# A Comparative Case Study of Detection of Radiation in Vegetable Leaves in a Coastal Oil Producing and Hinterland Non-oil Producing Regions in Akwa Ibom State

**G.T. Akpabio and B.E. Bassey**

**Abstract** The purpose of this work is to determine how safe vegetable leaves are in an oil producing area, using a case study of the Akwa Ibom State. Radioactive radiation levels were detected for five samples of vegetable leaves namely Waterleaf (Talinum triangulare), Bitter leaf (Veronia amygdalina), Fluted pumpkin (telfairia occidentalis), Editan, (Lasientera Africana) and Afang (Gnetum africanum). The vegetable leaves were collected form Uyo (hinterland region) and Ibeno (coastal region) in Akwa Ibom. Radioactivity levels in each of these samples were determined. In Uyo, waterleaf had the least radioactive level of 0.00079 Bq/g while Editan recorded the highest level of 0.0019 Bq/g for Ibeno, its Fluted pumpkin showed the least of 0.0037 Bq/g whereas waterleaf records the highest radioactive level 0.0070 Bq/g. The higher radioactive level observed in Ibeno is attributed to the presence of radioactive materials in the environment due to oil drilling activities in the area.

**Keywords** Radioactivity · radiation · vegetable leaves · NORM

## 1 Introduction

Radiation is a form of energy that originates from a source and travels through some material or through space. The term radiation in its wavelike form emits particles, such as electrons, neutrons, or alpha particles as well as electromagnetic radiations. Nuclei that are not stable are radioactive (Tippler 1991). Radioactivity can be dangerous to human health. Naturally occurring radioactive materials (NORM), produced along with oil and gas production, are often concentrated at some points in the hydrocarbon production process. Concentrations of NORM are

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found in oil and gas production equipment and waste. The radioactive component is the major environmental concern, especially in places like Akwa Ibom State and other oil producing regions.

Many processes occur in a leaf, but the distinctive and most important is the process of food manufacture. Green plants posses the ability to manufacture food from raw material derived from the soil and air. It is on these activities that not only the life of plants but also the life of all animals, including man depends (Wilson et. al. 1971). All leaves are metabolic factories equipped with photosynthetic cells, but that vary enormously in size, shape and texture (Starr and Targgart 1995). Vegetables leaves are plant or part of plant (leaves) that is eaten as food (Hornby 2001).

There are a number of devices that can be used to detect the particles and photons emitted when a radioactive nucleus decays; such devices detect the ionization that these particles and photon cause as they pass through matter (Cutnell and Johnson 1998). The presence of radioactive substance is easily detected with a Geiger Muller (GM) counter, based on the ionization produced by the radioactive emanations, (Eno 1998). One of the most common radiation detectors is the Geiger counter. These radiation detectors are based upon the ionization or excitation of atoms by the passage of energetic particles through matter (Wilson and Buffer 2000). The GM counter is non-energy dissipative, hence effectively useful for environmental radiation measurements, (Sigalo and Briggs-Kamara 2004).

The rate at which radioactive materials disintegrate or decay is almost independent of all other physical and chemical conditions (Akpabio and Ituen 2006). The activity of a radioactive sample can be expressed in terms of the rate of decay, that is, the number of disintegration per second in the sample (Howill ands Sylvester 1976). Unstable nuclei are radioactive and decay by emitting $\alpha$ particles (4He nuclei), $\beta$ particles (electrons or protons), or $\gamma$ rays (photons) (Tipler 1991). Radioactivity, or the emission of $\alpha$- or $\beta$-particles and $\gamma$ rays, is due to the disintegrating nuclei of atoms. All radioactivities are statistical in nature and follow an exponential decay law, Equation (4).

The number of atoms disintegrating per seconds, dN/dt, is directly proportional to the number of atoms, N, present at the instant (Nelkon and Parker 1977). Hence;

$$\frac{dN}{dt} = -\lambda N \tag{1}$$

Where $\lambda$ is a constant characteristic of the atom concerned called the radioactivity decay constant. Thus, if $N_o$ is the number of radioactive atoms present at a time t = 0, and N is the number at the end of a time t is

$$N = N_o e^{-\lambda t} \tag{2}$$

The time it takes for the number of nuclei or the decay rate to decrease by half is called the half-life $T_{1/2}$. Equation (2) shows that:

$$\frac{N_o}{2} N_o e^{-\overline{\lambda t}} \tag{3}$$

Therefore,

$$T_{1/2} \frac{1}{\lambda} \text{In } 2 \; 2 \frac{0.693}{\lambda} - \tag{4}$$

$$T_{1/2} \frac{0.693}{\lambda} \tag{5}$$

### *1.1 Material and Method*

Waterleaf, Bitter leaf, Fluted pumpkin leaf, Afang leaf (Gnetum africanum), Editan leaf (Lasienthera africana) were each collected form Ibeno (Oil producing area) and Uyo (non-oil producing area) of Akwa Ibom State. The fresh samples of the vegetables were carefully plucked and mesh using the pestle and mortar. The meshed samples were now transferred carefully into the beaker and were placed directly under the Geiger–Muller tube. The experiment was repeated in each case in order to determine the average value and the distance between the Geiger–Muller tube and the beaker was kept constant throughout the experiment. Reports of environmental monitoring of radiation levels in which Geiger–Muller Counters have been used include Sigalo and Briggs-Kamara (2004) among others.

## 2 Results and Discussion

Results of the radiation levels in each of the vegetable samples for the two locations are presented in Tables 1 and 2.

At Ibeno (Table 1), waterleaf has the highest radiation level of 0.0070 Bq/g and Afang leaf the minimum of 0.0034 Bq/g. Table 2 shows that in Uyo, Editan had the highest level of radioactivity, followed by bitter leaf and the least in waterleaf. The histogram representing radioactivity in vegetables as shown in Fig. 2, give the comparison between Ibeno and Uyo. Ibeno generally has a higher level of radioactivity in the vegetable leaves when compared to Uyo. This is of great concern because according to Mgbenu et al. (1995), the exposure of human being to nuclear radiation is very harmful. Its damage to the human body depends on the absorbed dose, the exposure rate and the part of the body exposed. If the permissible level is greatly exceeded, the individual can suffer effects, which may be (a) somatic and (b) Genetic (Mgbenu et al. 1995). Similar results were found for roots of plants within the same environment and were obtained by Akapbio and Ituen (2006). Oil drilling sites and production facilities have many radioactive materials associated with them.

**Table 1** Experimental results for samples obtained from Ibeno LGA

| Samples | Mass | Background count for 10 min | Background + sample count for 10 min | Sample count for 10 min | Corrected count for 1 s | Counts per gram (Bq/g) |
|---|---|---|---|---|---|---|
| Water leaf | 6.029 | 109.0 | 134.0 | 25.0 | 0.042 | 0.0070 |
| Bitter leaf | 9.093 | 119.3 | 142.7 | 23.4 | 0.039 | 0.0039 |
| Pumpkin leaf | 9.0881 | 118.0 | 135.0 | 17.3 | 0.029 | 0.0037 |
| Editan leaf (Lasienther africanan) | 5.644 | 112.3 | 131.3 | 19.0 | 0.032 | 0.0060 |
| Afang leaf (Gnetum africanum) | 5.402 | 128.3 | 139.7 | 11.4 | 0.019 | 0.0034 |

**Table 2** Experimental results for samples obtained from Uyo LGA

| Samples | Mass (g) | Background count for 10 min | Background + sample count for 10 min | Sample count for 10 min | Corrected count for 1 s | Counts per gram (Bq/g) |
|---|---|---|---|---|---|---|
| Water leaf | 6.368 | 121.0 | 124.0 | 3.0 | 0.005 | 0.0079 |
| Bitter leaf | 9.462 | 107.7 | 120.0 | 9.0 | 0.015 | 0.0016 |
| Pumpkin leaf | 9.504 | 127.3 | 134.0 | 6.7 | 0.011 | 0.0012 |
| Editan leaf (Lasienther africanan) | 5.721 | 118.0 | 123.7 | 5.7 | 0.010 | 0.0019 |
| Afang leaf (Gnetum africanum) | 5.3922 | 117.3 | 121.3 | 4.0 | 0.019 | 0.0012 |

Drilling fluids used for onshore wells are primarily disposed of in reserve pit, while in many areas drilling fluids from offshore wells are primarily disposed of in reserve pit, while in many areas drilling fluids from offshore platforms have been dumped overboard (Reis 1996).

The offshore case is of importance to individuals in Akwa Ibom State because when oil is spilled on water, it spreads out over the water surface and moves with the wind and water current, (Reis 1996). This is the water that plants and animals in the area makes use of. Even though these levels of radioactivity are below the international permissible limit of 0.18 Bq/g, continuous accumulation over periods of time can be dangerous and the effects on humans have not been studied in depth.

## 3 Conclusion

The results show that the radioactivity levels in the vegetable in Ibeno (an oil producing area) is higher than at Uyo (a non-oil producing area).

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