Radioactive Bananas

Radiation

If a nucleus doesn't have the right balance of protons and neutrons, it is said to be **unstable.** An unstable nucleus will try and become stable by **radioactive decay.** There are three main types of radiation; **alpha, beta and gamma.**

Alpha radiation

•An atomic nucleus emits an alpha particle, which has 2 protons and 2 neutrons (a helium nucleus).
•Dangerous if ingested.

Beta radiation

•proton turns into a neutron, or a neutron turns into a proton.
•Beta plus decay is where a proton decays into a neutron and a positron (positively charged electron) and a neutrino are produced.
•Beta minus decay is where a neutron changes into a proton and an electron and a neutrino are emitted.
•It may cause skin damage if it remains on the skin.

Gamma radiation

•A high energy photon.
•Gamma rays are electromagnetic radiation, it is just like light and radio waves, only much higher in energy.
•Dense materials such as lead are needed to shield against gamma radiation.

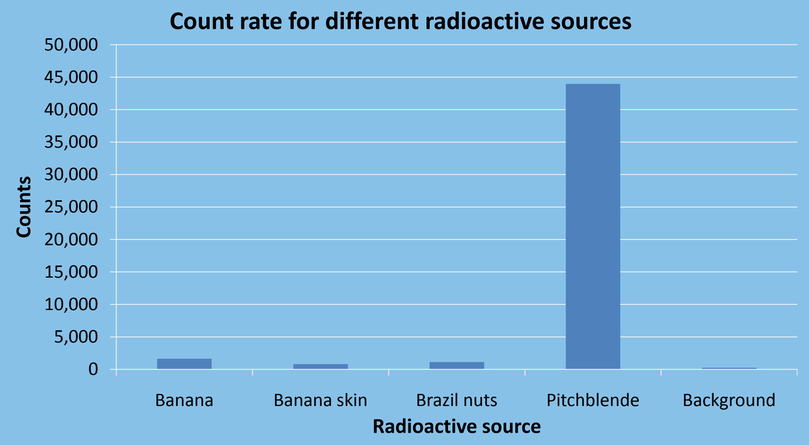
How radioactive are food sources in comparison to radioactive ores?

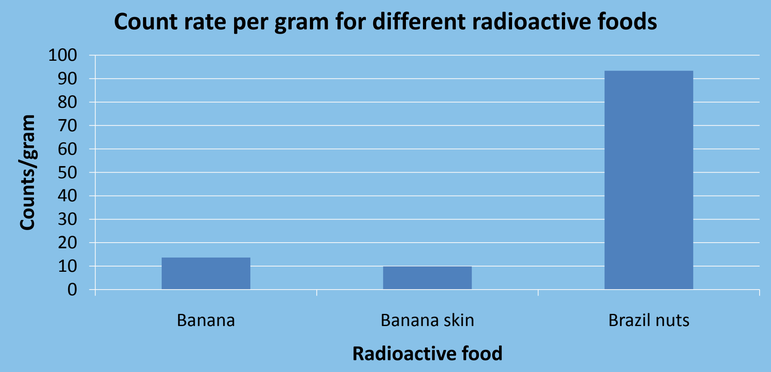
Hypothesis:

Bananas and Brazil nuts will be measurably more radioactive than the background radiation, but much less than radioactive ores. Brazil nuts will be more radioactive than bananas.

Method:

•All the foods and radioactive ores were weighed.
•Each source was placed at a fixed distance from the Cern@school particle detector for 10 minutes, and the count rate (measure of radioactivity) was recorded.
•A reading was made for background radiation by running the detector for the same amount of time with nothing in front of it.
•This was subtracted from all the other results.
•The new numbers for count rate were divided by the masses of the sources, so that they could be compared to each other.





Source	Mass in grams	Number of counts	Actual counts	Counts / gram
Background	N/A	245	N/A	N/A
Banana	101.36	1,629	1,384	13.65
Banana skin	55.51	794	549	9.89
Brazil nuts	9.33	1,116	871	93.35
Pitchblende (ore)	2.36	43,950	43,705	18,519

Conclusion

From our experiment, we learned that bananas are indeed radioactive, and that the centre is more so than the skin. Per gram, brazil nuts are in fact more radioactive, but neither of these foods compares to the radioactivity we measured from the ores.

Radioactive Foods

The average banana contains roughly 0.5g of potassium, **0.0117%** of which is the **radioactive isotope potassium 40.**

Humans naturally receive **10µSv per day** (Sieverts are units showing how high a radioactive dose is) whereas eating a single banana only gives 0.1µSv. Bananas therefore, are **not at all dangerous** in reasonable quantities.

The additional exposure after eating a banana will only last a few hours because the kidneys work to restore normal potassium levels.

Power Stations

Potassium-40 in bananas naturally undergoes **beta decay.** This is different to the fission which occurs in a nuclear reactor when atoms of unstable uranium- 239 are bombarded with **neutrons**, causing them to split apart into several smaller 'daughter nuclei' and neutrons, releasing energy in a chain reaction as heat.

This is then used to power a steam turbine. However, this would not work for the potassium-40 atoms in bananas, as it's **not unstable enough** to undergo the fission which occurs in nuclear reactors.

Fatal Banana Count

It takes **30 Gy** of radiation to kill a human within 48 hours. The number of peeled bananas needed to expose a human to this much radiation can be expressed through the **Fatal Banana Count Formula**:
N= 30m/1.767359407*10^-9

Where N is number of bananas and m is mass of the victim in kg. For an average human mass of 62 kg, it would take 1,052,417,518,000 bananas being digested **simultaneously** to receive 30Gy of radiation.

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