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RESEARCH ARTICLE

PRODUCTION, CONSUMPTION AND NUTRITIONAL CONTENT OF FIVE NEGLECTED VEGETABLES IN TWO SECONDARY CITIES OF BURKINA FASO.

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Abstract

Vegetables have a potential to alleviate food insecurity. However, the non-consumption of indigenous (neglected) vegetables either by choice or ignorance of their nutritional potential might limit their contribution. The purpose of this study was to evaluate the production, the consumption and the nutritional content of five neglected vegetables. Firstly, the study was conducted using a descriptive survey on 116 producers and 137 consumers by conducting face to face interview and administration of questionnaires. Two distinctive questionnaires were administrated to assess production and consumption of vegetables. A survey was carried in the garden for production and in households for consumption which were around of Fada N'Gouma and Diébougou town, respectively located in Est and South-West regions of Burkina Faso. Secondly the nutritional content of collected vegetables was determined through standardized methods. Most of the producers in the Eastern region were women (91.07%) compared to the South-Western where all were men. For consumption, all of the respondents were women. Okra was the most produced vegetable (98.3 %) compared to amaranth, black nightshade, jute mallow and African eggplant. Vegetables were mainly produced on dry season (75 %). More than the half of producers were beginning this activity less than 6 years ago. Vegetables were grown on small plots. Vegetable were daily consumed in the surveyed households. The main process consumption way was sauces. The fresh vegetables form was most preferred than the dried one. Household have satisfactory knowledge about the nutritional interest of vegetables consumption.

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Introduction:-

Vegetables contributed to food security for several populations in Africa (Rubaihayo, 2002). In sub-Sahara Africa, vegetables constitute a significant part for balancing diets (Grubben and Denton, 2002; Muandu and Kabuye, 1999). They are also the most important source of micronutrients (Yang and Keding, 2009; Oyenuga and Fetuga, 1975). There is a large diversity of vegetables in Sub-Sahara Africa (Icard-Vernière et al., 2010; Kahane et al., 2005) but only a few of them are used for human consumption. In Burkina Faso especially, previous studies showed that vegetables are an important source of nutrients and micronutrients (Walingo and Abukutsa-Onyango, 2010; Traoré et al., 2017). However, Sub-Saharan Africans have shown high level deficiencies for micronutrients such as vitamin A (Hama-Ba et al., 2017). In this part of the world, vegetable consumption is very low comparatively to the average recommended. It was noted an average of 24.2g/day/capita in Burkina Faso. Supplying of vegetables in cities was essentially through purchase or production. Previous studies showed that in urban areas, supplying of vegetables was essentially through purchase (Hama-Ba et al. 2017; Kamga et al., 2013). Vegetables were grown in urban and peri urban gardens around cities. There are a few data concerning vegetables production and its consumption in rural and secondary cities.

Indeed, the previous studies scope was limited to urban area (principal cities). Up to day, there is no published report on the production and consumption of neglected vegetable in rural and secondary cities in Burkina Faso. Such studies are however, important as they provide a nation-wide assessment. Such investigations will also provide more data to better understand the contribution of vegetables to food security.

This study therefore sought to assess the production, the consumption and nutritional content of five neglected vegetables with regard to food security.

The surveys were focus on amaranth (*Amaranthus cruentus*), black nightshade (*Solanum scabrum*), jute mallow (*Corchorus olitorius*), okra (*Abelmoschus esculentus*) and African eggplant (*Solanum aethiopicum*).

Materials and Methods:-

Survey locations:-

Survey was conducted in the East and the South-West region of Burkina Faso. In the East region, four villages around Fada N’Gourma was concerned (Bolontou, Tchangou, Modré and Abaza). For the South-West region, three villages around Diébougou (Bapla, Bapla-Birifor and Nanè) were chosen. These localities produce vegetables and procure the nearest cities in vegetables. These locations were choosing based on their level of acute malnutrition ranged 3.2% and 6.2% respectively for South-West and East region (Ministère de la santé, 2016).

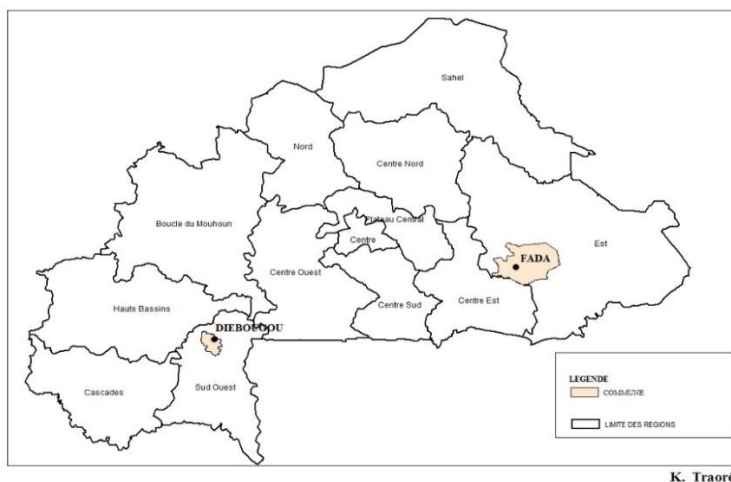


Figure 1:-Location of survey sites

Data collecting method:-

The investigation was focus on gardeners and householders. Face-to-face interviews were conducted using structured questionnaire to collect information about the local production and usually way of consumption of these vegetables. Two questionnaires were administrated to gardeners and householders respectively. The questionnaire was peer-reviewed and pilot tested in real conditions.

The investigation on vegetable production was concerning the respondent social characteristics, the vegetables produced, the production season and production reasons of vegetables, gardeners experience and their fields' size, the production cycle of each vegetables and the usage of the incoming of the activity.

Concerning vegetables consumption, the questionnaires were administrated to the responsible of the household dish. Questionnaires were taking into account the consumed vegetable, the preferred forms and the conservation technics of vegetables in the household, the cooking way, the knowledge of nutritional content of vegetables.

Analysis of nutritional content of vegetables:-

Determination of nutritional content of vegetables was concerned eggplant fruit and leaves, and okra fruits and leaves. The nutritional content of amaranth, black nightshade and jute mallow leaves have been published elsewhere (Traoré et al., 2017).

The nutritional content was determined with conventional methods (AOAC, 1990). Beta carotene content was determined by High Performance Liquid Chromatography as described by Craft (1992).

For survey, questionnaires conception and the data collection were made through SPHINX 5.1.0.2. Data analysis was made using SPHINX 5.1.0.2 and Excel 2010.

The data on nutritional content of vegetables was analyzed using Excel 2010. Statistical analysis was performed with XLSAT 7.5.2, using PCA analysis.



Figure 2:- Concerned vegetables: (a) Amaranth leaves; (b) Black nightshade leaves; (c) Jute mallow leaves; (d) Eggplant fruits; (e) Eggplant leaves; (f) Okra fruits; (g) Okra leaves.

Results:-

Vegetables production and availability:-

Characteristics and seasonability of vegetables production:-

Survey was concerned 116 producers including 60 producers of Diébougou and 56 producers of Fada N’Gourma. Results showed that producers were exclusively constituted by men in South-West region (100%). However, in East region men are less represented (8.93%). In both localities, okra appeared to be the most produced vegetable (98.3%) followed by amaranth (96.5%), African eggplant (92.9%), black nightshade (75.4%) and jute mallow (70.4%). Results showed that vegetables were most grown in dry season (figure 3). The large part of producer was growth vegetables in the small plots ranged from 2 m² to 20 m² (74.9%, 86.2%, 89.5%, 56.5%, and 70.4 % respectively for amaranth, jute mallow, black nightshade, okra and eggplant). The plot size varied depending on vegetable produced (figure 6). Okra was found to be produced on the biggest plots ranged more than 30 m² (15.7 %).

The consumed parts:-

The edible part of the vegetables was the leaves for amaranth, nightshade, and jute mallow. While both leaves and fruits for okra and eggplant are used with the fruits being the most used. Young stalk of amaranth, black nightshade and eggplant leaves is often used by consumers. For that, these vegetables were harvested with their young stalks. The harvesting frequency depends on vegetables. Okra fruits, eggplant fruits and leaves and jute mallow leaves were most harvested first after 8 to 12 weeks after planting. Amaranth and jute mallow were harvested between 4 to 6 weeks after planting. For okra leaves, first harvesting occurred between 12 to 14 weeks. Harvesting frequency for okra fruits is once every three days (59.7 %) and once seven days for eggplant (25.81%). Black nightshade (20.98%) and amaranth (22.6%) leaves were harvested once every seven days. Jute mallow (22.22%) was harvested once every 10 days. During the production cycle of vegetables, several harvesting can be done by gardeners. On the same producing area and from the same semi, producers can harvest several crops, depending on speculation but also on the parts of the plant consumed. On average, these harvests can range from 4 harvests for rarely consumed parts such as okra leaves to 20 harvests for most consumed parts.

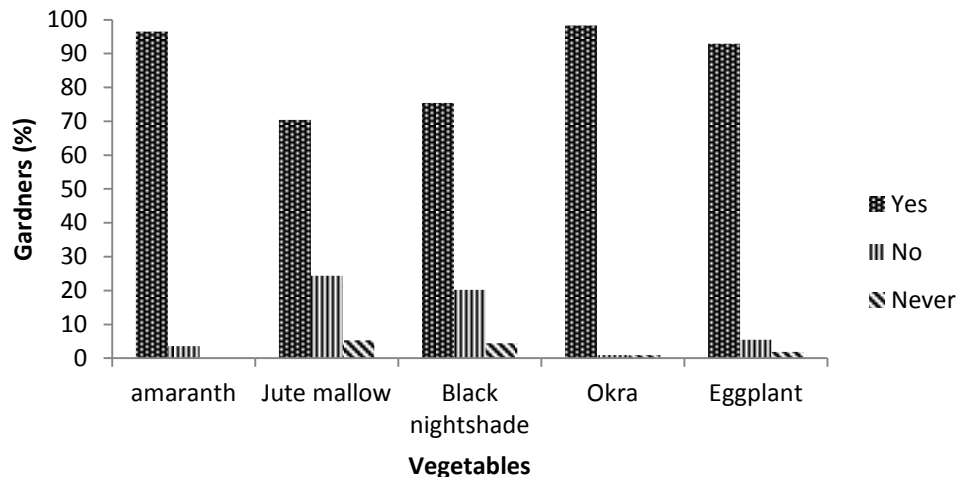


Figure 3:- Importance of vegetables production

The producer's experience

Results showed that amount the producers, more than the half (58.1 %) were done vegetables production since 6 years ago. There were a few parts of producers (19 %) who have done this activity since more than 12 years (Figure 4).

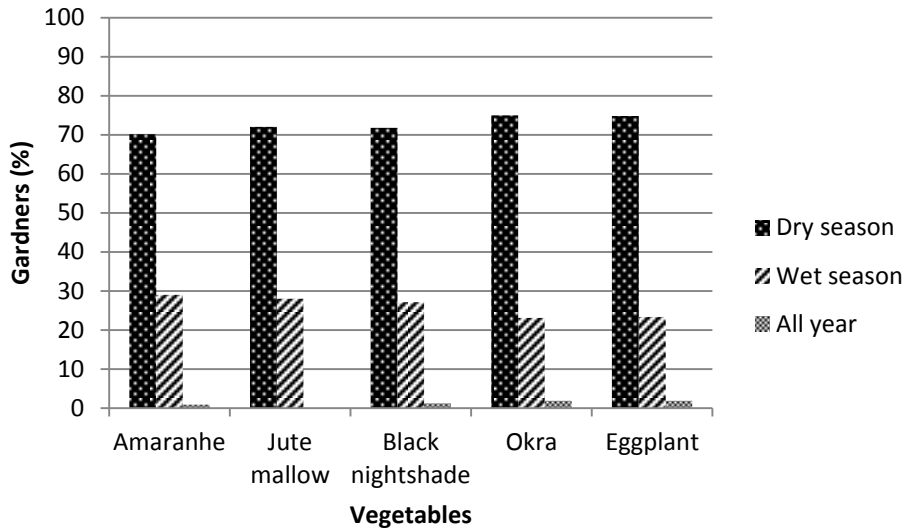


Figure 4:- Production season of vegetables

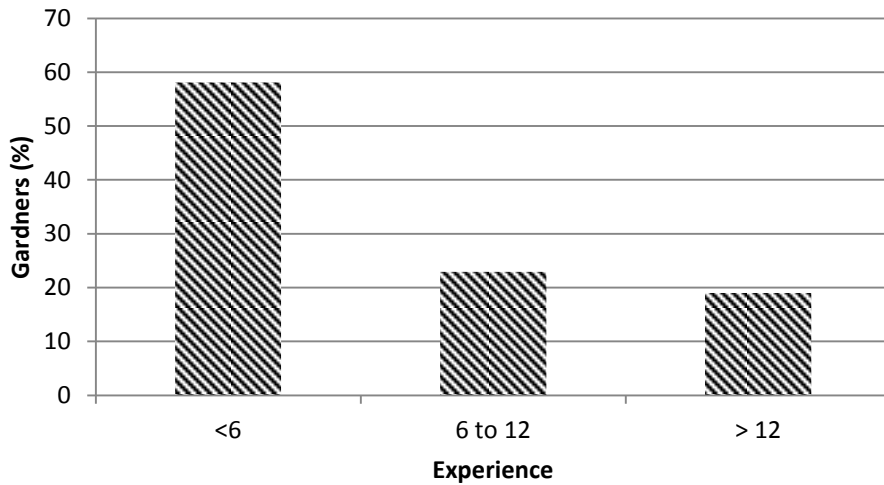


Figure 5:- Experience of producers (in year)

Gardiner’s motivations in vegetables production:-

There were several reasons which lead gardeners in vegetables production. Amount these reasons, yield (28.4%, 32.1%, 30.2%, 29.8% and 29.5 %) and easiness to cultivate (22.1%, 32.1%, 29.4%, 24.6% and 24.7%) were the most respectively for amaranth, jute mallow, black nightshade, okra and eggplant (figure 5). Besides, okra and eggplant were also produced for their profitability. However, amaranth, jute mallow and black nightshade were produced to satisfy customer's needs.

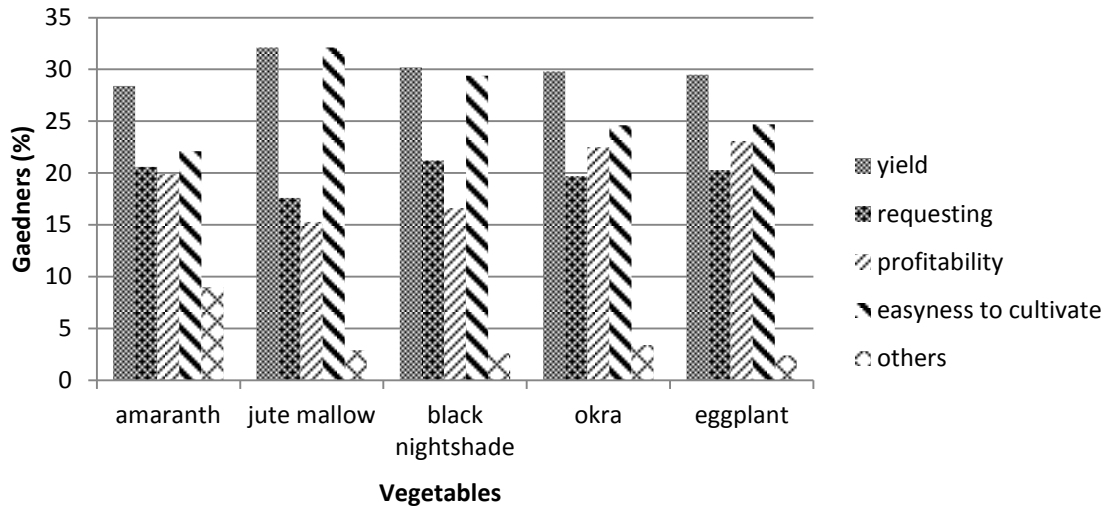


Figure 6:- Gardiner's motivations in vegetables production

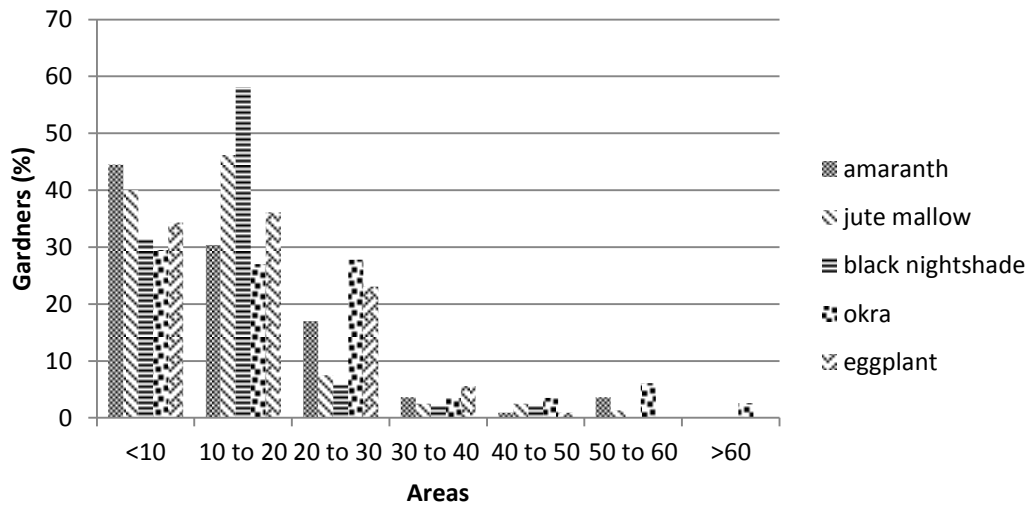


Figure 7:- Vegetables production area size

Survey on vegetables consumption:-

Diversity on consumed vegetables in the household and supplement source:-

Globally, 138 households were randomized in both two cities. All of the respondents in households were women. The results showed a diversity of vegetables consumption on the surveyed areas. Among the consumed vegetables it appears that amaranth, okra, Jute mallow, African eggplant and black nightshade are among the first six commonly consumed vegetables. All of the surveyed households were consumed amaranth, okra and African eggplant. The supplying of households was making through production (86.95 %), purchasing (69.59 %), or other way such as gifts (2.20 %) (Figure 7).

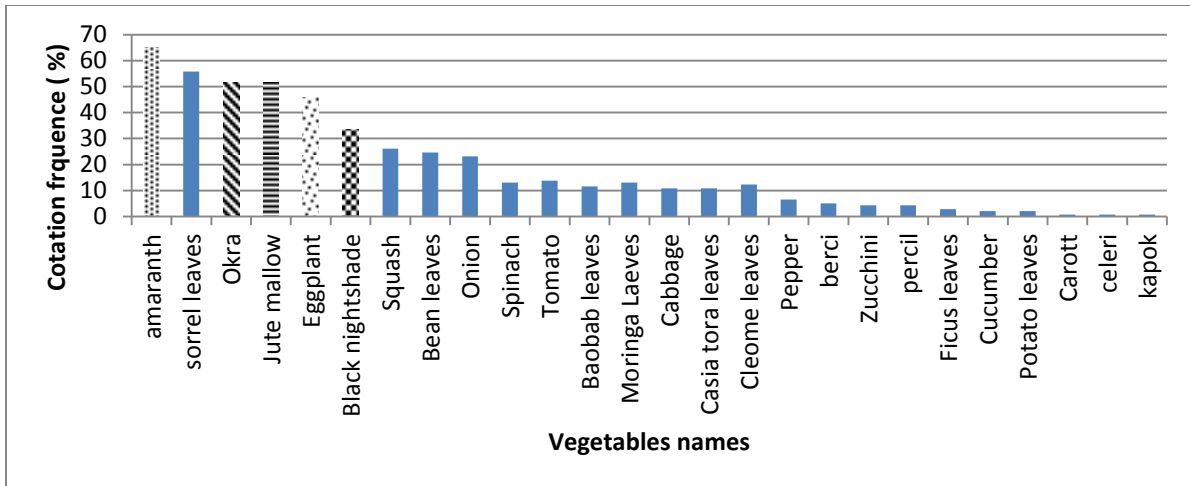


Figure 8:- Commonly consumed vegetables

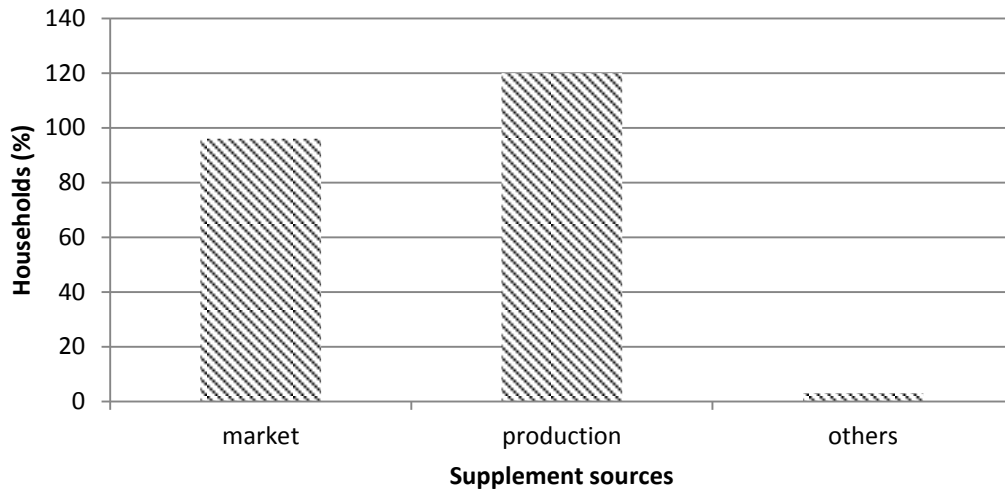


Figure 9:- Supplement sources of households

Preferred forms of vegetables:-

All of the vegetables were preferred on their fresh form. But a few number of households preferred dried leaves of jute mallow (5.80%) and eggplant (2.17%) (Figure5). The supplement of households is making through production (69.59%), purchasing (86.95%), or other way such as gifts (2.17%). Vegetables are often dried for conservation purpose. The commonly dried were jute mallow leaves, okra fruits and African eggplant leaves.

Vegetables were dried through sun dried method or drying on the shadow. The drying method depends also on the nature of the product. Leaves were preferably dried on shade. However, fruits were sun dried. The color of the dried product was the most criteria parameter, which allows evaluating the quality of the drying process.

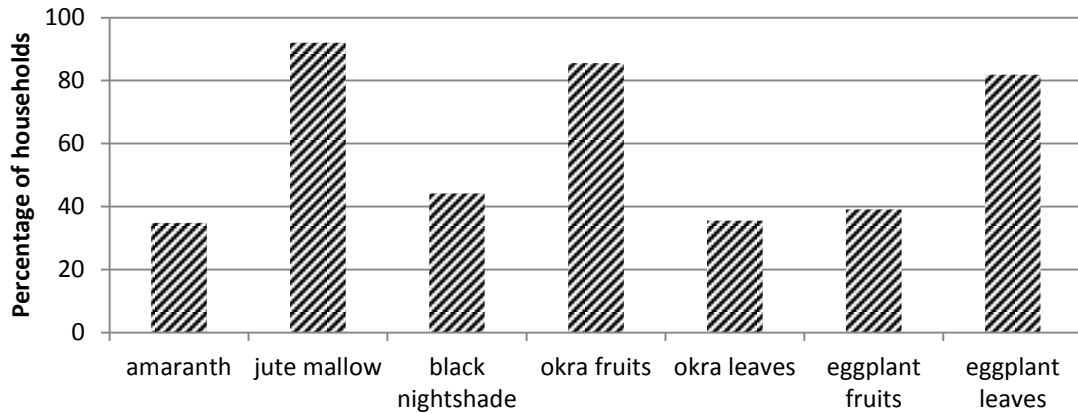


Figure 10:- Frequently dried vegetables

Common processes way of vegetables:-

Vegetables are more used in sauces and soups, like balls. For these preparations, boiling was the most process used. These usages often occurred after frying, particularly for leafy vegetables (figure 10). Leafy vegetables were also consumed like balls after boiling wringing out, pressing and seasoning with oil and salt. Fruits vegetables were used in sauces and soups. Vegetables were consumed every day in the surveyed household. The kind of vegetables consumed depends on their availability. Depending on the consumption way, the same sauce can be consumed more than one time on the day.

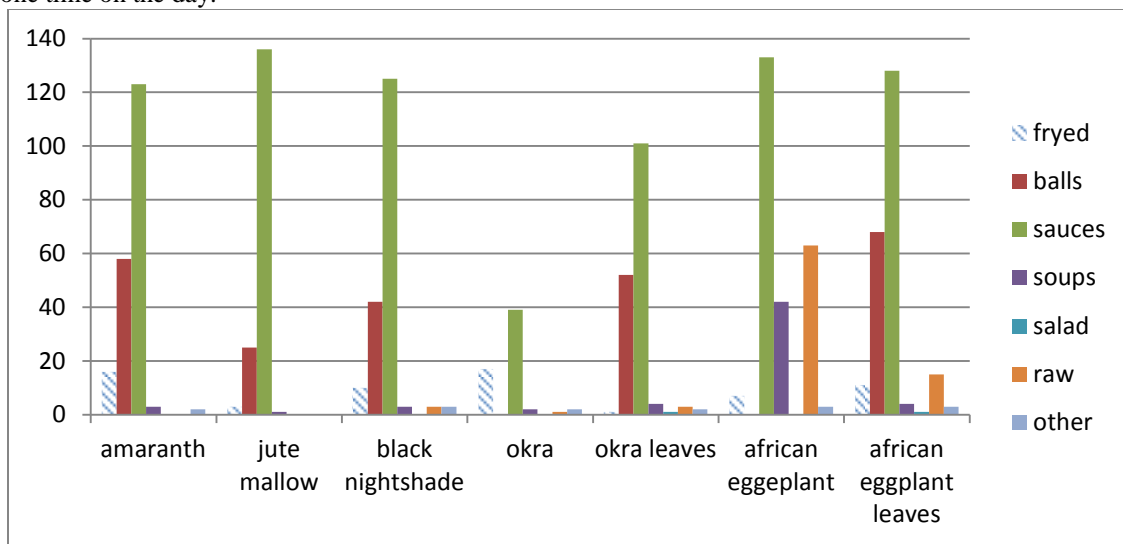


Figure 11:- Commonly usages of vegetables

Knowledge on the importance of vegetables:-

Results showed that the respondents were sensitized on the nutritional importance of vegetables consumption (Figure 12). All of them presumed that vegetables consumption bring vitamins for human body. More than 90% think that vegetable consumption protects human body against diseases.

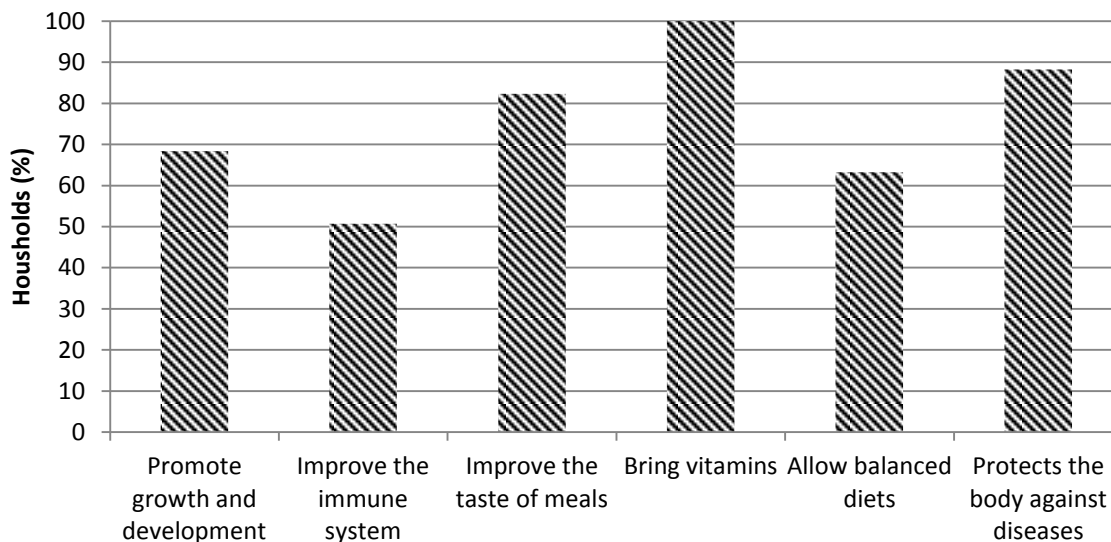


Figure 12:- Respondent's awareness on vegetable importance on human body

Nutritional content of vegetables:-

Table1:- Proximate composition of vegetables

Vegetables	Ash (g/100g)	Lipids (g/100g)	Protein (g/100g)	Carbohydrates (g/100g)	Energetic kcal/100g	value	Beta carotene mg/100g
Amaranth	16.33±1.27	7.56±0.37	25.21±2.63	25.68±2.36	271,60		24.25±2.29
Black nightshade	10.57±1.12	7.11±1.22	39.74±1.92	25.94±5.05	326,71		16.40±0.08
Jute mallow	12.40±1.44	6.64±1.46	29.18±0.47	27.88±3.76	288		27.71±1.75
Eggplant fruits	10,25±0,02	5,06±0,01	13,26±0,04	39,60±0,04	256,9581		26.29 ±0,46
Eggplant leaves	12,71±1,27	2,90±0,41	48,13±0,29	34,62±0,89	357,1007		5.03±0,32
Okra fruits	11,86±0,14	3,32±0,20	10,07±0,20	29,96±0,46	189,9695		0
Okra leaves	12,10±2,03	3,07±0;14	40,11±0,14	14,40±0,52	245,6871		5.47±0,12

The table 1 presents the proximate composition and beta carotene content of the vegetables. The PCA representation of the five vegetables nutritional content was made along two axes (F1 and F2), which represent 64.15% of the variabilities (Figure 13). The F1 axis appears to be strongly linked to the protein content meaning that eggplant and black nightshade leaves have the highest protein content. F2 axis appears to be linked to beta carotene and lipids and beta carotene content meaning that Jute mallow and amaranth have the highest lipids and beta carotene content. Okra is found to have de less level of each of the analyzed nutrients.

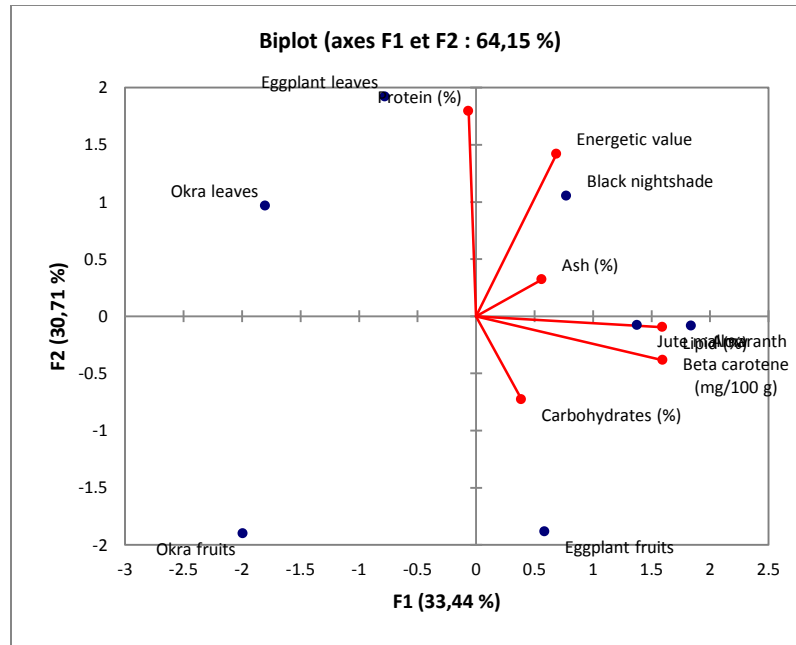


Figure 13:- ACP representation of vegetables nutritional content

Discussion:-

Amaranth, black nightshade, jute mallow, okra and eggplant are all grown by the surveyed gardeners. These results may be due to the cultural acceptance of these vegetables. For example, okra is identified to be one of the most consumed vegetables in household diet in Burkina Faso (Mathieu-Daudé and Barrot, 2001).

The high production of vegetables during the dry season would be due to three principle reasons. First, vegetables growth represents a secondary activity for producers, which were generally farmers. They produce the other speculations such as maize, sorghum, rice... during rainy season for their own consumption and for sale.

Secondary, during staples foods production, some vegetables are naturally growth in fields such as amaranth and jute mallow leaves. Okra was also grown, but these productions are essentially to household consumption. Third, this activity procures a supplementary incoming for producers. They estimate the profitability of their activity through their ability to cope with their family's expenses such as children's schooling, motorcycle purchase, and health care. They also evaluate it through their ability to invest to their activity through the purchase of agricultural equipment such as carts, irrigation equipment and agricultural inputs. For women especially, vegetable production contributes to a diversification of household dishes.

The production areas are located around water points such as wells, dam, drilling. According to producers, the irrigation system used for vegetables production in dry season allows optimization of the quantities of water for some vegetables.

The productions were first used for consumption, especially in the East region where the activity was largely done by women (97.07%). In the South-West region, all of the investigated producers were men. This result shows that vegetable growth has a socio-economic importance in this region (Oluoch et al., 2009).

The use of small plots to growth vegetables might be due to the motivation of producers, the frequency of harvest and the number of harvest from the first harvest. On the same area, producer might have about 4 up to 20 harvesting cycle depending on vegetables and on the production practices during a production cycle.

The large part of producers has six years experience. This result shows that there is a recent interest on vegetables production in the surveyed area. These results were similar to those found by Pasquini et al. (2009) in urban areas of

Lokossa, Nairobi and Kisumu, and in the Nairobi peri urban zone. This interest could be explained by efforts of some non-governmental organization to promote traditional vegetables. The characteristics of the production areas make them similar to the home garden describe by Gockowski et al. (2003).

There was diversity on vegetables consumption. The vegetables consumed include garden growth vegetables, picking vegetables and natural growth vegetables. Okra was the most consumed vegetable in all locations. The same result was found by Mathieu-Daudé and Barrot, (2001), Hama-Ba et al. (2017) in Burkina Faso and by Kamga et al. (2013) in Cameroon.

When available, vegetables were preferred on their fresh forms (Hama-Ba, 2017; Kamga et al., 2013). However, some vegetables are dried in order to conserve them. Drying on a shade or sun drying methods was used separately or successively. The first method was used to reduce de moisture of vegetable which was put on a shade to finish drying process. According to respondents, sun drying loads to loss some nutrients. They also think that sun drying alters vegetables colors.

Vegetables were more consumed in sauces, where the most process applied were boiling (Hama-Ba et al., 2017, Kamga et al., 2013; Rakotonirainy et al., 2010). This process was identified to loss of some nutrients.

The respondents knew the interest of vegetables consumption on their health (Hama-Ba et al., 2017, Kamga et al., 2013; Rakotonirainy et al., 2010). They think that vegetables consumption brings them vitamins and protect their body against diseases. Nutritional content of vegetables (Table 1) showed that they content proteins and beta carotene especially on leafy vegetables. these results reinforce respondents' thoughts on the nutritional benefits of vegetable consumption. Indeed, proteins are identified as building and repairmen food, and vitamins were protector foods.

The nutritional content of the five vegetables show that amaranth and jute mallow have the highest beta carotene content. These results were confirming the point of view of the consumer which think that consumption of vegetable bring vitamins for human body.

Conclusions:-

Study showed that there is diversity on consumed vegetables in the surveyed areas. Amaranth, okra, eggplant, black nightshade and jute mallow were the most consumed. Vegetable growing in the survey location was a recent activity for a large part of producers. Small plots are used for vegetables production.

Vegetable supplying was made through production more than purchase. This result showed that vegetable production contributed to the enhancement of nutritional content of diet in households. Nutritional content of the consumed vegetables especially protein and beta carotene content confirm costumer's knowledge on the importance of vegetables consumption. The most process used for vegetables preparation in households included boiling. However, this process was found to reduce some nutrients content on the final sauces.

In order to preserve nutrient content on vegetables, it's necessary to improve their preparation and their conservation way.

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