products causes considerable losses in the organoleptic quality of food. Blanching inactivates chlorophyllase and other enzymes responsible for senescence and rapid loss of green colour. Alkalizing agents in brine solutions, such as sodium bicarbonate, disodium glutamate, sodium hydroxide, and magnesium hydroxide, have been used to raise the pH of green vegetables and therefore, retain chlorophyll after processing (Koca *et al*., 2007). The degree of greenness, attributed to chlorophyll pigments, is important in maintaining the final quality of these kinds of vegetables (Nisha et al., 2004). Chlorophyll compounds fulfill certain biological functions that are effective as long as the chlorophyll derivative conserves the basic porphyrin ring structure. Chlorophyll absorbs sunlight during photosynthesis and converts it to energy to plant as well as stimulating immune system, help combat anemia, normalize blood pressure, purifying blood and liver detoxification, help prevent cancer and is being used in cancer therapy (Inanc et *al*,. 2011). Thus, the presence of chlorophylls and their transformation products contribute organoleptic attributes such as colour and odour to the soup product (Minguez-Mosquera *et al*., 2002 and Turkmen et al., 2006).

The quantity of sweet potato leaves was highest in formulation F1, followed by F2 then F3 and F4. The concentration of the leaves affected the greenish colour which increased with increasing concentration of sweet potato leaves. High intensity of taste in this study described by bitterness, was revealed byF4 which scored highest intensity for taste. The bitterness in F4could have been contributed by high proportional of Cassava leaves compared to other formulation. F4 soup formulation was found to be the least acceptable probably due to high levels of residual cyanogen. Umuhozariho *et al*., 2013 demonstrated a strong correlation between bitter taste and cyanogen (HCN) potential in cassava. The high texture of F4 may be attributed by high proportional of Sweet potato leaves compared to other formulations which is associated with tenderness, thus make the texture softer than all formulations. The finding supported by the Bonsi *et al*., 2014, who explained on the tenderness of sweet potatoes leaves was due to lower fiber content than other tropical root crops such as cassava and the low fiber content coupled with high moisture content makes them generally much tender than cassava leaves. Followed by F3 where the bitterness may be due to high concentration of Amaranth among all formulation.

Consumer test

Table 5. Shows that consumers acceptance to the formulation where FI and F2 were highly accepted than F3 and F4. Colour is a primary attribute, which attracts consumer attention and therefore influences acceptance (Nkuba et al., 2018). The currentstudy also found that acceptability scores reduced with increasing concentration of amaranth, F1 with 60% amaranth, F2 with 70% amaranth and F3 with 80% with acceptability mean score of 5.6, 5.0 and 4.5 respectively. This is probably caused by proportional of amaranth in the vegetable soup formulation since as proportional increase the colour were changed to dark green colour. A study by (Gupta and Prakash2011) found similar observations whereby a micronutrient-rich traditional product incorporated with Amaranths at 4, 8 and 12% levels resulted in an inverse relationship where the overall acceptability score at ($p<0.05$) was 7.97 ,6.99 and 6.57 respectively. Another study of soup mix made in three different proportions of amaranths leaves powder and arrow root starch in the ratio of 5:55, 10:50, 15:45 respectively revealed that soup prepared by using 5:55 (amaranths leaves powder: arrowroot starch powder) had maximum acceptability (Peje, 2019). Another consumer study for the four varieties of maize flour were composited with amaranth leaf powder at the level of 0, 1 and 3% (w/w) substitution respectively and extruded into snacks showed that the acceptability of the snacks decreased with increasing amaranth concentration, only a very small proportion (2-8%) of the panel liked the snacks extremely (Beswa,2016). The findings from Ssepuuya, (2018) on the contribution of instant amaranth soup to boarding school and adolescents showed that formulated soups acceptability ranged between 6.0 and 6.7 for all the sensory attributes, except mouthfeel and aftertaste (had scores between 5.4 and 6.0). Thus, different consumer has different choice and preference towards product liking and acceptance. The varied consumers' preferences provided insight into the sensory attributes that are important to individual consumer acceptability of samples (Mongi*et al*., 2013). According to literature, drivers of liking defined as the attributes, which have the most important effects on overall liking (Kuesten and Bi, 2018). This is also supported by Barrett *et al.,* (2010) who explained that once customer is attracted by the appearance and color of a product, this is usually followed by putting it into the mouths, where the aroma and taste take over. Another study also described the importance of colour as primary attribute which attracted consumer attention therefore

influences the mind of the consumer when choosing food and therefore acceptance (Pobee *et al*., 2017). Therefore, to attract consumers, food colour is an important attribute to be considered when preparing food.

Relationship between descriptive attributes and acceptance by the Partial Least Square Regression (PLSR)

Figure 1 shows correlation between descriptive attributes and hedonic through Principle Component Analysis (PCA). F1 was closely associated with colour, aroma and mouth feel. This is supported by **Figure 3**, which shows the contribution of each attribute towards the acceptance of vegetable soup formulations and provide insight into the sensory attributes that are important to individual's consumer preference of soup. Good color, aroma and mouth feel attributes were strong contributors while texture and taste being negatively related implying ~~it was not a~~ weak contributor for soup preference. Vegetables soup formulation F1 and F2 were positively correlated to colour, aroma and mouthfeel (Figure 3). This ~~may be~~ might have been enhanced by the high proportional of sweet potato leaves and the average proportional of amaranth (60,70,80 and 40) % for F1, F2, F3 and F4 respectively Although F4 was positively correlated with texture and taste, most consumers did not prefer the taste and texture of the formulated soup vegetables (Figure 3). However, color and appearance are the preliminary attributes that attract consumers to a food product and hence considered as guide for a good quality of foods associated with acceptability (Singh, 2014). Though in the current study acceptability of the formulated soup increased in the following order F1, F2, F3 and finally F4 which was based on the colour, aroma and mouth feel.

CONCLUSION

Acceptability of healthy solar dried vegetable powders is important for the nutrition and well-being of consumers. The current study revealed that colour, mouth feel and aroma were the drivers for positive consumer preference. These attributes were positively correlated with liking while texture and taste were negatively correlated. All formulated soups were acceptable. F1 was the most acceptable and F4 the least acceptable. Solardrying of vegetables to produce powdered soups, may be considered as a practical way to preserve fresh vegetable which can be used during off season.This would ensure availability of the soups throughout the year and hence improve the health and well-being of the community.

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APPENDICES

Appendix 1: Quantitative Descriptive Sensory Evaluation Form

Sensory Evaluation Form Quantitative Descriptive Analysis (QDA) of Iron rich product.
Sex…………………Age…………..Date………………………………… Time…………...…

Please evaluate each coded sample in the order they are listed. Choose appropriate number in a scale from 1 to 9, where 1 is low intensity and 9 is high intensity. How do you find the following characteristics for Product? Put the appropriate number against each characteristic. Colour, aroma, texture, taste and mouth feel

Sample number ……………………………….

Colour ____

Faint 1 2 3 4 5 6 7 8 9

Very concentrated

Aroma ____

Not aromatic 1 2 3 4 5 6 7 8 9

Aromatic

Texture ____

Not soft 1 2 3 4 5 6 7 8 9

Soft

Taste ____

Not bitter 1 2 3 4 5 6 7 8 9

Bitter

Mouth feel ____

Not good 1 2 3 4 5 6 7 8 9

Good

What is your total liking of the product?

____

Appendix 2: Consumer test form Sensory Evaluation Form

Consumer test of Iron rich product

Sex…………………Age…………..Date………………………………… Time…………...…

Please evaluate each of the coded samples from left to right. Indicate how much you like or dislike each sample by checking the appropriate sample attribute and indicate your preference (7-1) in the column against each attribute. Put the appropriate number against each attribute. Key :7-Like very much, 6- Like moderately, 5-Like slightly, 4-Neither like nor dislike, 3-Dislike slightly, 2-Dislike moderately, 1- Dislike very much.

Sample code				
Attribute	Coded number (Sample 174)	Coded number (Sample 668)	Coded number (Sample 296)	Coded number (Sample 353)
Color				
Taste				
Aroma				
Mouth feel				
Overall Acceptability				

Comments………………………………………………………………………………………