Page 31 to 40

Volume 1 • Issue 1 • 2017

Research Article

Scientia Ricerca

Nutrition and Food Toxicology

ISSN: 2573-4946

Comparison of Nutrient Composition of *Hypochondriacus* Amaranth Grain with the Conventional Cereals in Kenya and organoleptic evaluation of Amaranth-based porridges for consumption by HIV and AIDS Infected Children

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Received: March 15, 2017; **Published:** April 21, 2017

Abstract

Introduction: The genus *amaranths (L)* belongs to the family *amaranthaceous*. Amaranth is one of the few plants whose leaves are consumed by humans as vegetables while the seeds are used the same way as cereals. Out of the various species of amaranths, three have been selected over the years as the choice for human and animal consumption. *A. caudatus, A. Cruentus* and *A. Hypochondriacus* are grown for grain in Kenya while amaranthus *tricolour* is grown primarily for the leaves. This study focused on *A. Hypochondriacus* because it is common, has the highest yields and is disease-tolerant Grain amaranth is a nutritious food source and a promising alternative grain for the modern diet. Studies have shown that grain amaranth is high in protein of high quality, good source of dietary fibre and minerals like iron, zinc, magnesium, phosphorous and manganese. Although the nutrition quality of amaranth grain in other countries has been established, information on nutrient composition of the locally grown varieties is scanty and not documented. Amaranth grain is an underutilized crop in Kenya and yet it has the potential to broaden the food base, enhance diet diversification and reduce the levels of malnutrition.

Objectives:

1. To determine nutrient composition of the locally grown Hypochondriacus amaranth grain and compare with the conventional cereals in Kenya.
2. To determine the organoleptic attributes of amaranth based porridges for HIV and AIDS infected children attending the comprehensive care clinic at Thika District Hospital, Kenya

Methods: Proximate nutrient composition was established using the standard AOAC methods and Energy Dispensive X-rays Flourensce (EDXRF) analysis was done to establish the content of micronutrients. Sensory evaluation of the fermented amaranth porridge, unfermented amaranth porridge, unfermented amaranth maize blend porridge and unfermented fingermillet blend porridge was carried out using the hedonic scale test adapted from Larmond, (1977).

Results: Local hypochondriacus amaranth has higher content of proteins (15.29%), total lipids (8.5%), dietary fibre (5.5%), iron (20.0 ± 0.8 mg/100g), zinc (4.0 ± 0.6 mg/100g) and potassium (428 ± 1.2 mg/100g) when compared to the common local cereals (KEBS 2007). The amaranth maize blend was most preferred. The amaranth *wimbi* porridge exhibited the lowest sensory qualities.

Citation: Dr. Winfreda Maoga., *et al*. "Comparison of Nutrient Composition of Hypochondriacus Amaranth Grain with the Conventional Cereals in Kenya and organoleptic evaluation of Amaranth-based porridges for consumption by HIV and AIDS Infected Children." *Nutrition and Food Toxicology* 1.1 (2017): 31-40.

Conclusion: Amaranth grain is more nutritious than the local cereals commonly consumed in Kenya and can be recommended for the nutrition management of the nutritionally vulnerable groups. Porridge preparations consisting of amaranth maize, fermented amaranth and pure amaranth were acceptable with regard to overall acceptability based on the hedonic scale.

Keywords: *Amaranth grain (hypochondriacus); Local cereals; Nutrient Composition; Organoleptic attributes*

Volume 1 Issue 1 April 2017
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Introduction

Amaranthus are widely distributed; short-lived annual herbs occurring in temperate and tropical regions (Kauffman and Weber, 1990; Yarger., *et al*. 2008). There are 60 to 70 species and about 6000 varieties within species which can be categorized into one of the four categories: grain, vegetable, ornamental or weed (Yarger., *et al.* 2008). The main species grown as vegetables are *A.tricolor, A. Dubius, A. lividus, A.cruentus, A. palmeri, and A. Hybrdus while A.hypochondriacus, A.cruentus* and *A. caudatus* are the main grain species (AAC, 2009; Teutonic and Knorr, 1985). The amaranth grain has a unique composition of protein, carbohydrates and lipids. Along with the high protein, amaranth provides a good source of dietary fiber and minerals including iron, zinc, and magnesium, phosphorous, copper and manganese (Tacio, 2009; Kalac and Moudry, 2000). Amaranth grain is a non-grass cereal found in its unique class called *pseudo cereal.* Though it produces seeds that can be used as a cereal, it does not belong to the grass family (Bressanni, 1989; Yarger., *et al*. 2008). Grain amaranth can be used as whole seeds or as flour to make products such as porridge, cookies, cakes, pancakes and bread. A number of studies have concluded that amaranth grain has high protein content and high protein quality therefore, has the potential to substitute expensive animal protein sources by complementing other cereals (Tacio, 2009, Lotter, 2005 and Bressani, 1989). Although the nutrition quality of amaranth grain in other countries has long been established, it is an underutilized crop in Kenya and yet it has the potential to broaden the food base, enhance diet diversification and reduce the levels of malnutrition (Mwangi, 2006). Consumption of vegetable amaranth is common in Kenya but the consumption of amaranth grain is a relatively new phenomenon and there is limited scientific documentation on nutrient composition and consumption of amaranth grain in Kenya. This study aimed at generating data on nutrient composition of the locally grown *hypochondriacus* amaranth grain.

Methods

Nutrient analysis of the amaranth grain

Data collection instruments included the common laboratory glassware, Incinerator, analytical balance, Auto Analyzer and Energy Dispensive X-rays Flourences (EDXRF) spectrometer. The chemicals, reagents and the standards used for nutrient content analysis were of the analar grade from Fisher Scientific and Merck pharmaceuticals.

Proximate Composition: The proximate analysis of the amaranth grain was done in duplicates using the official methods of analysis of AOAC (2000).

Moisture Content: Moisture and dry matter contents in amaranth grain were determined by air oven method (AOAC, 2000, 925.10).

Protein Content: Crude protein in amaranth grain was determined by Kjeldhal method using 6.25 as the coefficient of conversion of total nitrogen to protein (AOAC 2000, 920.87).

Crude Fat: Crude fat was determined by the acid hydrolysis method (AOAC 2000, 922.060].

Total Dietary Fiber: Total dietary fibre was determined according to AOAC method (AOAC 2000, 991.43].

Ash: The ash content was determined by incinerating the second duplicate obtained from total dietary fiber analysis for 5 hours at 525°C. This was then cooled in a dessicator and then weighed. The weight of the ash was determined by subtracting weight of the crucible and celite.

Carbohydrate: Available carbohydrate was estimated by difference using the AOAC, (2000) method after analysing for all the other components.

Minerals: Determination of iron, potassium, calcium, zinc, copper, selenium, potassium, and manganese was carried out using the Energy Dispensive X-rays Flourescence (EDXRF) Analysis (Holysynka., *et al.* 1987).

Sensory Evaluation Test: The four samples of amaranth grain based porridge were organoleptically evaluated by a 17 member untrained sensory panel using a 9-point hedonic scale. The number was limited to only 17 after screening the 52 caregivers for age and health factors. The remaining 35 caregivers were disqualified due to various limitations for sensory evaluations (Lawless., *et al*. 1998; Meilgaard., *et al.* 1999). Among the limitations were food allergies, presence of colds, sinus problems, mouth sores, antibiotic medications, dental and gum diseases and cigarette smoking. No caregiver was disqualified by the age factor as they were all below sixty-five years old. Attributes of the porridge samples evaluated included appearance, texture, flavour, consistency and overall acceptability. The panellists were briefed on the objective of the study. All the porridges were coded and were presented simultaneously. The porridges together with an evaluating sheet (Appendix 4) were presented to the sensory panellists and they were asked to evaluate each of the porridges independently using the hedonic scale. The 9-point hedonic scale had anchor terms as follows:1-dislike extremely, 2-dislike much, 3-dislike moderately, 4-neither dislike nor like, 5-like, 6-like moderately, 7-like much, 8-like very much, 9-like extremely. Panellists chose a term that best describes the attributes of the different porridges. The panellists were presented with water at room temperature to rinse their mouths after each sample. The results were used to establish the acceptability of the four samples of porridges based on the mean ratings

Results

The results on the proximate composition of locally grown hypochondriacus amaranth grain are as shown in Table 1.

Nutrient	(% w/w) in amaranth grain (DMB)
Moisture	11.00 ± 1.04
Crude protein	15.29 ± 0.80
Total lipids	8.50 ± 0.90
Total dietary fibre	5.50 ± 0.20
Total ash	2.51 ± 0.20
Carbohydrate	60.00

Table 1: *The Percentage nutrient composition of amaranth grain.*
DMB – Dry matter basis.

The moisture content of the grain was at 11.0% indicating that it was fairly dry probably due the climatic and storage conditions. The 11.0% moisture content is within the 6%–11% range reported by Teutonic and Knorr, (1985) and Singhal and Kulkani (1988). However, the moisture level is lower than in local cereals like *Eleusine corocana* (Finger millet) (13%), *Zea mays* (Maize) 14%, *Sorghum boicolour* (L.) *Moench* (Sorghum) 13%, *Triticum* spp. (Wheat) 15.5% and *Avena sativa* (Oats) 12.0%, (KEBS, 2007).

Crude protein content of the grain was found to be at 15.29%, higher than the 8.5%-14.0% reported in most cereals (Bressani, 1987). However, it falls within the 15.2%-17.8% range reported by Bressani, (1987) but higher than the levels in most local cereals like finger millet (6.8–8.5%), sorghum (8.5%), wheat (10.5%) and oats (11.0%), (KEBS, 2007) and lower than the 17.9% reported by Singhal and Kulkani, (1988).

The total lipids content of the local *hypochondriacus* was 8.50% dry matter which was higher than in finger millet (2–5%), maize (3–5.0%) and sorghum (4.7%), (KEBS, 2007). The content is slightly lower than the 8.8%-12.1% reported by Bressani, (1987) but higher than 4.8%-7.7% reported by Singhal and Kulkani, (1988).

The carbohydrate content of local amaranth (60%) falls within the 57.0%-67.9% range reported by Singhal and Kulkani, (1988) but it is slightly lower than the 62% reported by Saunders and Becker, (1984). The total dietary fibre was 5.5%. This is more than double the level of the 2.2% reported by Singhal and Kulkani, (1988) but falls within the 3.4%–5.7% found by Bressani, (1990). The 5.5% dietary fibre content of the local *hypochondriacus* amaranth grain is also higher than the content of local cereals like maize (1.0-3.0%), finger millet (1.8–3.0%), sorghum (2.5%) and oats (2.5%) (KEBS, 2007). The local amaranth grain is high in dietary fibre.

Total ash of the local *hypochondriacus* was found to be at 2.51%. The content was lower than the 3.3%-4.1% range reported by Singhal and Kulkani, 1988 and the 2.6%-4.4% by Teutonic and Knorr, 1985. The ash content is slightly higher than in some of the local cereals like maize (1.8–2.0%), sorghum (1.5%), wheat (1.3%) and oats (1.8%) (KEBS, 2007). From these findings, there are slight variations in the proximate composition of the local *hypochondriacus* amaranth grain compared to findings of other studies. This can be attributed to factors like the genetic composition, agronomical/environmental conditions and soil variations (Bressani, 1987).

Micronutrient Content in the Local Amaranth Grain

The local amaranth grain was analyzed for its micronutrient content and the results are as shown in Table 2. The iron content of the local amaranth grain was 20.00 ± 0.8 mg/100g. The content is lower than the 53mg/100g reported by Bressani, (1987), but falls within the 9.1–21.7mg/100g range by Becker., *et al*. (1981). However, the content is much higher compared to most common grains like maize (3mg/100g), wheat (3.5mg/100g), finger millet (9.9mg/100g), sorghum (5.7mg/100g), oat (4mg/100g), rice (0.9mg/100g) and soya bean (11.5mg/100g) (Becker., *et al.* 1981).

The zinc content was 4.0 ± 0.6 mg/100g dry matter basis and is slightly higher than the 3.8mg/g reported by Bressani, (1987) and the 3.6–3.9mg/100g by Becker., *et al.* (1981). The zinc level is also higher than the levels in maize (2.5 mg), wheat (1.0 mg) rice (1.2) and finger millet (1.5 mg). The selenium content was 0.87 mg/100g.

Calcium content was 250 ± 1.0mg/100g, and is above the 137–167mg/100g reported by Becker., *et al.* (1981) and the 244mg/100g by Bressani, (1987). The calcium level is lower than that found in finger millet (358 mg) but higher than the levels in soybean (240 mg), oats (54 mg), rice (32 mg), wheat (39 mg), sorghum (21 mg) and maize (8 mg), Bressani,(1987). Magnesium level was 246 mg ± 1.1/100g. This is less than the 342mg/100g reported by Bressani, (1987) and the 292–363mg/100g by Becker., *et al*. (1981). This level is also lower than that found in wheat (288 mg) but higher than in maize (142 mg), rice (130 mg), finger millet (140 mg), sorghum (140 mg) and oats (183 mg), Bressani, (1987).

Micronutrient	Mg/100g (dry weight basis)
Iron	20.00 ± 0.8
Zinc	4.00 ± 0.6
Selenium	0.87 ± 0.2
Calcium	250.00 ± 1.0
Magnesium	246.00 ± 1.1
Phosphorous	450.00 ± 0.9
Potassium	428.80 ± 1.2
Manganese	0.81 ± 0.6
Copper	2.80 ± 2.0
Beta carotene	0.01 ± 0.4
Ascorbic acid	1.49 ± 1.4

Table 2: *Mean of Micronutrient Content in Local Hypochondriacus Grain.*

The phosphorous content was 450mg ± 0.9/100g. The phosphorous content is also lower than the 570mg/100 reported by Bressani, (1987) and the 600mg/100g by Becker., *et al.* (1981). The 450mg/100g level of phosphorous in the local amaranth grain is higher than the level found in maize (234 mg), finger millet (250 mg), sorghum (363 mg), wheat (383 mg) and rice (130 mg) (Bressani,1987). However, the content is lower than in soyabean (690 mg) and oats (546 mg) Bressani, (1987).

Potassium level was 428 ± 1.2 mg/100g which is less the 532mg/100g reported by Bressani, (1987) and the 563mg/100g by Becker., *et al.* (1981). This level is quite high when compared with the levels found in common cereal grains like maize (320 mg), finger millet (314), sorghum (220 mg) and rice (130 mg) Bressani, (1987). Manganese content was 0.81 ± 0.6mg/100g, much lower than the 2.9 mg/100g reported by Bressani, (1987) and the 1.9–2.9 mg/100g reported by Becker., *et al.* (1981). This level is also lower than the levels found in cereals like rice (1.1 mg) and finger millet (1.9 mg) but higher than that found in maize (0.55 mg) (Bressani, 1987).

The copper level was 2.8 mg/100g which was high compared to the 0.86–2.40mg/100g reported by Bressani (1987) and the 0.6–0.8mg 100/g reported by Becker., *et al*. (1981). This is also very high when compared to that found in cereals like maize (0.35 mg), wheat (0.9 mg), rice (0.25 mg), finger millet (0.5 mg) and sorghum (1.8 mg) (Bressani, 1987). The high copper levels in the local amaranth grain may be associated with levels in the soil where it was grown. The beta carotene content was 0.05 ± 0.4mg/100g and ascorbic acid was 1.49 ± 4.0 mg/100. The ascorbic acid content was below the 2.8 - 3.0mg/100g reported by Saunders and Becker, (1984).

Sensory Evaluation of The Amaranth Based Porridge Samples

Different porridges made from pure plain amaranth, fermented amaranth, amaranth maize blend and amaranth wimbi blend porridges were tasted with respect to appearance, texture, flavour, consistency and overall acceptability. The sensory evaluation was done by a panel of 17 untrained panellists and the results were as shown in Table 3.

Appearance

The appearances of amaranth and blended amaranth porridges were liked on the hedonic scale of between 1 and 9, with 1 being dislike extremely, 2-dislike much, 3-dislike moderately, 4-neither dislike nor like, 5 liked 6-like moderately, 7-like much, 8-like very much, 9-like extremely and 9 being highly likely. Amaranth maize blend had the highest mean score (6.44 ± 0.73) meaning that the amaranth maize blend was liked moderately based on the hedonic scale. Fermented amaranth and pure amaranth had mean scores of 5.56

± 0.96 and 5.69 ± 1.58 respectively and this meant that the two were also liked moderately with regard to appearance. Wimbi amaranth blend scored the least (5.25 ± 0.86) with regard to appearance and was liked based on the hedonic scale.

Attribute	Porridge sample	Mean scores ± SD
Appearance	Pure plain amaranth	5.69 ± 1.58
	Fermented amaranth	5.56 ± 0.96
	Amaranth maize blend	6.44 ± 0.73
	Amaranth wimbi blend	5.25 ± 0.86
Texture	Pure plain amaranth	5.41 ± 1.23
	Fermented amaranth	5.59 ± 1.00
	Amaranth maize blend	6.18 ± 0.88
	Amaranth wimbi blend	5.35 ± 1.17
Flavour	Pure plain amaranth	5.35 ± 1.27
	Fermented amaranth	5.56 ± 0.96
	Amaranth maize blend	6.82 ± 0.39
	Amaranth wimbi blend	5.35 ± 0.79
Consistency	Pure plain amaranth	5.76 ± 1.15
	Fermented amaranth	5.47 ± 0.62
	Amaranth maize blend	6.41 ± 0.51
	Amaranth wimbi blend	5.59 ± 0.94
Overall acceptability	Pure plain amaranth	5.71 ± 1.10
	Fermented amaranth	5.76 ± 0.44
	Amaranth maize blend	6.88 ± 0.33
	Amaranth wimbi blend	5.65 ± 0.70

Table 3: *Panellists' mean Scores on the Sensory Attributes of the Porridge Samples.*

Texture

Results showed that the highest mean score (6.18 ± 0.88) for texture was for the porridge made from the amaranth maize blend followed by fermented amaranth with a score of 5.6. The pure amaranth and the *wimbi* amaranth blend had a mean score of 5.4 each. The results indicate that amaranth maize blend porridge and fermented porridge were liked moderately while the pure plain amaranth and the *wimbi* amaranth blend porridges were liked based on the hedonic scale.

Flavour

With regards to flavour, amaranth maize blend porridge had the highest mean scored of 6.8 which indicated that it was liked much. Fermented amaranth had a mean score of 5.6, which means that it was liked moderately. The pure plain amaranth and *wimbi* amaranth blend porridge shared a mean score of 5.4 each, which meant that the three porridge samples were liked.

Consistency

The highest mean score of 6.4 for amaranth maize blend indicated that the porridge was liked moderately in terms of consistency. Pure plain amaranth porridge followed with a mean score of 5.8 (liked moderately), wimbi amaranth blend porridge with a mean score of 5.6 (liked moderately) and finally fermented amaranth porridge with a mean score of 5.5 (liked moderately). These results indicate that the pure amaranth porridges, wimbi amaranth blend and fermented amaranth porridges were liked moderately with regards to consistency.

Overall acceptability

The overall acceptability in the four porridge samples showed that amaranth maize blend porridge rated highest with a mean score of 6.9 meaning that the porridge was liked much. The other porridges: fermented amaranth porridge with a mean score of 5.8, pure plain amaranth porridge with a mean score of 5.7 and wimbi amaranth blend porridge with a mean score of 5.6 were moderately liked in terms of overall acceptability.

Differences in Porridge Samples

Analysis of variance and the Turkey's Studentized Range Test on the mean scores were done to measure statistical difference in appearance, texture, flavour, consistency and overall acceptability of fermented amaranth porridge from all the other porridges. The fermented amaranth porridge was used as the reference porridge since it was the porridge to be for the intervention because studies have shown that there is enhanced nutrient bioavailability in fermented porridges. (Okoth., *et al*. 2005).

The Turkey's Studentized test compares the means of every treatment to means of every other treatment and finds wether the difference between any two means is greater than the standard error would be expected to allow. When there are multiple comparisons being made, the probability of making type 1 error increases but the Turkey's test corrects it and is thus more suitable for multiple comparisons. The formula for the Turkey's Studentized test is as follows:

$Q_s = Y_A - Y_B$

SE

Where:

Q_s: Is the minimum significant difference

Y_A: Is the larger of the two means being compared

Y_B: Is the smaller of the two means being compared

S_E: Standard error of the data

If the Qs value is larger than the Q critical value obtained from the distribution, then the two means are significantly different. The four different porridges were tested with respect to appearance, texture, flavour, consistency and overall acceptability as shown in Table 4.

Variable	*Sample porridge*	*Mean score*	*Difference from reference*	*Minimum sig. Difference(critical value from distribution)*	*P- value*
Appearance	Amaranth maize blend	6.44	0.88	1.01	0.0217
	Pure amaranth	5.69	0.13		
	Fermented amaranth	5.56			
	Wimbi amaranth blend	5.25	0.31		
Texture	Amaranth maize blend	6.18	0.59	0.98	0.1136
	Fermented amaranth	5.59			
	Pure amaranth	5.41	0.18		
	Wimbi amaranth blend	5.35	0.24		

Flavour	Amaranth maize blend	6.82	1.41*	0.79	< .0001
	Fermented amaranth	5.61			
	Pure amaranth	5.35	0.06		
	Wimbi amaranth blend	5.35	0.06		
Consistency	Amaranth maize blend	6.41	0.94*	0.76	0.0088
	Pure amaranth	5.76	0.29		
	Wimbi amaranth blend	5.59	0.12		
	Fermented amaranth	5.47			
Overall acceptability	Amaranth maize blend	6.88	1.12*	0.64	< .0001
	Fermented	5.70			
	Pure amaranth	5.61	0.06		
	Wimbi amaranth blend	5.55	0.12		

Table 4: *Differences in Porridge Samples by Sensory Attribute.*

*Indicates the differences that are larger than the critical value obtained from the distribution hence a significant difference between the means

Appearance

Based on the Turkeys' student test, the fermented amaranth porridge was not significantly different from the amaranth maize blend porridge, amaranth *wimbi* blend porridge and unfermented amaranth porridge. However, there was significant difference between *wimbi* amaranth blend and amaranth maize blend as shown in Figure 1.

Texture

The overall p-value was 0.11 indicating that the samples of porridges did not explain the texture as significantly different. The minimum significant difference was 0.98 and this means that the fermented amaranth was not significantly different from amaranth maize blend porridge, amaranth *wimbi* blend porridge, and unfermented amaranth porridge (Figure 1).

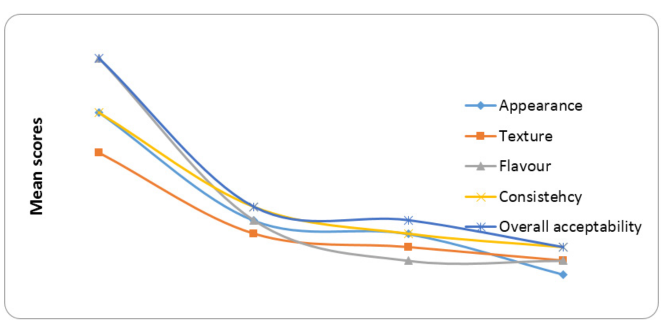

Figure 1: *The ratings of the sensory atrributes in the different porridges.*

Flavour

The overall p-value for flavour was < .001 indicating that the samples of porridges explained the flavour as significantly different. The minimum significant difference was 0.79. This means the amaranth maize blend porridge was statistically different from the fermented amaranth porridge as the difference from the reference porridge (fermented amaranth porridge) was higher than the minimum significant difference (critical value from the distribution). However, the fermented amaranth was not significantly different from amaranth *wimbi* blend porridge and unfermented porridge as shown in figure 1.

Consistency

The overall p-value for consistency was 0.0088 indicating that the samples of porridge were significantly different. The minimum significant difference was 0.76; hence the amaranth maize blend porridge was significantly different from the fermented amaranth porridge. The amaranth *wimbi* porridge and the unfermented amaranth porridge were not statistically different from the fermented amaranth porridge as shown in Figure 1.

Overall Acceptability

The overall acceptability of the four different porridges had an overall p-value of 0.0001 indicating that the samples of porridge were significantly different. The minimum significant difference was 0.64 showing that it was only the amaranth maize blend porridge that was statistically different from the fermented amaranth porridge. The amaranth *wimbi* blend porridge and the unfermented amaranth porridges were not statistically different from the fermented amaranth porridge (Figure 1).

The results show that the amaranth maize blended exhibited higher sensory qualities in all the tested attributes; meaning it was most preferred followed by the fermented amaranth porridge. The amaranth maize blend was most preferred probably due to the long held dietary practice of consuming maize and maize-based products by the panellists. The amaranth wimbi porridge exhibited the lowest sensory qualities probably due to its dull colour. However, the fermented amaranth porridge was recommended and used for the intervention for two reasons. The first reason is documented evidence of enhanced nutrient bioavailability in fermented porridges (Okoth., *et al.* 2005). Enhancing nutrient bioavailability is very critical for nutritionally vulnerable groups such as the children infected with HIV and AIDS. The second reason is that in addition to enhanced bioavailability the porridge did achieve acceptability based on the hedonic scale ratings of its attributes as discussed earlier.

Conclusions

The local amaranth grain (*hypochondriacus*) has higher content of proteins, total lipids, dietary fibre, iron, zinc and potassium when compared to the common local cereals. This means that the amaranth grain is more nutrient dense than the local cereals commonly consumed in Kenya and can be recommended for the nutrition management of the nutritionally vulnerable groups such as the HIV-infected children.

Porridge preparations consisting of amaranth maize, fermented amaranth and pure amaranth were acceptable with regard to overall acceptability based on the hedonic scale. The most preferred porridge in all the attributes tested by the panellists in the sensory evaluation of different amaranth based porridges was the amaranth maize blend. Future formulations may consider using this combination as long as the aspect of enhanced nutrient bioavailability is worked out. The second in overall acceptability was the fermented amaranth porridge. The least preferred was the amaranth and finger millet blend in all the attributes tested.

Introduction of amaranth grain flour for porridge for the HIV and AIDS infected children attending the Comprehensive Care Clinic at Thika District Hospital was a new idea as they had not used the flour before. From the findings, the amaranth grain is higher in nutrients and can be utilized by people with HIV and AIDS.

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Citation: Dr. Winfreda Maoga., *et al*. "Comparison of Nutrient Composition of Hypochondriacus Amaranth Grain with the Conventional Cereals in Kenya and organoleptic evaluation of Amaranth-based porridges for consumption by HIV and AIDS Infected Children." *Nutrition and Food Toxicology* 1.1 (2017): 31-40.