

## Clinical Research

## KingMed Laboratories advances IGF-1 testing with multichannel LC and high-resolution MS

### KingMed Laboratories

Based in Guangzhou, Guangdong, China, KingMed Diagnostics Group Co., Ltd. (hereafter referred to as KingMed) is an ISO9001:2008 accredited service laboratory offering clinical diagnostic, clinical trials, health management, and hygiene testing. KingMed performs a wide spectrum of tests, including endocrinology, reproductive health, hematology, molecular pathology, genetic, and many more.

After years of development, they have become one of the market leaders of the Independent Clinical Laboratories (ICL) industry in China.<sup>1,2</sup> Since 2009, the company has taken the lead in exploring the application of mass spectrometry in medical tests in China, while aiming for the global market in the future.

The era of accurate growth hormone testing is upon us, and KingMed Laboratories is leading the way by leveraging the advantages of multichannel liquid chromatography (LC) combined with high-resolution mass spectrometry.

In China, scientists from KingMed are focused on independent medical examinations and pathology. By utilizing multichannel LC and high-resolution Thermo Scientific™ Orbitrap™ mass spectrometry, the laboratory has developed an assay to detect a growth hormone in human biological matrix. This reliable method provides efficient and accurate testing of the growth hormone insulin-like growth factor 1 (IGF-1), which helps to determine growth abnormalities and evaluate proper pituitary function.

To handle their high annual test volume (for this assay), KingMed expanded their capabilities by introducing the Thermo Scientific™ Transcend™ TLX-4 system to separate and detect IGF-1, specifically polymorphs, using the Thermo Scientific™ Q Exactive™ Plus hybrid quadrupole-Orbitrap mass spectrometer.



Figure 1. Transcend II TLX-4 system in KingMed Lab

## Exploring new markets for precision medical testing services

In recent years, mass spectrometry has been increasingly used in clinical practice.<sup>9</sup> Mass spectrometry can detect larger molecules, such as proteins, and has been applied in clinical practice for the detection of IGF-1 in serum.

In 2019, KingMed began development of an IGF-1 medical test using high-resolution accurate mass (HRAM) mass spectrometry. Thus, a precedent was created in the third-party medical testing industry to provide more accurate growth hormone testing services.

The Transcend multichannel liquid chromatography system allows up to four independent LC channels to be run in parallel, thus increasing mass spectrometer utilization by engaging up to four separate LC channels combined with one mass spectrometer. Multichannel LC combined with Thermo Scientific™ TurboFlow™ technology, for online sample cleanup of complex matrices, enables complete automation of IGF-1 analysis. The Orbitrap technology provides enough resolution for isotope pattern deconvolution in individual charge states of the IGF-1 protein for certainty in results.

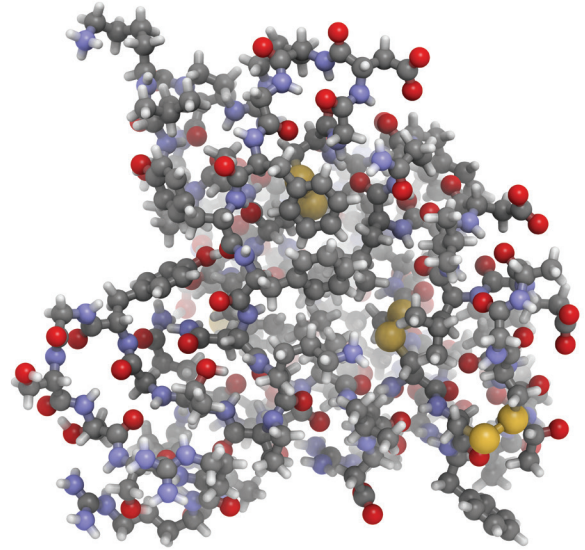


Figure 2. Insulin-like growth factor 1

### About growth hormone and IGF-1

Insulin-like growth factor 1 concentration is regulated by growth hormone (GH) and is a sensitive indicator of its biological function. Therefore, IGF-1 is used to evaluate whether there is an excess or deficiency of GH in the body.

Growth hormone analysis plays a crucial role in normal human growth and development, especially in children and adolescents. Lack of growth hormone in children can cause conditions, such as shorter than average stature, growth retardation, or dwarfism. Conversely, excess growth hormone can lead to diseases, such as gigantism and acromegaly.

IGF-1 is a protein that has three pairs of disulfide bonds that are close to the N- and C- terminal ends of the protein. It is difficult to break into highly specific fragment ions for conventional triple quadrupole LC mass spectrometry quantification. Therefore, the ability to detect intact proteins of IGF-1 is the preferred approach.

KingMed was the first laboratory in China to introduce multi-channel LC combined with HRAM MS for clinical examinations.

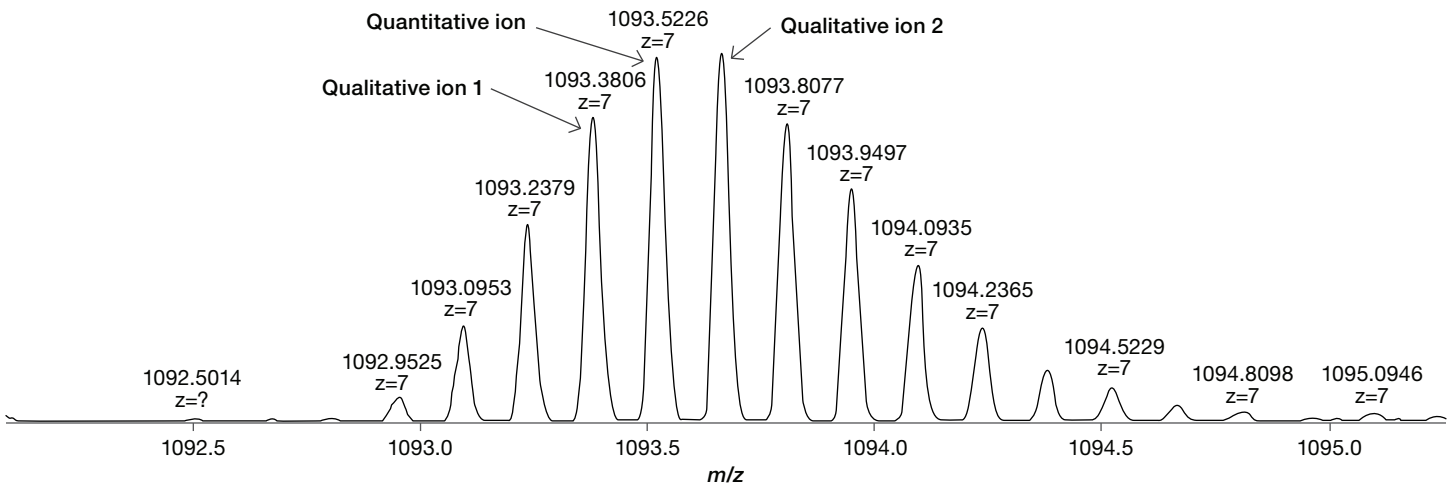


Figure 3. Mass spectrum for insulin-like growth factor quantitative and qualitative ions

Advantages of IGF-1 being detected by high-resolution mass spectrometry:

- Mass spectrometry helps achieve **higher sensitivity and lower limits of quantification** down to 4 ng/mL, which is not easily achieved by immunoassay. For individuals with low IGF-1 value, the KingMed IGF-1 assay using high-resolution mass spectrometry allows for better analytical performance thus providing more accurate results.
- **High specificity** results in effective resistance to interferences from other substances (IGF-binding proteins).
- **Better consistency.** When applying internal standard materials such as **WHO 02-254**, a more precise calibration can be obtained. Results from different batches are comparable, with better long-term consistency of tests and more accurate monitoring of potency.
- **Polymorphisms** of IGF-1 protein sequence can be identified. The change in amino acid sequence from polymorphism can be determined using HRAM mass data.



Figure 4. Q Exactive Plus Hybrid Quadrupole-Orbitrap Mass Spectrometer

### Increased throughput and high efficiency

A growing demand for IGF-1 tests requires higher throughput from the LC-MS system. The Transcend multichannel LC system is perfectly suited for this need.

KingMed selected the Transcend TLX-4 four-channel online TurboFlow technology sample clean-up to carry out IGF-1 testing. The system is equipped with four loading pumps to perform the online TurboFlow sample cleanup, four elution pumps to perform chromatographic separations, a CTC dual-head autosampler to service the four independent channels, and a valve interface module to direct the liquid flow paths. This system can increase throughput up to four times and truly maximize high-throughput experiments.

### Intelligent automatic optimization – The perfect combination of hardware and software

Thermo Scientific™ Aria™ MX software, the intelligent control software of the Transcend system, eliminates the need for users to program complex valve switching between channels or timing autosampler injections. By simply setting the chromatographic gradient, a data time window of mass spectrometry collection, the software automatically optimizes the channel switching to achieve the most efficient simultaneous analysis on four channels.

TurboFlow technology enables fully automated online sample cleanup prior to UHPLC separation and MS analysis. This provides higher productivity, lowers costs, and reduces sample processing time.

Benefits of multichannel LC technology:

- Increases throughput and flexibility
- Decreases cost per sample
- Incorporates the leading precision of Thermo Scientific™ Vanquish™ Flex UHPLC pumps
- Reduces mass spectrometer idle time
- Increases sample throughput without changing validated methods



Figure 5. The latest Transcend TLX-4 system with Vanquish pumps

In addition to Aria MX software, Thermo Scientific™ TraceFinder™ software provides the user with the ability to develop methods, acquire data, and process with one software platform, while the Aria MX software works in the background to control multi-channel experiments.

### Utilizing online TurboFlow to improve selectivity

Online TurboFlow can be configured on Thermo Scientific liquid chromatography platforms.

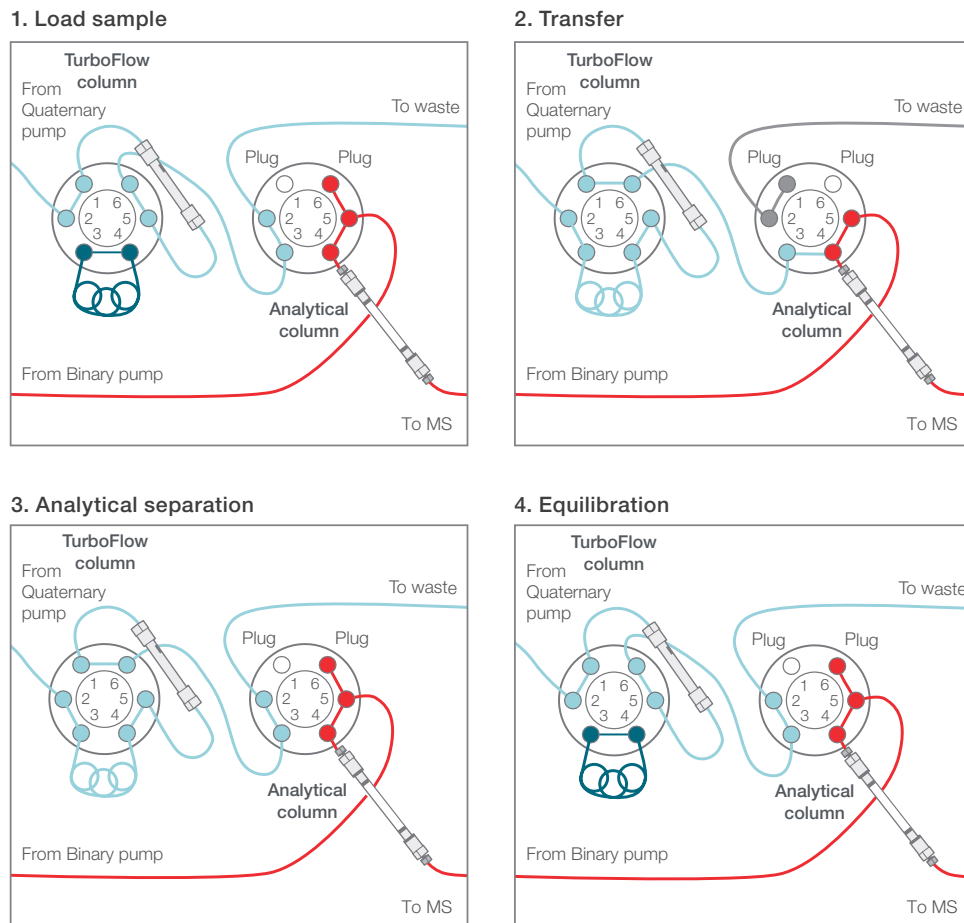
Online TurboFlow improves analysis by:

- **Eliminating pre-treatment**  
Direct injection of biological samples, food, etc.
- **Reducing ion suppression**  
Samples are purified online with high specificity.
- **Saving time**  
Complex sample preparation process is simplified.
- **Simplifying method development**  
The same method can be applied to different substrates.

### Multichannel LC combined with Orbitrap mass spectrometry

In 2011,<sup>4</sup> laboratories began to explore the advantages of using high-resolution mass spectrometry to quantify IGF-1, and its reliability has been proven in long-term clinical practice.

Since this development, KingMed further advanced efficiency and accuracy with the Transcend multichannel liquid chromatography system combined with Orbitrap mass spectrometry to deliver the gold standard in IGF-1 testing.



Aria MX software controls pump operation, valve switching, cleaning, and gradient procedures.

Figure 6. Online solid phase extraction, such as TurboFlow, flow path of liquid phase system (Focus mode)

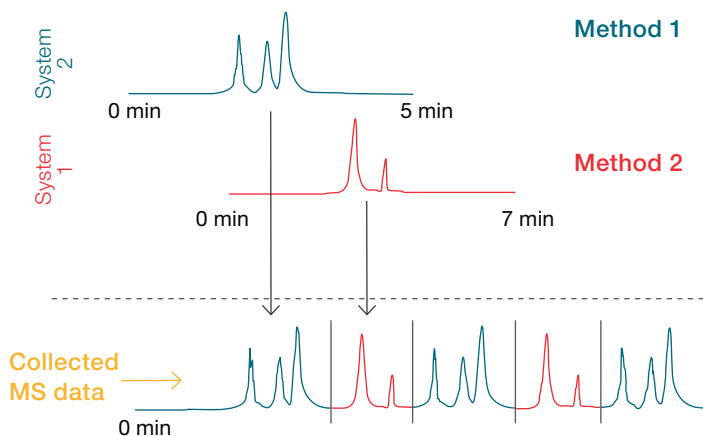


Figure 7. The Transcend multichannel liquid chromatography system allows up to four independent LC channels to be run in parallel, thus maximizing the efficiency of the mass spectrometer.

#### References

1. Spotlight on Guangzhou. *Nature*, 2016. <https://doi.org/10.1038/nj0483>
2. China Independent Clinical Laboratory Industry Report, 2019-2025, April 2019. [https://www.reportlinker.com/p04170501/China-Independent-Clinical-Laboratory-Industry-Report.html?utm\\_source=PRN](https://www.reportlinker.com/p04170501/China-Independent-Clinical-Laboratory-Industry-Report.html?utm_source=PRN)
3. Vukajlović, J.M.; Panić-Janković, T. Mass Spectrometry in Clinical Laboratories, April 8th 2021. <https://www.intechopen.com/chapters/76164>
4. Bystrom, C.; Sheng, S.; Zhang, K.; Caulfield, M.; Clarke, N.J.; Reitz, R. (2012) Clinical Utility of Insulin-Like Growth Factor 1 and 2; Determination by High Resolution Mass Spectrometry. *PLoS ONE* 7(9): e43457.

#### Ordering information

Product	Part number
Q Exactive™ Plus Hybrid Quadrupole-Orbitrap™ Mass Spectrometer	IQLAAEGAAPFALGMBDK
Transcend System (TLX-1, TLX-2, TLX-4)	60500-60201, 60500-60202, 60500-60203

#### Additional resources

Thermo Scientific **Technical Note 73190** – Quantification of insulin-like growth factor 1 in human serum by Vanquish UHPLC with Q Exactive high-resolution accurate-mass mass spectrometry for clinical research

Thermo Scientific **Technical Note 73770** – Fast and accurate quantitation of intact IGF-1 from serum by HRAM LC-MS for clinical research

[Transcend UHPLC Brochure](#)

[Transcend TLX Spec Sheet](#)

[Thermo Scientific™ Orbitrap Exploris™ 120 mass spectrometer](#)

[Q Exactive Plus hybrid quadrupole-Orbitrap mass spectrometer](#)

Learn more at [thermofisher.com/TranscendMultichannelSystems](https://thermofisher.com/TranscendMultichannelSystems)

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