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Research Article

Determination of Heavy Metals Recovered from Artificially Ripe Banana with Calcium Carbide

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Abstract

Calcium carbide is frequently used by vendors to hasten the ripening of banana fruits, and this practice has a long history. Calcium carbide is connected to the negative consequences of heavy metals. Measurements of heavy metal concentrations on artificially ripe bananas manufactured using calcium carbide in Katsina state and throughout Nigeria are essential to assist the authorities in regulating the use of chemical ripening agents for food safety and consumption. The purpose of the study is to assess the levels of heavy metals in banana fruits that have been artificially ripe. A sample was collected from Mairuwa Fadama of Katsina state's Funtua local government Area. The Banana pulp and peel were analyzed for heavy metal (arsenic, calcium, lead and cadmium) content using standard methods. The results were statistically analyzed in order to compare the mean value of the heavy metals in the banana peel and pulp. A p-value of 0.05 or lower was considered significant. Results showed that heavy metal concentrations in banana peel are higher than in banana pulp. The findings give important details about the heavy metal content of the banana peel and pulp eaten in Katsina State. Additionally, the findings showed that banana peels contain considerable levels of heavy metals than the pulp.

Keywords: Banana; Calcium Carbide; Ripening

Introduction

The banana, *Musa sapientum*, is a member of the Musaceae family and one of the most traded tropical fruits in the world. It is the fourth largest food crop in Africa and a popular economic crop that provides a significant portion of income for more than 70 million people worldwide [1]. Bananas are grown primarily in Nigeria for their nutritious and delicious ripe fruits, and its consumption spans many segments of society, including all age groups, because it is highly digestible and provides the necessary calories and essential micronutrients Ariyo., *et al*. [1]. Bananas are known to have numerous health benefits, according to Oyeyinka and Afolayan [3]. The ripening process imparts numerous qualities and nutritional properties to fruits. Fruit ripening is the final stage of fruit development and is a combination of physiological and biochemical events that result in changes in pigments, sugar content, acid content, flavor, texture, and aroma that make the fruit appealing and tasty (Perotti., *et al*. 2014). Though this practice reduces post-harvest banana losses, particularly during transportation, it is frequently accompanied by induced ripening with artificial agents (ethylene glycol, kerosene, ether, calcium carbide, and so on) to meet consumer demands and other economic factors [4]. These artificial ripening agents are toxic when used incorrectly, and their consumption can lead to skin disease, cancer, neurological disorders, and organ failure. Ikhajiagbe and co. [5].

Mango, pineapple, plantain, banana, citrus, guava, pawpaw, avocados, and water melon are among the major fruits grown in Nigeria [6]. Fruit transportation and distribution from farms to markets can take several days. The naturally ripened fruits

may become overripe and spoiled during this time. In addition to spoilage, naturally ripened fruits can be damaged during transportation, increasing economic loss for fruit sellers. Fruit sellers prefer harvesting fruits before full ripening and artificially ripening the fruits before selling to consumers to minimize loss [7]. This maturation process can be artificially accelerated by using various chemicals, the most common of which is calcium carbide. Fattah and Ali [8] discovered that many wholesalers sold chemically ripened fruits to avoid financial loss. According to reports, a variety of chemical and biological agents are used to artificially ripen fruits. Chemical agents include ethylene gas, ethephon, ethylene glycol, etherel, and calcium and potassium carbides [9].

Calcium carbide, which is used to induce and accelerate fruit ripening, is considered extremely dangerous because it contains traces of the heavy metals arsenic and cadmium. Hussain and co. [10]. Despite these health risks, the use of chemical ripening agents is unregulated in Nigeria, owing to a lack of awareness among stakeholders such as policymakers, farmers, traders, and consumers, as well as food and drug regulatory agencies. As a result, more research is needed to determine how these ripening agents affect the nutritional value and quality of the fruits sold in our markets.

CaC_2 can be applied to fruits in a variety of ways to help them ripen. Some farmers in Nigeria continue to use CaC_2 for ripening purposes; some dealers place fruits in an enclosed compartment with a large amount of CaC_2 block, and before closing the compartment, water is sprinkled into the compartment; others place a small packet of carbide in a fruits container, and carbide powder is spread onto the fruits surface [11]. It was also discovered that when a CaC_2 block was placed in a box alongside an unripe banana, all of the bananas ripened within 24 hours Mahmood., *et al*. [12].

The purpose of this study is to determine the heavy metals recovered from artificially ripe bananas in Katsina state using calcium carbide.

Materials and Methods

Sample collection and preparation

Thirty kilogram (30 kg) of banana fruit was procured from Mairuwa Dam site of Funtua local government, Katsina state. A matured but unripe fruit was selected for this study. Grade one Calcium carbide was purchased from Katsina central market. All the selected sample of banana was fresh, undamaged, firm and healthy and labeled as described by Lawrence., *et al*. [13].

Sample treatment

The mature green banana samples were cleaned with tap water before being transported to the laboratory for further processing. The samples were divided into five treatment groups of five kilograms (5 kg), with each group subjected to the same atmospheric conditions described by Turner and colleagues [14] as in table 1. The time it took for the entire fruit to change color from green to yellow was used to calculate the fruit ripening time [15].

Treatment No.	Details of Treatment
T1(Control)	Fruits was allowed to ripe naturally without calcium carbide
T2	5kg of Fruits and 1g of calcium carbide in muslin cloth for 48hours
T3	5kg of Fruits and 2g calcium carbide in muslin cloth for 48hours
T4	5kg of Fruits and 3g of calcium carbide in muslin cloth for 48hours

Table 1: Detail treatment of Banana fruits with calcium carbide.

Laboratory analysis

Determination of heavy metals

Two acid washed platinum crucibles were filled with 20g of banana pulp and peel. Each container received 20 ml of concentrated HNO3 and was left for 20 minutes (it is imperative that this step be carried out before the addition of perchloric acid otherwise, explosion may occur). 2 ml of $HClO_2$ and HCl in a 10:1 ratio were added and left for about 10 minutes. The banana pulp and peel standard solutions were aspirated into the air-acetylene flame of the Varian 220 (fast sequential) Atomic Absorption Spectrometer. A blank sample was also prepared and analyzed alongside the sample. Arsenic residues in different samples were determined using ICP-AES (Inductively Coupled Argon Plasma-The samples were heated in the crucible in a hot plate from 135-1800c and evaporated almost to dryness). 10 ml of deionized water was added and gently boiled to dissolve the residue. Cool and filter through No. 42 wattman filter paper into a 100 ml volumetric

flask with deionized water. Spectrometry (Atomic Emission Spectrometry), while calcium was determined using the Flame Photometric method (AOAC, 1998).

Results and Discussion

The experiments were carried out to measure the amount of heavy metals recovered from banana fruit pulp and peel that were both naturally ripe and ripened with CaC_2 at different concentrations.

Figure 1 and 2 is the results of heavy metals recovered in parts per million (ppm), where the highest concentrations of arsenic were found in the pulp and peel at 3g (1.36 ppm and 2.29 ppm), 2g (1.19 ppm and 2.02 ppm), and 1g (0.89 ppm and 0.89 ppm) of CaC_2. Arsenic was absent from the pulp and peel of untreated bananas (0.00 ppm).

The amount of calcium was also observe to increases with the increase of CaC_2 of pulp and peel 3g (37.87 ppm and 291.20 ppm), 2g (26.25 ppm and 286.08 ppm), 1g (22.74 and 213.38 ppm) and least concentration was observed from untreated (0.29 ppm and 55.85 ppm).

The amount of lead contents increases with the increase of CaC_2 concentration of pulp and peel in 3g (0.68 ppm and 0.78 ppm), 2g (0.11 ppm and 0.40 ppm), 1g (0.08 ppm and 0.33) and (0.01 ppm and 0.10 ppm) in the untreated banana.

Cadmium at pulp and peel in 3g (0.52 ppm and 0.79 ppm), 2g (0.27 ppm and 0.59 ppm), 1g (0.19 ppm and 0.38 ppm) and absent in the untreated.

The results revealed that high heavy metal concentration in the peel is due to the direct contact of banana has with the chemical of CaC_2 and it increases with increase of the concentrations at both pulp and peel.

The findings are consistent with the findings of Maduforo., *et al*. (2020) on heavy metals in banana varieties sold by fruit vendors in Enugu, Nigeria. The result of heavy metal increases as the chemical ripening agent increases. Similar work was also done by Adekalu., *et al*. (2020) on Survey on the use of Calcium Carbide as ripening agent in Ilorin metropolis, his findings revealed that artificially ripe

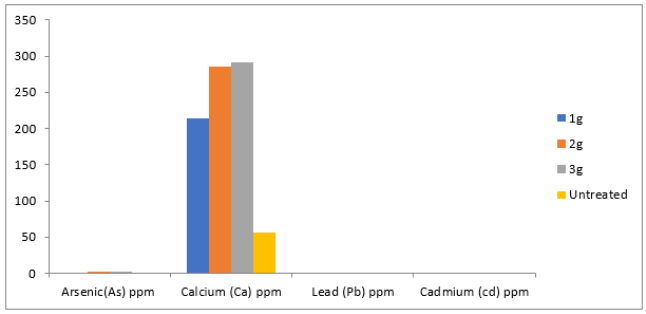

Figure 1: Heavy metals recovered from Banana pulp ripped with calcium carbide.

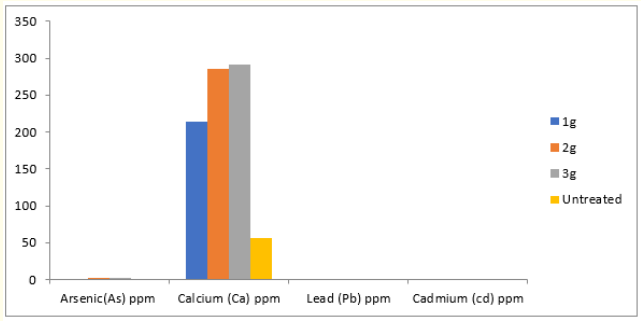

Figure 2: Heavy metals recovered from Banana peel ripped with calcium carbide.

banana with CaC_2 had high level of heavy metal contents compared to naturally ripen samples (controls) [16,17].

Conclusion

The heavy metal content of banana pulp and peel was determined in the study, which was conducted in Katsina state, northern Nigeria. The banana peel had a high calcium and arsenic level, according to the findings. Contrary to popular belief, calcium carbide is frequently used to ripen fruits, so the levels of cadmium and lead are low and increase with an increase in calcium carbide. However, because banana peel contains the most heavy metals, it should be consumed with caution to avoid a long-term buildup of heavy metals in the body's cells. To serve as quality control, the investigation should be repeated frequently and in different regions of Nigeria.

Recommendations

The finding of the study recommends the following:

- The government should regulate the use of calcium carbide as a ripening agent and recommend safe methods of ripening fruits.
- Allowing bananas to ripen naturally before consumption will help to reduce health hazards because most chemical ripening agents are toxic to human health..
- Proximate analysis should be carried to determine the nutritional values of the naturally ripped and artificially ripped banana fruits.
- Research on metabolic effect of chemically ripped banana fruits should be carryout to determine the histopathological effects of heavy metals.

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