

## Investigations of Heavy Metal Content in Green Crackers by HHXRF

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### Abstract

A no of news was seen about green crackers being unsafe due to presence of heavy metals. In response to this alarming news, A study of checking heavy metal contents in green as well as normal crackers was undertaken and there are some interesting results which will be discussed in this small article.

**Keywords:** Green Crackers; HHXRF; Fireworks

### Introduction

Green crackers are crackers that are made from ingredients that is intended to cause the air to be more clean as compared to normal crackers [1]. Green crackers, as the name suggests, are found to be less harmful as compared to normal firecrackers. In Green Crackers, the emissions come down by 15 to 30%. The aim of producing green crackers is to control the environmental pollution. Based on the current ecological situation, green crackers in India have become more of a necessity and all Indian states have made a policy to market these green fireworks in the future.

### Experimental Methods

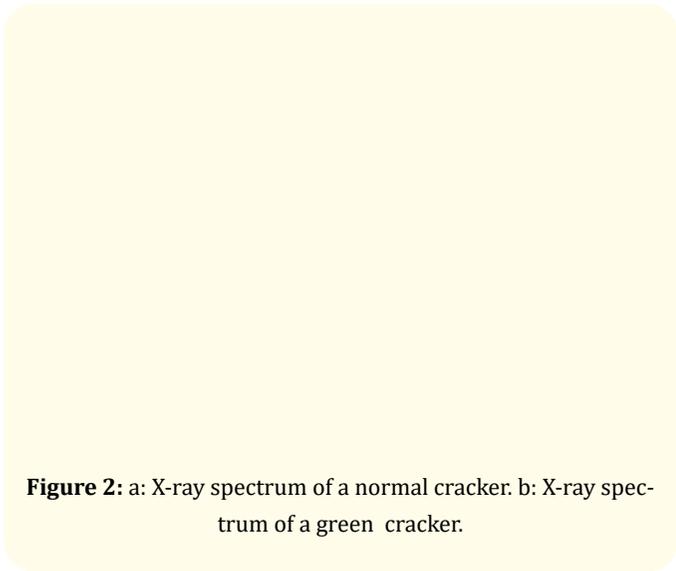
Hand held XRF (HHXRF) was used to analyze the chemical composition of samples. The sample was obtained from the market and paced directly under the HHXRF in which Rhodium tube was used as X-ray tube for irradiation. Figure 1 gives the image of HHXRF set up. The spectrum was obtained in 20 seconds. A Typical spectrum of normal crackers is shown in Figure 2a and of green crackers is shown in Figure 2b. The beam lines were of (Beam 1 from 12 to 36 keV) and Beam 2 from 0-12 KeV).

Figure 1 shows the HHXRF which was used to detect contents of crackers.

**Figure 1:** HHXRF set up.

### Results and Discussion

Table 1 gives the ppm and % levels of important elements and which shows a large variation between normal and green crackers. It is seen that while in normal cracker Ba is very high, it is small in green, Similarly Al. However Sr is high in green and not in normal. Hence Barium nitrate is harmful for the eyes and for the air and hence has been lowered in green. Sr is added in green for the red flame and has no harmful effect.



**Figure 2:** a: X-ray spectrum of a normal cracker. b: X-ray spectrum of a green cracker.

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Elements	Normal	Green
Al	1.90%	7700 ppm
Si	690ppm	2.8%
Ca	2.43%	1.97%
Ba	4.67%	2500
Sr	101 ppm	4.67%

**Table 1:** ppm and % values of elements.

**Conclusion**

It is concluded that the news of heavy metal content is misleading and it has been seen that green crackers do have lower contents of harmful metals and may be considered safe for lighting. This is a preliminary study and can be extended to a wide variety of crackers sold in the market.

**Bibliography**

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