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Application Note

Food & Beverage

XGT

XGT12

Elemental analysis of single rice grains using XRF micro-analysis

Rice is an important food source for humans, and represents the principal food source for over half the world population. It is native to south-east Asia, and has been cultured for over 7,000 years.

In this application note, individual rice grains are investigated using the XGT-5000 x-ray fluorescence micro-analyser, providing insight into the elemental changes occurring during rice processing.

Rice

Freshly harvested rice is comprised of two main components – the white 'germ', and the brown outer hull (also known as the bran). White rice, found in most kitchens, has undergone a polishing process, which strips the bran from the kernel, leaving behind the softer germ (see Figure 1). However, whilst the germ contains mainly carbohydrate and small amounts of iron, iodine, magnesium and phosphorus, it is the bran which has the main nutrients (including proteins, minerals and vitamins). After polishing the bran is rarely wasted – generally it is used as a versatile animal feedstock, but recent research has demonstrated its filtering capability, removing cadmium and copper from waste water.

Figure 1: Rice grains before (left) and after (right) polishing to remove the bran.

Grain analysis

Initial analysis was made on a section of a 70% polished grain (ie, polishing has reduced the grain to 70% of its original weight). There is clear identification of mineral elements on the external surfaces, which reflect the partial removal of the bran from the grain. For a relatively light polish, this residual bran is not unexpected.

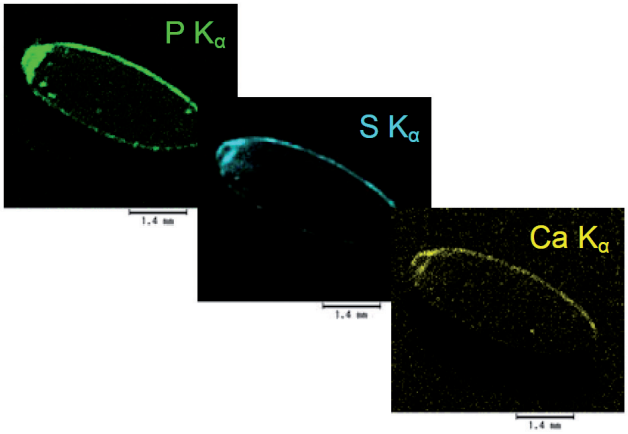


Figure 2: Element images of 70% polished rice grain.

The degree of polish varies according to the desired use of the rice. For example, production of sake (rice wine) requires highly polished rice, since the bran is subject to rancidity and will ruin the wine flavour. Rice for eating is more tolerant to bran, and indeed it is not uncommon to find brown (unpolished) and white (polished) rice varieties available.

Figure 3 shows elemental images acquired from two different grain types. The left hand grain is a typical Japanese rice for eating, whilst the right hand grain is for sake brewing. It is clear that the degree of polish on the sake rice is higher than its edible counterpart, as evidenced by the degree of mineral elements present on the grains.

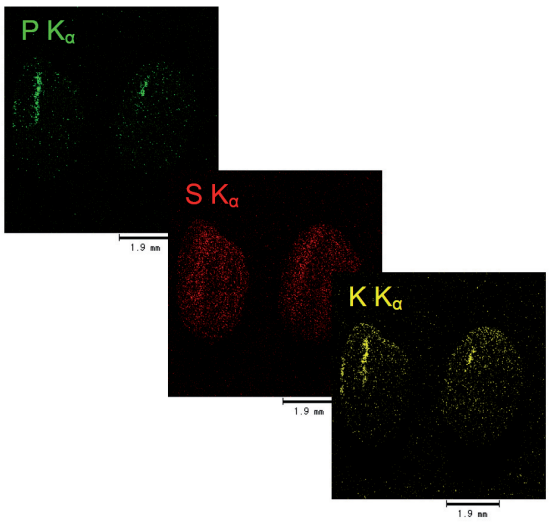


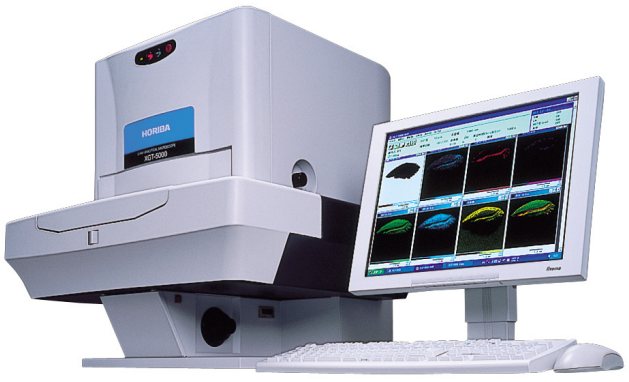
Figure 3: Comparison between two commonly available rice grains, for eating (left grain) and sake production (right grain).

The XGT-5000 micro-XRF instrument provides a facile and fast method of studying the polishing processes, providing information on degree of polish, composition of removed and residual bran, and potential contamination from the polishing process.

Within the food industry general, this ability to discretely analyse microscopic particles with spatial resolutions ranging from 10 µm up to 1.2 mm is extremely important. The XGT-5000 offers further advantages though – in particular, the ability to analyse for all elements from Na to U whilst maintaining the sample at normal atmospheric pressure. In this way, it is possible to non-destructively analyse typical food materials which often have relatively high water contents.

Summary

Individual rice grains have been imaged with high spatial resolution for elemental distribution, allowing minerals within the rice bran to be visualised. The extent of these minerals can be linked to the degree of polishing used.



XGT-5000

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