



PANalytical
get insight



EPSILON 1

Fortify your milk powder analysis



19	20	26	30
K	Ca	Fe	Zn
39.10	40.08	55.85	65.39

Accurate, easy and fast



Z Factory pre-calibrated

Z Possible to analyze with Epsilon 1

Z Not possible to analyze with Epsilon 1

1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.906	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.95	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.905	56 Ba 137.33	L	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.02	A															
L	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (146)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97		
A	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)		

Milk powder

Accurate, easy and fast analysis

The Epsilon 1 X-ray fluorescence (XRF) spectrometer is the ideal analytical solution for quantification of a number of key elements including potassium, calcium, iron and zinc in milk powder. These elements present as minerals are important nutrients for bones, teeth, muscles, blood pressure regulation, protein synthesis, nervous system, blood hemoglobin formation, wound healing and vitamin A transport.

Control and standardization of elemental content maintain and improve product quality and consistency. Considerable savings in time and cost are two of the many benefits XRF can bring to milk powder production.

The Epsilon 1 is delivered pre-calibrated for easy quantification of the most commonly controlled elements in milk powder. The system produces fast, cost-effective, precise and accurate data without the need for additional chemicals or operating gasses.

The measurements are carried out directly on the solid milk powder with little to no sample preparation. Measuring relatively large sample volumes (grams) results in more representative characterization of the milk powder. Since XRF is a non-destructive technique, the sample can also be measured subsequently by other analytical techniques, if required.

PANalytical has a strong reputation for high-end X-ray instrumentation. Epsilon 1 is built using PANalytical market-leading technology with superior quality, worldwide service and application support.

The total solution consists of:

- Epsilon 1 instrument with user software
- Factory pre-calibration for potassium, calcium, iron and zinc in milk powders
- A NIST validation standard
- A starting kit for preparing the first 100 liquid cups for loose powder analysis

19 K 39.10	20 Ca 40.08	26 Fe 55.85	30 Zn 65.39
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Epsilon 1 spectrometer



Sample preparation foils

Preparation tool

Liquid cups

Validation sample

Results in just 4 steps

Easy sample preparation



1 Use the handy tool for preparing the loose powder cup.



2 Fill the cup two thirds full.

Easy analysis



3 Place your sample for measurement.



4 Enter sample name and touch the 'measure' icon.

Easy results





Measure in your
own language
Ten most common
languages are available
for the operator:

測量
Measure
測定
Mesurer
Messung
Mesure
Zmierzyć
Medida
Измерить
Médir

Built to fortify

The Epsilon 1 is a fully integrated energy dispersive XRF analyzer consisting of a spectrometer, built-in computer and analysis software. Powered by the latest advances in excitation and detection technology the Epsilon 1 is a star performer in the low-cost benchtop instrument class. A well-designed optical path, a wide range of excitation capabilities ranging from 10 to 50 kV for light and heavier elements and a highly sensitive SDD detector system contribute to the Epsilon 1's uniqueness.

- 1 Self-contained system**
Built-in computer running Microsoft Windows 7 with a powerful CPU and 120 GB hard drive ensures flexibility to store and handle thousands of results.
- 2 Repeatability for years**
A low-drift X-ray tube and a handy drift correction routine give compliant results for years without the need for time-consuming re-calibration.
- 3 Maximum sensitivity**
The thin-window Ag anode X-ray tube, designed and manufactured by PANalytical, ensures high quality and sensitivity. The 50 kV X-ray tube and generator is ideal for exciting higher energy elements like Fe and Zn, resulting in faster analysis times.
- 4 Dust protection**
In order to shield the delicate heart of the system from spillage, a protection foil is in place. In case of spillage, the foil can be replaced easily by the operator.
- 5 Economical footprint**
Compact design with a built-in computer and touch screen reduces the requirement of valuable lab space to less than 0.15 m².
- 6 Easy operation**
High-resolution (1024 x 768), 10.4" LCD touch screen for easy walk-up and operation



Advantages of XRF for milk powder analysis

- Unmatched analytical precision and accuracy compared to other techniques
- Quick screening method
- Simple, fast and safe sample preparation
- Non-destructive analysis
- Wide analytical concentration range (ppm – %) reducing the necessity for dilution and associated errors



7 Easy communication

USB and network connections for use of standard computer peripherals enable extended use, application development and seated operator.

8 Best accuracy

Highly concentrated samples can cause detector saturation resulting in lower accuracy or longer measuring times. Epsilon 1 uses the latest in silicon drift technology to handle these highly concentrated samples without any loss of accuracy or increased measuring times.

9 Atmospheric variations

Low-energy X-ray photons characteristic of sodium, magnesium, aluminium, silicon, phosphorus and sulfur are sensitive to air-pressure and temperature variations. Built-in temperature and air-pressure sensors compensate for these atmospheric variations, ensuring excellent results whatever the weather.

10 Sample positioning

Highly repeatable sample positioning reduces sample-to-sample variations.

Safety guaranteed

Epsilon 1 complies with the latest Machinery Directive, CSA, IEC, EMC, Vollschutz norms and standards for protection and radiation safety to guarantee a safe instrument for the operator.





Easy, robust and accurate of milk powder

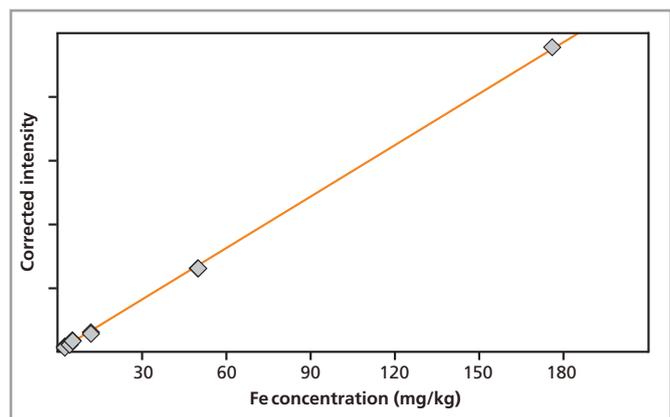
Calibration

Eight commercially available CRM standards from NIST, BCR and IAEA were used to pre-calibrate Epsilon 1 for potassium, calcium, iron and zinc in milk powder. Each milk powder standard was measured twice to improve the robustness of the calibration. The measurement time was 5 minutes per sample.

Element	Concentration range (mg/kg)	RMS (mg/kg)	Rel. RMS (%)	Correlation
K	9220 - 18600	301	2.4	0.9969
Ca	5353 - 13490	210	2.8	0.9978
Fe	1.8 - 175.6	2.4	3.1	0.9992
Zn	39.6 - 151.0	0.8	0.6	0.9998

The RMS value is a measure of the difference between the calculated concentration and the chemical concentration and is therefore a measure of the accuracy of the method (standard deviation).

The calibration root mean square (RMS) values presented in the table and the calibration graph demonstrate a high degree of accuracy for the method.



Calibration graph of iron in milk powder. Each standard was measured in duplicate.



quantification

Off-the-shelf quantification

Three off-the-shelf milk powder products with different fat content were analyzed. The measured concentrations are compared against the concentrations that are printed

on the labels of the bottles. The data in the table demonstrate excellent correlation between measured and given concentration.

Element	Milk powder with high fat		Milk powder with medium fat		Milk powder with low fat	
	Measured conc. (mg/kg)	Given conc. (mg/kg)	Measured conc. (mg/kg)	Given conc. (mg/kg)	Measured conc. (mg/kg)	Given conc. (mg/kg)
K	4667	4779	3944	4667	4331	4786
Ca	3500	3456	4317	4400	9738	9402
Fe	41	39	67	67	106	103
Zn	36.5	36.8	36.1	34.7	76.7	76.9

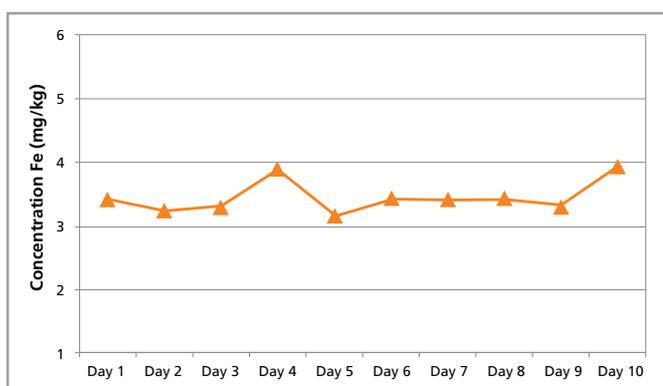


Precise results

Long-term precision

To test the precision of Epsilon 1, a milk powder with low fat content was prepared as a loose powder and measured once a day for a period of 10 days, without any re-calibration. The long-term precision of this method is illustrated graphically for iron and shown in the table on the right for potassium, calcium, iron and zinc. The average measured concentration, RMS and relative RMS values are presented in the table, together with the lower limit of detection (LLD). The data show the high long-term precision of Epsilon 1 and the capability of quantifying traces of iron and zinc in milk powder samples.

Element	Average conc. (mg/kg)	RMS (mg/kg)	Relative RMS (%)	LLD (mg/kg)
K	19276	84	0.4	2
Ca	12102	56	0.5	2
Fe	3.5	0.3	8.0	0.5
Zn	39.7	0.4	0.9	0.5



Epsilon 1 is a star-performing benchtop XRF instrument, well suited for the analysis of a number of key elements including potassium, calcium, iron and zinc in milk powders.

The results of the precision test for all four elements demonstrate high repeatability.



Enhanced Data Security

The Enhanced Data Security (EDS) software option is available for Epsilon 1 and specifically designed for GMP and GLP environments, and enables the user to comply with FDA 21 CFR Part 11.

The software includes every feature required to satisfy the strict environmental protocols:

- User right's management
- Log in with user identification to prevent improper use of the system
- Reporting of date and time in Universal Time Coordinate (UTC)
- Results are stored in the 'history' setting
- Inclusion of user names in reports
- Extensive audit trail of results
- LIMS integration

GMP, GLP and FDA 21 CFR Part 11



About PANalytical

PANalytical's mission is to enable people to get valuable insight into their materials and processes. Our customers can be found in virtually every industry segment, from building materials to pharmaceuticals and from metals and mining to nanomaterials. The combination of our software and instrumentation, based on X-ray diffraction (XRD), X-ray fluorescence (XRF) and near-infrared (NIR) spectroscopy as well as pulsed fast thermal neutron activation (PFTNA), provides our customers with highly reliable and robust elemental and structural information on their materials and is applied in scientific research and industrial process and quality control.

PANalytical employs over 1,000 people worldwide. The company's headquarters are in Almelo, the Netherlands. Fully equipped application laboratories are established in Japan, China, the US, Brazil, and the Netherlands. PANalytical's research activities are based in Almelo (NL) and on the campus of the University of Sussex in Brighton (UK). Supply and competence centers are located on two sites in the Netherlands: Almelo (X-ray instruments) and Eindhoven (X-ray tubes), in Nottingham, UK (XRF applications and standards), in Quebec, Canada (fusion sample preparation) and in Boulder CO, US (near-infrared instruments).

PANalytical is active in all but a few countries of the world. This worldwide sales and service network ensures unrivalled levels of customer support.

The company is certified in accordance with ISO 9001 and ISO 14001.

Visit www.panalytical.com for more information about our activities.

PANalytical is part of Spectris plc, the productivity-enhancing instrumentation and controls company.

Access to expertise

With the largest service network we are able to offer the most comprehensive support package possible.

Expertise:

- On-site training available
- XRF training courses
- Performance optimization
- Customizable expertise programs
- Assistance with multi-laboratory standardization

Care Agreements

Our customer support solutions have been developed with your business in mind. They are formulated as a family of four Care Agreements which can be tailored to your specific needs and provide fast, secure and reliable support.

- **ECONOMY:** indispensable coverage for self-sufficient operations
- **ADVANCED:** cost-effective support for routine usage
- **PREMIUM:** flexible package for high equipment usage
- **ELITE:** most comprehensive package for demanding environments

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