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Influence of age on the nutritional value of the Kenyan traditional leafy vegetable, C*orchorus olitorius*

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A household survey was carried out in Luanda division of Vihiga district to establish the extent of production and the time taken before first harvest of *Corchorus olitorius*. The vegetable was harvested from Maseno university's experimental plots. The vegetable, C*orchorus olitorius* was harvested at the 4th, 6th, 8th and 10th weeks from planting. The fresh vegetable was analyzed for proximate composition, ascorbic acid, beta-carotene, the minerals, iron and calcium and the anti-nutrients total oxalates, total phenols and nitrates during the four growing stages.

Results indicated that 99% of the households grew and consumed the vegetable. Harvesting of C*orchorus olitorius* started at 4 weeks from planting. The method of choice for cooking of the vegetable was boiling in plain water. The average proportion of cooking water was 875 milliliters, while the cooking-time averaged 40 minutes. About 27% of the households, however, reported adding ash filtrate from bean trash to the boiling water. Ashing helped to bring out the sometimes desired slimy taste of the cooked vegetables.

Results from the laboratory analyses indicated that *Corchorus olitorius* gradually increased in dry matter, crude fiber, total ash, calcium and iron. Gradual reduction in crude lipid, and crude protein, during growth was established. Soluble carbohydrates, ascorbic acid, beta-carotene, nitrates, total phenols and total oxalates did not show any definite trend during the four growing stages.

The study showed that stage of harvest influenced the nutritional value of the vegetable. The vegetable also showed increases in dry matter, crude fiber, total ash, calcium and iron with increase in age.

Key words: *Corchorus olitorius*, nutritional value, age.

Introduction

Traditional leafy vegetables represent an affordable and easily accessible source of micronutrients (vitamins and minerals). The vegetables are relied upon by most of the rural populations and the urban poor for provision of vitamin A, iron, zinc and iodine, the micronutrients of nutritional concern in the World today. Vitamin A deficiency is a major health problem in the less developed countries. Correcting mild to moderate vitamin A deficiency at the community level is thought to lead to at least a 23% reduction in mortality rates among young children, Viveka et al., (1998). Iron is an essential component of the blood haemoglobin and the iron containing enzymes of the body. Iron deficiency is one of the most prevalent problems of micronutrient malnutrition and it occurs in both developing and industrialized countries. The impact of iron deficiency or iron deficiency anaemia on the individual can result in life long disadvantages. The causes of the problem are many, but the principal cause is lack of iron-rich foods (Yeung, 1998). An international conference on Nutrition, estimated that over 2000 million people worldwide suffer from anaemia, most of which is related to iron deficiency. Greatest prevalence of anaemia is in developing nations (WHO, 1972).

Iodine deficiency disorders (IDD) is also thought to be one of the most common nutrient deficiencies in the world. Clinical deficiency presents itself as goitre (enlargement of the thyroid gland) detected either visibly or by palpation. Iodine deficiency affects intellectual development and acuity. This can be irreversible if the damage occurs in early childhood. However in older children and adults improved current performance has been demonstrated with supplementation. Iodine deficiency disorder is a public health problem in 118 countries Worldwide and there are approximately 1.5 billion people at risk (Marberly, 1994). Zinc is involved in many metabolic processes and its deficiency affects many functions including immunity and growth.

Introduction of exotic vegetables like cabbage, lettuce, kales, and spinach made communities abandon consumption of traditional vegetables. The reason for this was because exotic vegetables were perceived especially by the urban populations, to promote a sense of sophistication exhibited by the European colonizers. However increased poverty and the effects of urbanization in Africa have helped accelerate the recall into diets of traditional crops (FAO, 1988). *Corchorus olitorius* belongs to the family *Tiliaceae*. It occurs in the wild or cultivated forms, usually at seasonally flooded sites. The vegetable is prefered by many communities in Kenya especially in Western, Nyanza, Central and Coastal provinces. There are about 12 species reported in Kenya, half of which are used as edible vegetables. When cultivated the vegetable is first harvested at the fourth week after planting, usually by uprooting the plants or by cutting the stems a few centimeters above the ground. The harvesting continues for several weeks. In Western Kenya *Corchorus olitorius* is cooked with other coarse vegetables such as *Vigna unguiculata* Chweya et al (1999). When cooked with *Vigna unguiculata* leaves, milk or butter or both are added. Among the Swahili the leaves are pounded and cooked with meat then flavoured with lemon or limejuice. The mijikenda cook it in mixtures with cowpea, pumpkin, sweet potato, and coco yam leaves. The edible shoot tips and leaves are also used as potherbs by many communities. The nutritional value of *Corchorus olitorius* compares very well with other common tropical leafy vegetables. It is high in protein, fiber, calcium, iron, and beta-carotene Maundu et al (1999).This study aimed at establishing the prevalence, consumption, and changes in quality of C*orchorus olitorius* with plant age. The extent of production and consumption of C*orchorus olitorius* was assed and the changes in the levels of the minerals, (calcium and iron) the vitamins ascorbic acid and beta-carotene and the anti-nutrients, total oxalates, total phenols and nitrates during the four growing stages.

Materials and Methods

The field survey was carried out in Luanda division of Vihiga district; Western province, Kenya. Laboratory analyses carried out includes proximate chemical composition of the raw and cooked vegetables and minerals and anti-nutrients composition.

Sample population

The respondents interviewed were from 138 households, the key people in the households were mothers and in their absence, the father was interviewed. Additional 5% households were included to cover for attrition and incomplete questionnaires. The desired minimal sample size was therefore 145.

Sampling procedure

Two locations West Bunyore & South Bunyore from Luanda division were purposively selected with the help of the District Agricultural Officer. This was because of the following reasons: Proximity to the main market Luanda that was said to influence production; similar climatic conditions; production of the same foods. The two locations were also equally easily accessible. From the two locations, three sub-locations from each were randomly selected. The households were then proportionately selected from each sub-location.

Laboratory analysis

Corchorus olitorus Vegetable

The vegetable was obtained from Maseno University Horticultural farm because the farm was in the same Agro-Ecological Zone as the division surveyed and moreover in the plots the vegetable was grown under controlled conditions. The vegetable was harvested at four different growing stages 4^{th}, 6^{th}, 8^{th} and 10^{th} weeks .The leaves were harvested, placed into polythene bags measuring (16cm x 30cm) and transported in cool boxes to the laboratories of the Department of Food Technology and Nutrition, University of Nairobi within 24 hours for analyses of proximate chemical composition, nutrients and anti-nutrients and for storage studies, and cooking trials.
determination of moisture and dry matter was by (AOAC, 1984), crude protein was determined using the semi-micro Kjeldahl method (AOAC, 1984, determination of ether extract (crude lipid) was by (AOAC, 1984), Determination of crude fiber content was by (AOAC, 1984), determination of total ash was by (AOAC, 1984), determination of Ascorbic Acid: Ascorbic acid was analyzed as reduced ascorbic acid by (AOAC, 1984), determination of iron was by (AOAC 1980), Determination of calcium was by (AOAC 1980), determination of total oxalates was by method of Marshall et al (1967), Determination of nitrate-N was by the method of Cataldo et al (1975) with slight modification according to Chweya (1985) while determination of total phenols was by Folin-Denis method (Burns,1975).

Data analysis

Survey data was analyzed using the Statistical Package for Social Sciences (SPSS). Data was subjected to descriptive statistics that included the geometric means, 95% confidence interval and correlation variables. All the experiments were arranged in a completely randomized factorial design with four main treatments of harvested vegetables. The experiments were replicated twice. All data for proximate chemical composition were then subjected to analysis of variance (ANOVA) and means were separated by Duncan Multiple Range Test using Genstat 6th Edition and Costat Statistical Software Programmes.

Results and Discussion

Corchorus olitorius Production

Results obtained indicates that, all the households grow the vegetable. The vegetable is usually grown in the kitchen gardens mainly by women and by using seeds as the planting material. Of the respondents, 24% reported first harvesting the vegetable at the 2nd week 67% when between 3 and 4 weeks, 4% when between 5 and 6 weeks and 4% when between 7 and 8 weeks from planting. On average therefore, the vegetable is first harvested at the 4th week from planting.

Up to 83% of the respondents first harvest this vegetable by cutting the stems to give room for more branches, 9% by uprooting whole plants and 9% by picking only the leaves. If the harvesting is for the market, then the method of choice is by uprooting whole plant.

Laboratory analysis

Proximate Chemical Composition of raw *Corchorus olitorius* from different weeks of harvests

The proximate chemical composition of raw *Corchorus olitorius* from different growing ages is shown in Table 5.

The dry matter contents of the tenth week old vegetables were significantly higher ($P<0.05$) than those of the eighth week old, which were also significantly higher than the sixth and fourth week old vegetables. However, the fourth and sixth week old samples were not significantly different ($P<0.05$) among each other. The increase in dry matter with age was expected, increase in dry matter with age has been reported by (Murage,1990) while working with *Solanum nigrum*.

The crude protein contents of the vegetables from the fourth week harvest were significantly higher ($P<0.05$) than those from the sixth and eighth week harvests, which were not significantly different ($P<0.05$) among each other. However, the two were significantly higher ($P<0.05$) than those from the tenth week harvests. Values ranging from 14-23% for the same vegetable was found by other researchers (Imbamba,1973). This variation may be attributed to differences in agronomic practices and agro-ecological zone.

The crude lipid values from the fourth week harvest were significantly higher ($P<0.05$) than from sixth, eighth and tenth week harvests. Those from the sixth, eighth, and tenth weeks harvests were, however not significantly different ($P<0.05$) among each other. The values are similar to those reported by other researchers (FAO, 1970).

Crude fiber values from all the stages of harvests were not significantly different ($P<0.05$) among each other. Similar values for the crude fiber in *Solanum nigrum* has been found by other researchers (Murage, 1990). The crude fiber values were also within the range found by (Tindall, 1983).

The total ash contents for vegetables from the eighth week harvest were significantly higher ($P<0.05$) than those from the fourth and sixth week harvests, but both were not significantly different ($P<0.05$) from the tenth week harvests. Tenth week samples were significantly higher

(P<0.05) than the fourth and sixth week samples. There was a general increase in the total ash contents for this vegetable.

The soluble carbohydrate contents from the fourth, sixth and tenth weeks harvest were not significantly different (P< 0.05) among each other, but were significantly higher than those from eighth week harvest. Soluble carbohydrates increased, then a drop and finally increased. The variation in the eighth week of harvest may be attributed to the prevailing environmental conditions during growth of the vegetable. The samples were harvested during the dry season.

Table 5: Proximate chemical composition of raw *Corchorus olitorius* leaves from different harvests

	Percent of component					
Weeks from planting	Dry matter	crude protein	crude lipid	crude fiber	total ash	soluble carb.
4	16.6^{c}	26.8^{a}	7.3^{a}	12.8^{a}	11.8^{c}	24.8^{a}
6	16.3^{c}	22.7^{b}	5.3^{b}	14.5^{a}	15.0^{b}	26.8^{a}
8	20.5^{b}	22.5^{b}	4.9^{b}	11.0^{a}	18.8^{a}	22.3^{b}
10	21.6^{a}	18.2^{c}	4.8^{b}	11.5^{a}	18.4^{a}	27.2^{a}
SE	**±0.2**	**± 0.6**	**± 0.8**	**±1.4**	**±0.6**	**±1.4**

Means within columns superscripted by same letters are not significantly different from each other (P<0.05) by Duncans Multiple Range Test.

Levels of Vitamins and Minerals in *Corchorus olitorius*

The levels of beta-carotene, ascorbic acid, iron, and calcium are shown in Table 6. The levels of beta-carotene in the vegetables of eight weeks harvest were significantly higher (P<0.05) than those from, fourth, sixth and tenth weeks harvest. Those of the fourth and tenth week harvest were however not significantly different (P< 0.05) among each other, but were significantly higher than sixth week harvest. There was no definite trend in the levels of beta-carotene observed from these samples; the variation may be because of the agronomic practices. Carotene has been shown to be affected by amount of nitrogen fertilizers applied, increases in amounts of nitrogen fertilization leads to increased beta-carotene.

Table 6: Levels of beta-carotene, ascorbic acid, iron and calcium in *Corchorus olitorius* during growth (mg/100g of dry matter edible portion)

Weeks from planting	Reduced ascorbic acid	Beta-carotene	Calcium	Iron
4	1036.7[a]	26.9[b]	558.0[d]	53.1[d]
6	466.0[d]	11.1[c]	700.0[c]	110.5[c]
8	776.6[c]	50.3[a]	1394.0[a]	209.5[a]
10	957.9[b]	24.0[b]	1256.3[b]	151.0[b]
SE	**± 45.7**	**± 4.4**	**± 47.7**	**±8.3**

Means within columns superscripted by same letters are not significantly different from each other (P<0.05) Duncans Multiple Range Test.

The levels of ascorbic acid in vegetables from harvest at fourth week were significantly (p<0.05) higher than from tenth week, which were also significantly higher (P<0.05) than those from sixth and eighth weeks. The eighth week had also significantly higher (P<0.05) ascorbic acid than those from the sixth week. These levels of ascorbic acid are show to decrease on the sixth week then a general increase up to the tenth week. The differences in ascorbic acid may be as a result of variation in the climatic conditions during growth. The variation in climatic conditions has been shown to affect ascorbic acid contents. Other factors may be related to agronomic practices. These samples were planted at different times leading to possibility of variation in such factors as fertilizer application, spacing of the crops among others. These two have been shown to influence the nutritional value of the vegetables. Nitrogen application for example affects ascorbic acid differently for various leafy vegetables for example it may lead to decline in ascorbic acid in *Cleome gynandra* and a general increase in ascorbic acid in *Solanum nigrum* and others. The values obtained in this study agree with those reported by Ifon and Bassir (1980) ranging from 170 -210mg/100g for this vegetable. Maumba (1993) while working with *cleome gynandra L* showed increasing trend in ascorbic acid with age. Increase in ascorbic acid with age has also been reported by (Murage, (1990) while working with *solanum nigrum.*

The levels of calcium in the vegetables harvested at the eight week were significantly higher (P<0.05) than those harvested at the tenth week. These were also significantly higher (P<0.05) than those of sixth week. The values obtained with harvests at the fourth week were significantly lower (P<0.05) than at sixth week. There was a gradual increase in the levels of calcium to the eighth week then a decline at the tenth week. The decline may have been occasioned by changes in environmental conditions and specific part of the plant analysed.

The levels of iron in the eighth week samples were significantly higher (P<0.05) than the levels in all the other harvests. Those of tenth week were also significantly higher (P<0.05) than those from the fourth and sixth weeks. The fourth week samples were significantly lower in iron (P<0.05) than those of all the other weeks. There was a general decrease in iron contents up to seventh week then an increase to the tenth week. (Murage, 1990) while working with *solanum nigrum L,* reported an increase in levels of iron with increase in age of the plants.

Levels of Phenols, Oxalates and Nitrates for various ages of *Corchorus olitorius.*

The levels of total phenols, nitrates, and total oxalates are shown in Table 7. There was a significant increase then a decrease in the levels of total phenols in the vegetables. The samples which were six weeks old had significantly higher total phenols ($P< 0.05$) than those which were eighth weeks old, which were also significantly higher than those four and ten weeks old. Total phenols from fourth and tenth weeks were not significantly different ($P< 0.05$) among each other. The difference in the levels of phenols may be attributed to the variation in environmental conditions during growth. Mwafunsi (1992) and Onyango (1993), while working with *Solanum nigrum L.* reported an increase in the levels of total phenols with increase in plant age.

The levels of nitrates from the tenth week were not significantly different ($P<0.05$) with those from fourth and sixth weeks. These were significantly higher ($P<0.05$) than those from the eighth week.

Table 7: Levels of total phenols, nitrates, and total oxalates in *Corchorus olitorius* leaves of different ages (mg/100g dry matter edible portion)

Age (Weeks)	Total phenols	Nitrates	Total oxalates
4	1400.0^{c}	850.0^{a}	755.0^{b}
6	2200.0^{a}	762.5^{a}	785.0^{b}
8	1900.0^{b}	350.0^{b}	1130.0^{a}
10	1400.0^{c}	925.0^{a}	607.5^{c}
SE	**±163.3**	**±66.5**	**± 90.5**

Means within columns superscripted by same letters are not significantly different from each other ($P<0.05$) Duncans Multiple Range Test.

The levels of oxalates in the eighth week samples were significantly higher ($P<0.05$) than the levels in the fourth and sixth weeks samples, which were not significantly different ($P<0.05$) from each other. The levels in the fourth and sixth week samples were significantly higher ($P<0.05$) than in the tenth week samples. The variation in the total oxalates may be attributed to variation in environmental conditions and age of the plant.

Conclusion

From the study, it was established that *Corchorus olitorius* is grown and consumed by almost all the households in the study area. *Corchorus olitorius* was first harvested four weeks from planting. From the study it was established that the nutritional value of *Corchorus olitorius* vary with age of the plant. The variation in the nutritional value in many cases does not show a definite trend except in dry matter, proteins, minerals, oxalates and total phenols. These vegetables have high levels of vitamin A (beta-carotene) ascorbic acid, calcium, and iron. The levels of anti-nutrients are also high. The phenols for example are high in older vegetables. Leaves from younger plants have low dry matter, total ash, crude fiber, ascorbic acid, beta-carotene, calcium and iron. The oxalates, nitrates, crude lipid did not show a definite trend with age for the two vegetables.

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