

# LAB-X5000

## LAB-X5000 for the rapid determination of iron in cocoa powder and cocoa liquor

### INTRODUCTION

Over 4.5 million tonnes of cocoa are produced worldwide every year, with about 70% of the world's cocoa beans originating from four West African countries: Ivory Coast, Ghana, Nigeria, and Cameroon. Cocoa production is a labour intensive process beginning with the harvest of the crops when they are fully ripe, the removal of the cocoa beans, and the fermentation before sending the dried beans for processing.

During production, the nibs are extracted from the cocoa beans before being roasted to bring out the rich chocolate flavour. The nibs are then crushed into thick chocolate liquor that can be refined until smooth. After mixing with cocoa butter, the resulting chocolate liquor is further processed into cocoa powder, cocoa butter, or chocolate.

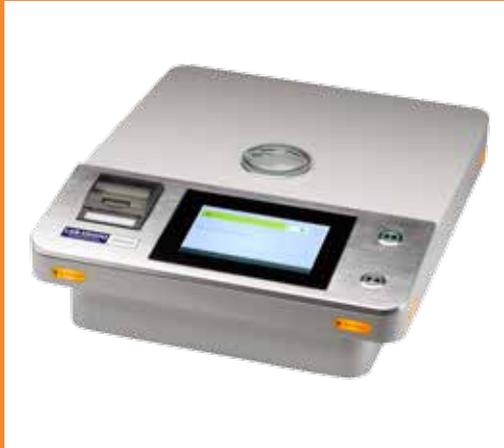
Iron content is monitored during the process to ensure a consistent taste and that there is no accidental contamination in chocolate products. Unlike other techniques, such as titration or inductively coupled plasma (ICP), energy dispersive X-ray fluorescence (EDXRF) is rapid, simple, and does not require the use of chemicals. It is a field-proven technique that is widely used in many other industries. With results available in seconds, it can be used by any operator with minimal training.

### COCOA POWDER ANALYSIS MADE EASY

With the Hitachi High-Tech LAB-X5000 EDXRF analyser, the analysis of cocoa mass and cocoa powder couldn't be easier. Once the analyser is calibrated, routine analysis is carried out by placing the cocoa product in a sample cup (see Sample Preparation section), placing the cup in the LAB-X's analysis port, and pressing a button to start the measurement. Results are displayed within seconds on the large, industrial LCD touch screen, showing the iron content. Pass/fail messages can also be setup for fast decision making and process adjustments.

The LAB-X5000 includes several features that help protect against damage caused by sample spills or dust to minimise downtime and prevent costly repairs. Sample cups fit inside a secondary safety window that will contain any potential leak from the cup and prevent dust from getting into the analyser. The LAB-X also includes an automated turntable that only places the sample above the X-ray tube and detector for the duration of the analysis, minimising the risk of damage or contamination to critical components.

A sample spinner is fitted to ensure that the LAB-X produces reliable results, even when measuring inhomogeneous samples such as powders.



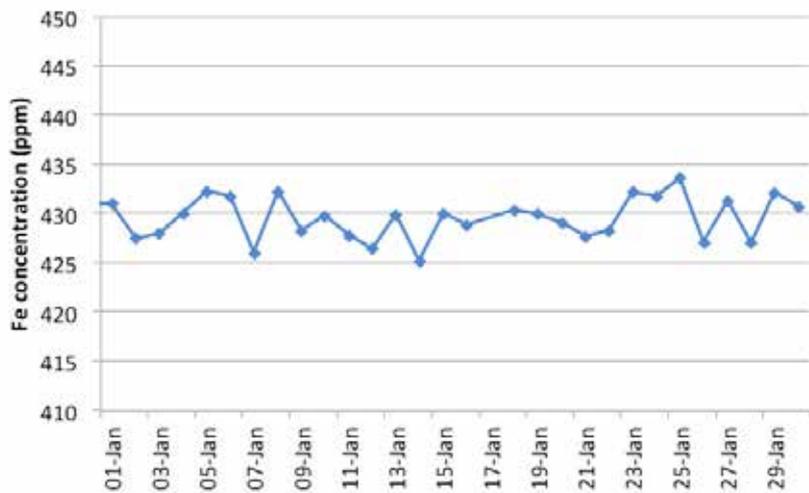
The LAB-X5000 benchtop analysers present many advantages:

- Compact and robust: ideally suited in a lab and near the production line
- Sample spinner: reproducible results, every time
- Robust: maximum uptime and low cost of ownership
- Fast: results in seconds for fast decision making

The analyser is calibrated by measuring a series of assayed samples. Setting-up samples (SUSs) are measured at the time of the calibration, and again in the unlikely event that the analyser would drift. There is no need to source calibration standards again and measure them, saving both time and money.

A quality control (QC) check sample can be analysed for traceability and quality assurance: once users have defined the QC sample's target iron content and control limits, the LAB-X's QC control chart will be updated with every new measurement result. Figure 1 shows the results for a cocoa powder QC sample measured on the LAB-X over the course of a month, demonstrating the analyser's excellent stability.

**Figure 1:** Cocoa Powder QC Sample



With up to 100,000 results stored in the analyser itself, operators can view new and old results easily, print them on the integrated printer for a hard-copy record, download them on a USB memory device as a CSV file, and upload them to our cloud service to manage them remotely. With the LAB-X connected to Wi-Fi, you do not need to be near the analyser to access your data!

## SAMPLE PREPARATION

The sample preparation is simple:

- Cocoa liquor: place the sample cup fitted with Mylar® film on a flat surface, pour the liquor in the cup up to its internal line, and let it cool down so it solidifies.
- Cocoa powder: weigh 6g of sample in a sample cup fitted with Mylar film, and use a manual press and a pressure of 10 tons to compact the powder.

Prepare a safety window with Mylar film, place it in the LAB-X analysis port, then place the prepared cup in the safety window. All you have to do now is to press the Start button.



## PERFORMANCE AND RESULTS

Two calibrations (one for cocoa powder, and one for cocoa liquor) were created for iron determination by measuring well-characterised samples to establish the relationship between iron content and X-ray signal. Both calibrations used the same parameters (see Table 1).

The data shown in Tables 2 and 3 highlights the typical performance that the LAB-X delivers for the analysis of cocoa products.

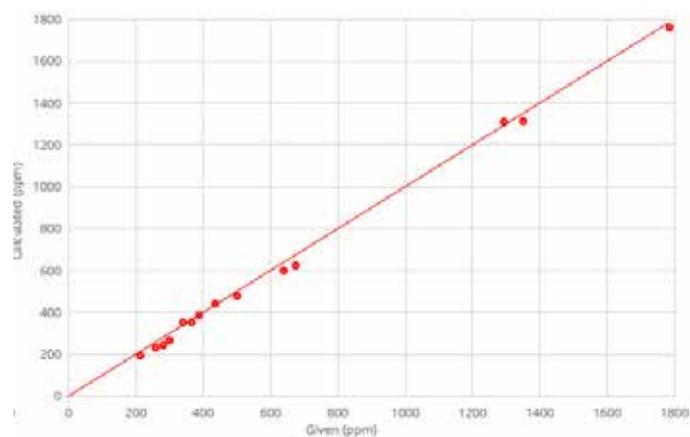
**Table 1:** Cocoa powder and cocoa liquor calibrations parameters

Analyte / Other element	Region of interest (keV)	Excitation condition	Regression model	Sample spinner	Measurement time (seconds)
Fe	6.28 - 6.52	Filter 2, 23kV 130µA	Self Absorption K Intensity	ON	60
K	3.22 - 3.41		n/a		

**Table 2:** Typical calibration performance for iron in cocoa powder

Analyte	Concentration range (ppm)	Standard error of calibration (ppm)	Measurement time (seconds)	Limit of detection (ppm)	Mid-range precision (95 % confidence) (ppm)
Fe	205 - 1777	23	60	1.5	4

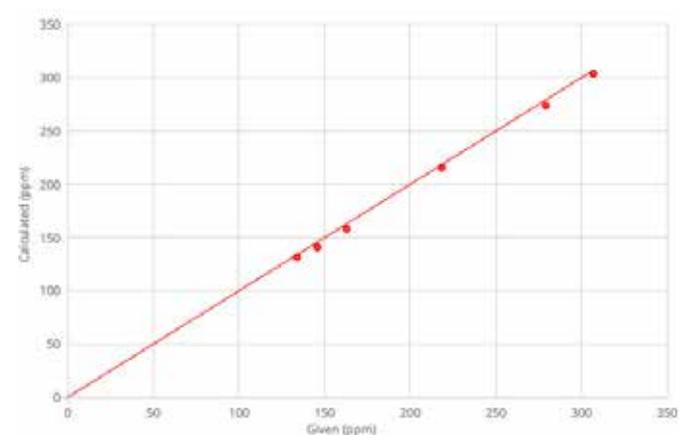
**Figure 2:** Calibration graph for Fe in cocoa powder



**Table 3:** Typical calibration performance for iron in cocoa liquor

Analyte	Concentration range (ppm)	Standard error of calibration (ppm)	Measurement time (seconds)	Limit of detection (ppm)	Mid-range precision (95 % confidence) (ppm)
Fe	132 - 305	2	60	3	2

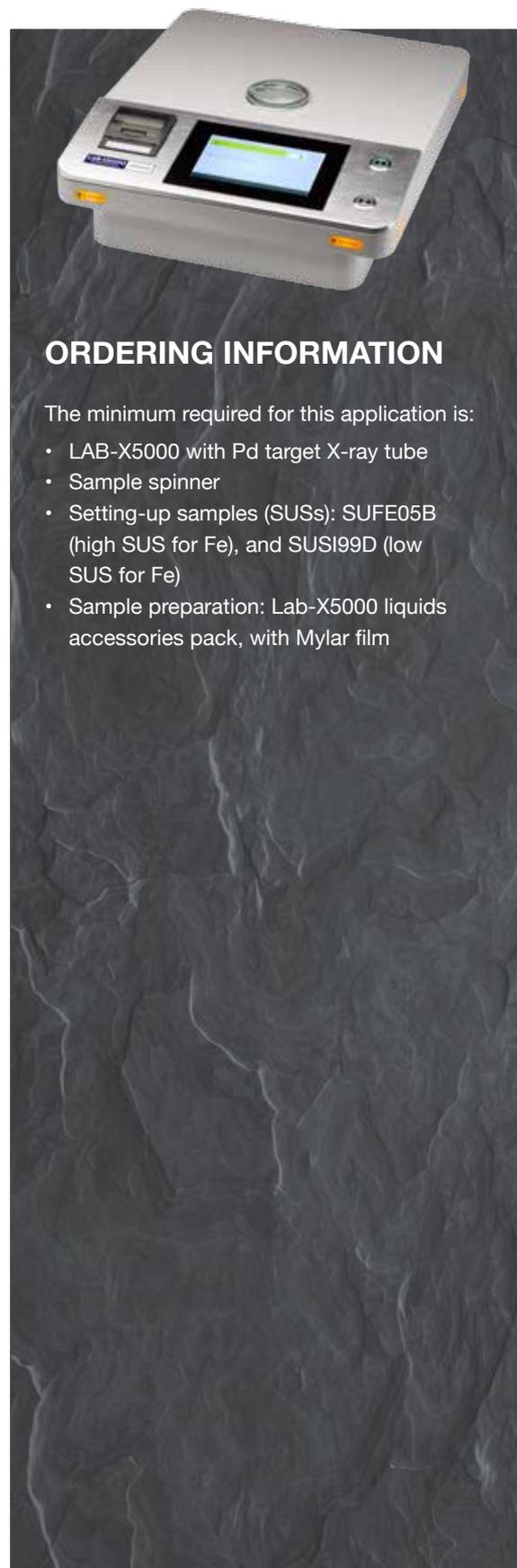
**Figure 3:** Calibration graph for Fe in cocoa liquor



## SUMMARY

Once calibrated, Hitachi High-Tech's LAB-X5000 provides accurate and repeatable analysis for the determination of iron content in cocoa liquor and cocoa powder. The analyser's ease of use and ruggedness make it an ideal tool alongside production and in the laboratory. With results available in seconds, operators can make immediate adjustments to the production process or halt the production of contaminated products, ensuring consistent product quality and potentially preventing costly product recalls.

Visit [www.hitachi-hightech.com/hha](http://www.hitachi-hightech.com/hha) for more information.



## ORDERING INFORMATION

The minimum required for this application is:

- LAB-X5000 with Pd target X-ray tube
- Sample spinner
- Setting-up samples (SUSs): SUFE05B (high SUS for Fe), and SUSI99D (low SUS for Fe)
- Sample preparation: Lab-X5000 liquids accessories pack, with Mylar film

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