Industry Focus

October 2024

LAB AUTOMATION

A curated collection of top articles, Thought Leaders and Insights from Industry

NEWS MEDICAL LIFE SCIENCES

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Foreword

Welcome to this edition of Lab Automation, where we share insights on the transformative power of lab automation across various scientific disciplines.

This compilation highlights the latest innovations in laboratory technologies, from groundbreaking robotic systems to AI-driven data analysis tools, showcasing their ability to enhance efficiency and accuracy in research.

One of our featured innovations is the *Absorbance 96 Automate*, the world's first on-deck plate reader, designed to seamlessly integrate into existing laboratory workflows. This compact device not only optimizes microplate reading but also exemplifies the shift towards more efficient and space-saving laboratory solutions.

Take a closer look at the critical role of lab automation in fostering international research collaborations. Automated systems boost both precision and reproducibility, which are essential in today's data-driven scientific landscape. By taking over routine, repetitive tasks, these technologies free up researchers to concentrate on the bigger picture—advancing innovation and making groundbreaking discoveries.

Additionally, we delve into the exciting developments in AI technologies, such as those predicting aging and disease risk through facial and retinal imaging. These advancements signal a new era in predictive healthcare, emphasizing the role of lab automation in enhancing our understanding of complex biological processes.

Additionally, we delve into the developments in AI technologies, such as those predicting aging and disease risk through facial and retinal imaging. These advancements signal a new era in predictive healthcare, emphasizing the role of lab automation in enhancing our understanding of complex biological processes.

Furthermore, the issue discusses the significance of fermentation in pharmaceutical manufacturing, shedding light on its critical applications in producing biopharmaceuticals like antiviral medications.

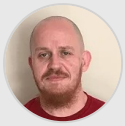
We hope you find inspiration within these pages to push boundaries, explore new technologies, and incorporate automation into your lab practices for better results and faster scientific advancements.

Together, let's embrace the future of lab automation and continue to drive innovation in our respective fields.

Enjoy reading!

Danielle Ellis
Editor
News Medical
Life Sciences

The Global Perspective: Lab Automation's Role in International Research Collaboration



By Reginald Davey

Reviewed by Lily Ramsey, LLM

International collaboration is essential for the advancement of scientific research. Scientists working together on international projects leverage the benefits of innovative technologies to improve research outcomes, with laboratory automation playing an increasingly important role in these efforts.

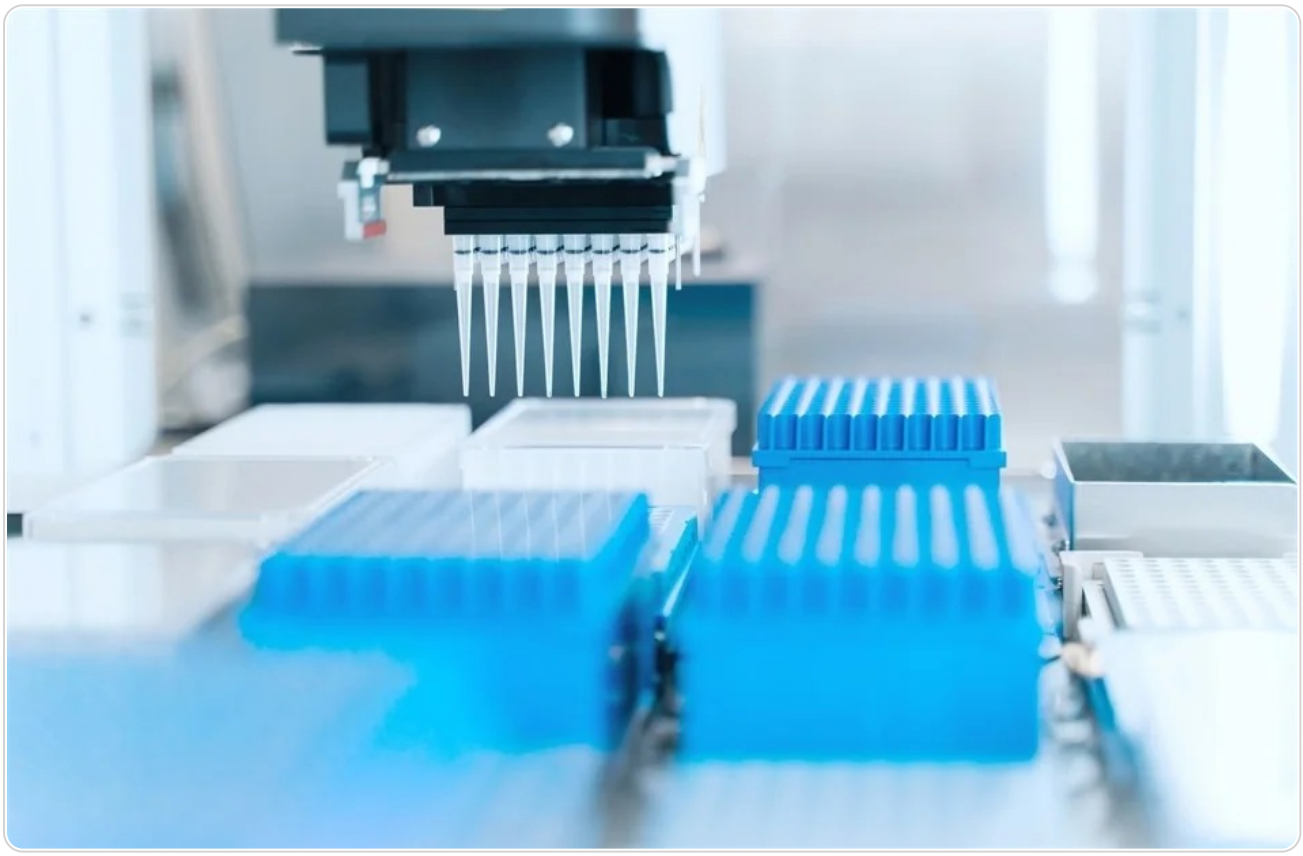


Image Credit: Elpisterra/Shutterstock.com

Lab Automation: Foundations and Impact

The modern laboratory is increasingly becoming automated, with tasks traditionally carried out manually by lab assistants now being performed by automated technologies such as algorithms, robots, automatic aliquoting machines, and pipette machines. Repetitive tasks such as liquid handling and library preparation are just two examples of lab tasks that are increasingly becoming fully automated.[1]

Partial or entire workflows can also be fully automated, bringing huge benefits for research teams in terms of throughput, accuracy, and reproducibility. Overall, automation vastly improves the quality of research data and makes optimal use of increasingly stretched resources and personnel in labs of all shapes, sizes, and specialisms. Automation can be a game-changer for these laboratories and the international research community.[1]

Laboratory automation has already had a significant impact on several research areas that demand high throughput, efficiency, accuracy, quality, and reproducibility, such as high-throughput screening, genomic sequencing, and numerous disciplines within the fields of analytical chemistry and life sciences.

Enhancing International Research Through Automation

International research teams working together on projects in multiple disciplines require ways of improving collaboration to work together successfully and reproduce high-quality results and data. Whether employed in a small, medium, or large laboratory, automation enables researchers to conduct experiments with precision and reproducibility at scale.

A number of benefits that automation brings to the table improve the work of international research teams. In an increasingly data-driven research environment, automation helps to enhance data accuracy, for instance.

One example of this would be the consistent automated plate streaking of samples in the microbiology lab which helps to improve the accuracy of pathogen differentiation.[1]

Automation also reduces human errors, such as handling-induced variability and sample labeling errors, which can impact reproducibility across international research. Furthermore, traceability, a major concern in scientific research, is vastly improved by automating lab processes: automation can take care of data custody chains and improve sample documentation accuracy, improving provenance.[1]

Another key benefit automation can bring is record digitization, making it easier to share data and results across academic institutions and R&D labs in multiple geographical locales.

Digital record-keeping systems improve workflow management, creating flexible and adaptable research structures and reducing errors.[4]

Lab automation has benefited several international projects over the past few decades, with one noteworthy example being the Human Genome Project.

One of the 20th and 21st century's great research achievements, scientists working on this project have leveraged several automated technologies and processes to improve data quality, traceability, efficiency, and international collaboration.[2]

Shotgun sequencing was one automated technology that was developed in the Human Genome Project.

In this process, DNA sequences are broken down into fragments via mechanical or enzymatic means and then cloned into vectors, allowing them to be sequenced individually, which was a key part of sequencing the entire human genome: thus, automation was central to this international research effort.[3]

Challenges and Solutions in Automated Collaborative Research

Whilst automation has been proven to help overcome common problems encountered in scientific research, leading to better international collaboration across multiple disciplines, achieving widespread automation in several fields is not without its key challenges.

Firstly, there is the question of cost: automated equipment is more expensive than traditional technologies, which, whilst not as much of an issue in large commercial laboratories, may hinder its uptake in smaller labs that may not have adequate funding.

Secondly, laboratories seeking to leverage the benefits of automation in international collaborative research can suffer from a lack of researchers trained in the use of automated systems and processes.

Furthermore, different devices from different vendors can make integration problematic at both a local and international level, especially with a lack of trained staff.

International research collaboration has its own unique issues, with examples being differences in infrastructure and the finances available to incorporate relevant automated infrastructure, differences in regulations and standards and data privacy concerns.

Implementing and fostering governmental and institutional partnerships could go a long way toward addressing many of these challenges.

Emerging Technologies in Lab Automation

Several emerging automation technologies are playing a key role in enhancing international

research efforts. AI and machine learning, for instance, are improving data analytics, experiment design, and data processing.

Industrial Internet of Things (IIoT) technologies help to improve communication between laboratory equipment at an international scale.

Modular automation systems are also democratizing automation, making it possible for smaller laboratories, which are part of international projects, to justify the cost of automation by providing them with increased flexibility.[1]

New commercial solutions are always emerging, further enhancing international research teams' capabilities to work together across multiple key scientific industries.

Future Directions in Lab Automation and International Collaboration

According to McKinsey Research, there has been a steady increase in automation hardware vendors in recent years: this number has doubled between 2008 and 2013, from 93 to 206.[4]

This has led to a dynamic vendor landscape, with novel partnerships between vendors and companies in the pharma field and other key scientific research areas.

Breakthroughs in automation technology will likely continue to have an impact in the coming years, moving automation to the forefront of scientific research. Increasing collaboration between international stakeholders and increasing recognition of the beneficial role of lab automation can only positively impact international research collaboration.[4]

Final Thoughts

Whilst automation should not be considered a “one size fits all” solution, the benefits it brings in terms of data accuracy, reproducibility, efficiency, quality, safety, and traceability, to mention but a few, are becoming more apparent to the international research community.

Whilst there are some key challenges that need to be urgently addressed, such as the high cost of automated infrastructure investment, especially for smaller labs and in developing nations, which otherwise could be frozen out of these research efforts due to cost considerations, these problems are being addressed by multiple stakeholders.

In short, automation can be a huge boon to international research collaboration, helping to advance research and bring new products to market across a wide range of scientific

disciplines and industries.

References and Further Reading

1. Automata (2024) What is Lab Automation? (online) automata.com. Available at: https://automata.tech/what-is-lab-automation/ (Accessed on 07 May 2024)
2. Wilson, S et al. (2021) Innovative technological advancements in laboratory medicine: predicting the lab of the future *Biotechnology & Biotechnological Equipment* 36 pp. S9-S21 [online] tandfonline.com. Available at: https://www.tandfonline.com/doi/full/10.1080/13102818.2021.2011413 (Accessed on 08 May 2024)
3. Zhang, J et al. (2011) The impact of next-generation sequencing on genomics *J Genet Genomics* 38(3) pp. 95-109 [online] PubMed. Available at: https://pubmed.ncbi.nlm.nih.gov/21477781/ (Accessed on 08 May 2024)
4. McKinsey & Company (20223) From bench to bedside: Transforming R&D labs through automation [online] mckinsey.com. Available at: https://www.mckinsey.com/industries/life-sciences/our-insights/from-bench-to-bedside-transforming-r-and-d-labs-through-automation (Accessed on 08 May 2024)

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Written by

Reginald Davey

Reg Davey is a freelance copywriter and editor based in Nottingham in the United Kingdom. Writing for AZoNetwork represents the coming together of various interests and fields he has been interested and involved in over the years, including Microbiology, Biomedical Sciences, and Environmental Science.

Absorbance 96 Automate revealed: The world's first on-deck plate reader for laboratory automation

From Byonoy

Reviewed by Maria Osipova

Feb 7 2024

Byonoy proudly launches the world's first on-deck plate reader, the Absorbance 96 Automate to revolutionize automated laboratory workflows with integrated microplate reading. This groundbreaking instrument merges a sleek, compact design with a lightweight build and z-axis serviceability, positioning it as the ultimate platform-agnostic solution for effortless integration. Engineered to integrate into both traditional decks and state-of-the-art robotic systems seamlessly, the Absorbance 96 Automate is set to redefine measurement technologies for automated laboratory workflows.

Image Credit: Byonoy

Highlighted features

- Easy Integration: The Absorbance 96 Automate distinguishes itself with its unparalleled

ease of integration into systems equipped with a microplate gripper. Its ultra-compact size, coupled with a highly functional design and advanced technological features, guarantees a hassle-free integration process. Users can communicate with the device seamlessly through the intuitive Absorbance 96 App, which can be conveniently controlled via a scheduler using Sila2 or a dedicated driver.

- Compact footprint: With its radically small footprint (dimension: 15,5 x 9,5 cm), it can be easily incorporated on the deck occupying a single SBS position, saving valuable deck space and eliminating the need for additional third-party hardware.
- Unparalleled performance with high read-time capability: Integrated sensors within the Absorbance 96 Automate guarantee precise microplate detection, significantly streamlining absorbance-based assays in automated workflows. Boasting 6 LEDs and 96 detection units, this cutting-edge device achieves an impressive 5-second read time, highlighting its remarkable capability for swift data acquisition during automated workflows.

> *“It is an exciting moment for Byonoy as we expand our capabilities in the lab automation sector. The integration of Absorbance 96 Automate into liquid handling systems not only provides researchers with seamless microplate reading for automated workflows but also allows for significant savings in on-deck space and reduced hardware costs. This achievement is a result of great teamwork, and I look forward to its application across various labs.”*
>
> *Dr. Yousef Nazirizadeh, CEO and Head of Research, Development, and Production, Byonoy*

Discover how to elevate your lab automation and learn more about Absorbance 96 Automate and its specifications. Read the Byonoy news here.

Source:

Byonoy

AI model predicts aging and disease risk using facial and retinal images

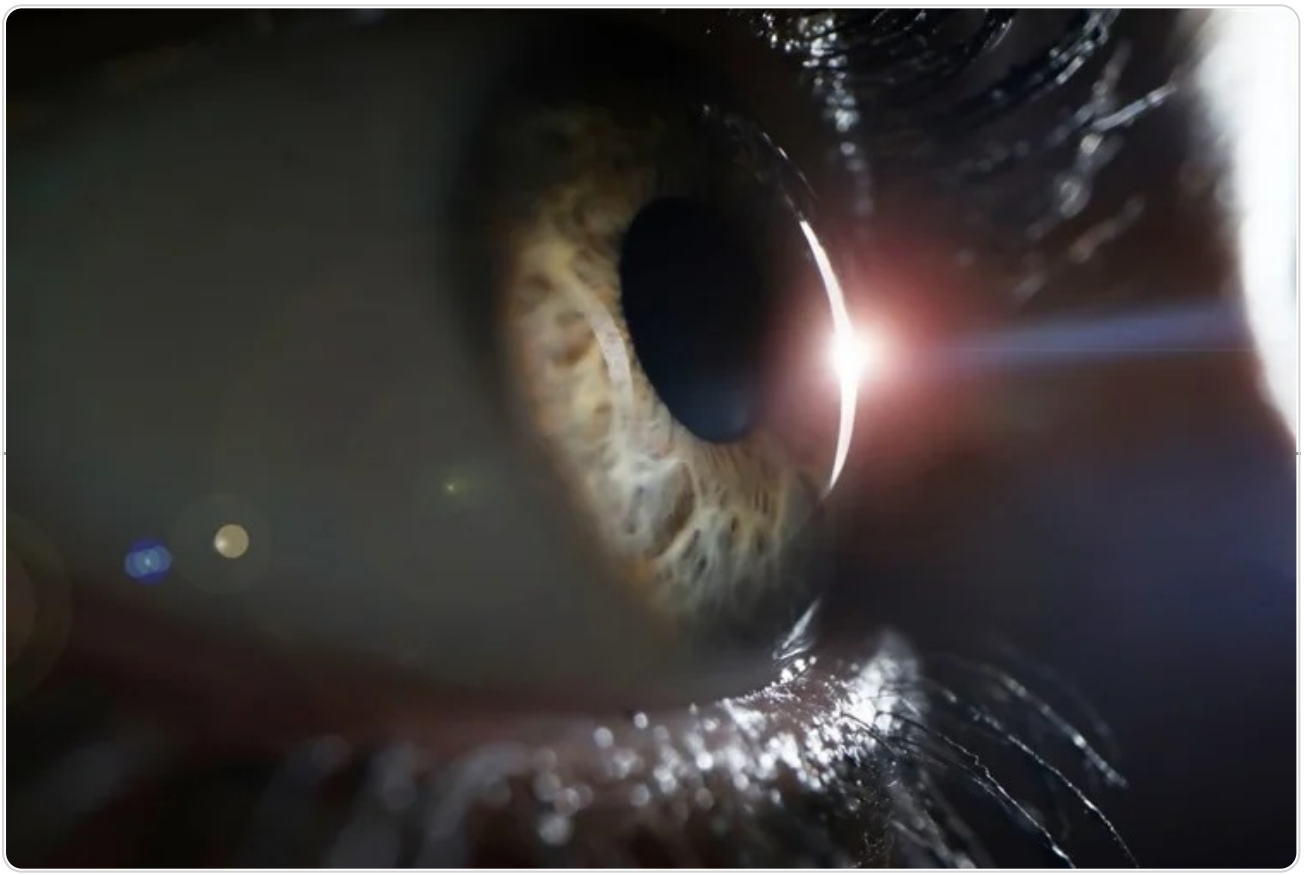
By Dr. Chinta Sidharthan

Reviewed by Susha Cheriyedath, M.Sc.

Jan 9 2024

Innovative Approach to Aging and Disease Prediction

In a recent study published in the journal *Proceedings of the National Academy of Sciences*, a team of scientists from China developed a multimodal method using an image Transformer system that uses tongue, retinal, and facial images and estimates biological age, which can be used to predict the risk of chronic diseases related to age.



Study: Accurate estimation of biological age and its application in disease prediction using a multimodal image Transformer system. Image Credit: H_Ko / Shutterstock

Background on Biological Age and Chronic Diseases

The identification and standardization of markers that can be used to predict the risk of chronic diseases related to aging and their clinical use for managing the health of the aging

population has thus far proven difficult due to the heterogeneity in tissues and organs. Time is not the only determining factor in many chronic diseases associated with various organ systems. However, biological age, a marker of chronological aging, is determined based on the functional and structural changes that occur during aging.

Environmental and genetic factors can be responsible for these changes, and a reliable method for determining biological age is clinically important to predict the risk of numerous age-related diseases and ensure early intervention. Artificial intelligence (AI) has recently been used to identify biomarkers such as retinal age, brain image-derived brain age, facial age, and epigenetic clock based on deoxyribonucleic acid (DNA) methylation patterns.

Study Methodology and AI Model Development

In the present study, the researchers developed an AI-based modeling system that uses tongue, retinal fundus, and facial images to estimate biological age and obtain information on and predict the risk of chronic, organ-specific diseases. The optic nerve contains axons derived from the central nervous system, which makes retinal images a potential indicator of brain health. Furthermore, microbiome exposure deduced from tongue images can be an indicator of the health of the oral cavity and the gastrointestinal tract.

The AI tool is based on a Transformer-based architecture, and facial, tongue, and retinal images from a group of healthy participants were used to train and validate the model. Subsequently, images from participants who had various chronic diseases or known risk factors for chronic diseases were used to test the model. These images were used to understand how various lifestyle factors and chronic diseases would impact biological age.

The Transformer-based AI model uses a cross-attention module to estimate biological age using combined information from retinal fundus, facial, and tongue images. Linear projection modules were initially used to process these images and construct classification and image tokens that correspond to these images. These tokens were then used as the input data for the multimodal Transformer architecture, which is optimized through a backpropagation algorithm that uses the loss function between chronological age and predicted biological age.

The training dataset was obtained from participants who were longitudinally followed for health checks. Three-dimensional (3D) scanning of the face, retina, and tongue and relevant medical information were obtained from the participant's medical records and blood tests using fasting blood samples. Other metadata for the study consisted of lifestyle factors such as alcohol use and smoking, demographic information, and information gathered from clinical laboratory tests and physical examinations. Images from a second cohort of participants were

used as the independent validation cohort.

Results from the AI-Based Biological Age Prediction

The study reported that images of the tongue, retina, and face from over 11,000 healthy participants were used to train the AI-based model to predict biological age, while images from close to 3000 participants with six major chronic diseases were used as the test dataset. The significant difference between the healthy and diseased cohorts in the AgeDiff, defined as the difference between chronological and predicted biological ages, was calculated.

AgeDiff was found to be a reliable marker to be used independently or in conjunction with other known risk factors to stratify the population and predict the progression of age-related chronic diseases. The researchers believe their multimodal AI-based biological age prediction tool was more accurate than other biological age prediction tools that used phenotypic data, epigenetic clocks based on DNA methylation information, blood profiles, or transcriptome aging clocks.

The validated AI-based model showed a robust ability to detect the progressive changes associated with aging and exhibited accurate biological age-predicting abilities. The results also indicated that individuals with chronic diseases exhibit several deviations associated with AgeDiff that can be used to detect and assess the progression of chronic diseases.

Implications of the Study

Overall, the findings indicated that the Transformer-based multimodal AI tool that uses facial, tongue, and retinal fundus images can accurately detect and predict the progression of age-related chronic diseases.

Journal reference:

- Wang, J., Gao, Y., Wang, F., Zeng, S., Li, J., Miao, H., Wang, T., Zeng, J., Baptista-Hon, D., Monteiro, O., Guan, T., Cheng, L., Lu, Y., Luo, Z., Li, M., Zhu, J., Nie, S., Zhang, K., & Zhou, Y. (2024). Accurate estimation of biological age and its application in disease prediction using a multimodal image Transformer system. *Proceedings of the National Academy of Sciences*, 121(3), e2308812120. https://doi.org/10.1073/pnas.2308812120, https://www.pnas.org/doi/full/10.1073/pnas.2308812120

Written by

Dr. Chinta Sidharthan

Chinta Sidharthan is a writer based in Bangalore, India. Her academic background is in evolutionary biology and genetics, and she has extensive experience in scientific research, teaching, science writing, and herpetology. Chinta holds a Ph.D. in evolutionary biology from the Indian Institute of Science and is passionate about science education, writing, animals, wildlife, and conservation. For her doctoral research, she explored the origins and diversification of blindsnakes in India, as a part of which she did extensive fieldwork in the jungles of southern India. She has received the Canadian Governor General's bronze medal and Bangalore University gold medal for academic excellence and published her research in high-impact journals.

Scientists discover key age-related biological shifts at 40 and 60

By Hugo Francisco de Souza

Reviewed by Susha Cheriyedath, M.Sc.

Aug 16 2024

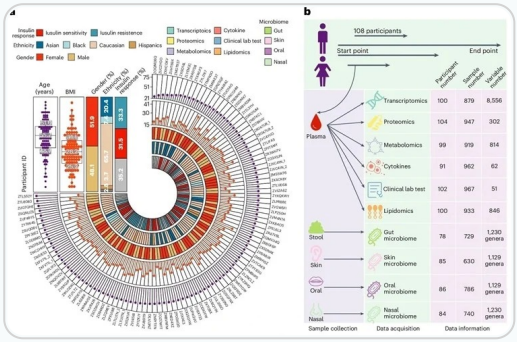
Study: Nonlinear dynamics of multi-omics profiles during human aging. Image Credit: tomertu / Shutterstock

In a recent study published in the journal *Nature Aging*, researchers in Singapore and the United States conducted comprehensive profiling of a longitudinal cohort (n = 108) using next-generation multi-omics techniques to reveal the nonlinear dynamics of human aging. The study cohort comprised individuals residing in California between the ages of 25 and 75, followed up for up to 6.8 years (median = 1.7 years).

The study revealed that only 6.6% of molecular markers showed linear age-associated changes, whereas a substantial 81% exhibited nonlinear patterns, highlighting the complexity of the aging process. Molecular markers analyzed during the study revealed that human aging is not a linear process, with chronological ages of around 44 and 60 demonstrating dramatic dysregulation of specific biological pathways, such as alcohol and lipid metabolism during the

40-year transition and carbohydrate metabolism and immune regulation during the 60-year transition. These findings provide unprecedented insights into the pathways (both biological and molecular) associated with human aging and present a significant leap in identifying therapeutic interventions against age-associated chronic diseases.

Background



a, The demographics of the 108 participants in the study are presented. b, Sample collection and multi-omics data acquisition of the cohort. Four types of biological samples were collected, and 10 types of omics data were acquired.

Aging is defined as the time-related deterioration of physiological functions associated with health and survival. Decades of research have identified that these physiological changes strongly correspond with the risk and incidence of chronic diseases, including diabetes, neurodegeneration, cancers, and cardiovascular diseases (CVDs).

Recent research using next-generation, system-level, high-throughput omics technologies suggests that, unlike previously believed, aging is not a linear process. The study utilized techniques such as transcriptomics, proteomics, metabolomics, and microbiome analysis to uncover the complexity of aging at a molecular level. Specific chronological ages may serve as thresholds corresponding to significant nonlinear metabolism rates and molecular profile alternations. For example, both neurological diseases and CVDs are known to demonstrate substantial spikes in population-level prevalence at ~40 and ~60 years.

Unfortunately, despite this relatively novel knowledge, the literature has hitherto mainly investigated the biology of aging with the assumption that aging is a linear process. This approach has potentially masked mechanistic insights essential for developing therapeutic interventions against age-related diseases, hindering the quest for extended human lifespans and healthier old ages.

About the study

The present study aims to address this gap in the literature by using a battery of deep multi-omics profiling technologies to investigate the specific alternations in biological and molecular pathways associated with different adult age groups. The study was conducted on a cohort of healthy adult volunteers from California, United States (US), between the ages of 25 and 75. Participants were eligible for the study if they lacked a clinical history of chronic

diseases, including anemia, CVD, cancer, psychiatric illness, or bariatric surgery.

Baseline data collection included a modified insulin suppression test, fasting plasma glucose (FPG) test, and hemoglobin A1C (HbA1C) test to establish participants' insulin sensitivity, diabetes, and average glucose levels, respectively. Furthermore, participants' body mass indices (BMIs) were recorded at study enrolment and follow-up.

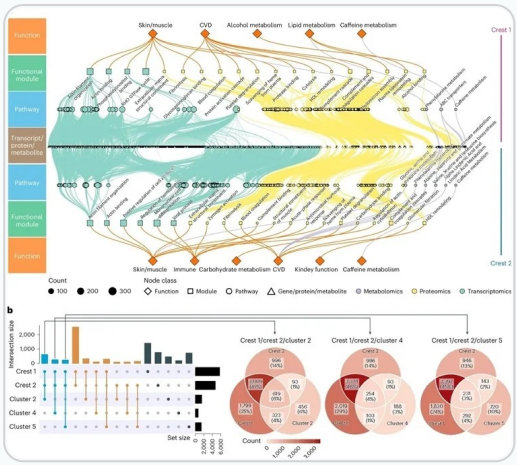
> *"...5,405 biological samples (including 1,440 blood samples, 926 stool samples, 1,116 skin swab samples, 1,001 oral swab samples and 922 nasal swab samples) were collected. 135,239 biological features (including 10,346 transcripts, 302 proteins, 814 metabolites, 66 cytokines, 51 clinical laboratory tests, 846 lipids, 52,460 gut microbiome taxons, 8,947 skin microbiome taxons, 8,947 oral microbiome taxons and 52,460 nasal microbiome taxons) were acquired, resulting in 246,507,456,400 data points."*

The battery of multi-omics tests comprised seven distinct evaluations, namely 1. transcriptomics (using RNA extracted from flash-frozen peripheral blood mononuclear cells [PBMCs]), 2. proteomics (using liquid chromatography of participants' plasma samples), 3. untargeted metabolomics (using plasma-derived metabolite profiles generated via reverse-phase liquid chromatography [RPLC] and hydrophilic interaction chromatography [HILIC]), 4. cytokine data (derived from Luminex-based multiplex assays of participants' plasma), 5. plasma lipidomics (using differential mobility spectrometry), 6. microbiome analysis (using genomic sequencing of participants' stool, skin, oral, and nasal samples), and 7. standard clinical laboratory tests (metabolic panel, complete blood counts, kidney and liver panels, high-sensitivity C-reactive protein [hsCRP], etc.).

Study findings

The included study cohort comprised 108 participants (51.9% female) between the ages of 25 and 75 (median 55.7). Participants were sampled for multi-omics data every 3-6 months (median follow-up period = 1.7 years, maximum = 6.8 years). This rigorous longitudinal analysis allowed the researchers to capture both linear and nonlinear molecular changes associated with aging. Mulit-omics findings highlighted the importance of nonlinear approaches in characterizing biological aging by revealing that of the investigated molecules, only 6.6% demonstrated linear age-associated changes, while 81.0% demonstrated nonlinear patterns.

Importantly, these molecular patterns were surprisingly consistent across all seven multi-omics investigations, suggesting that these changes have deep biological implications. A trajectory clustering analysis approach employed to group molecules by their temporal similarity revealed the presence of three distinct clusters (clusters 5, 2, and 4).



a, Pathway enrichment and biological functional module analysis for crests 1 and 2. Dots and lines are color-coded by omics type. b, The overlapping of molecules between two crests and three clusters.

The first comprised a mRNA and autophagy-associated transcriptomics module exhibiting a dramatic increase around 60 years of age. This pathway maintains cellular homeostasis and demonstrates increased aging-related disease risk. The second comprises a phenylalanine metabolism pathway encapsulating serum/plasma glucose and blood urea nitrogen, both of which substantially increase at around age 60, highlighting reduced kidney function and increased CVD risk. The third includes pathways related to caffeine metabolism and unsaturated fatty acid biosynthesis, critical to cardiovascular health.

To better elucidate peaks in microbiome and molecule dysregulation across the adult aging process, researchers employed a modified Differential Expression Sliding Window Analysis (DE-SWAN) algorithm. Analysis findings highlight the presence of two prominent peaks (crests) corresponding to ~40 and ~60 years, consistent across the full range of multi-omics profiles (particularly proteomics). Modules in the first peak were found to be strongly correlated with alcohol and lipid metabolism. In contrast, those in the second peak were strongly correlated with immune dysfunction, kidney function, and carbohydrate metabolism.

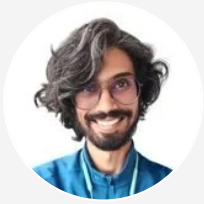
Conclusions

The present study highlights the highly nonlinear nature of the biological and molecular processes associated with human aging, as demonstrated by seven distinct multi-omics investigations. The study is noteworthy in that it additionally identifies specific patterns in the aging process that dramatically increase at around 40 and 60 years, corresponding to biologically meaningful dysregulation of alcohol and lipid metabolism (at ~40) and immune dysfunction, kidney performance, and carbohydrate metabolism (at ~60).

> *"These comprehensive multi-omics data and the approach allow for a more nuanced understanding of the complexities involved in the aging process, which we think adds value to the existing body of research. However, further research is needed to validate and expand upon these findings, potentially incorporating larger cohorts to capture the full complexity of aging."*

Journal reference:

- Shen, X., Wang, C., Zhou, X. *et al.* Nonlinear dynamics of multi-omics profiles during human aging. *Nat Aging* (2024), DOI – 10.1038/s43587-024-00692-2, https://www.nature.com/articles/s43587-024-00692-2



Written by

Hugo Francisco de Souza

Hugo Francisco de Souza is a scientific writer based in Bangalore, Karnataka, India. His academic passions lie in biogeography, evolutionary biology, and herpetology. He is currently pursuing his Ph.D. from the Centre for Ecological Sciences, Indian Institute of Science, where he studies the origins, dispersal, and speciation of wetland-associated snakes. Hugo has received, amongst others, the DST-INSPIRE fellowship for his doctoral research and the Gold Medal from Pondicherry University for academic excellence during his Masters. His research has been published in high-impact peer-reviewed journals, including PLOS Neglected Tropical Diseases and Systematic Biology. When not working or writing, Hugo can be found consuming copious amounts of anime and manga, composing and making music with his bass guitar, shredding trails on his MTB, playing video games (he prefers the term 'gaming'), or tinkering with all things tech.

AI breakthrough: Speech analysis predicts Alzheimer's progression with 78.5% accuracy

By Tarun Sai Lomte

Reviewed by Lily Ramsey, LLM

Jun 27 2024

In a recent study published in Alzheimer's & Dementia, researchers developed a method for predicting the progression of Alzheimer's disease (AD).

Study: Prediction of Alzheimer's disease progression within 6 years using speech: A novel approach leveraging language models. Image Credit: fizkes/Shutterstock.com

Background

Individuals with mild cognitive impairment (MCI) have a heightened risk of AD. Therefore, accurate prediction of the progression from MCI to AD can help in treatment-related decisions, selection for trials of new drugs, and participation in rehabilitation programs. AD pathology has been conventionally assessed using neuroimaging techniques or biomarkers.

Various studies have evaluated these (conventional) methods for predicting MCI to AD

progression. However, they are expensive and invasive, limiting their applicability.

By contrast, neuropsychological tests (NPTs) are the most accessible for cognitive decline assessment. Computer-based approaches have been tested for predicting MCI-to-AD conversion using NPTs. Speech in NPTs can be used to predict cognitive decline.

Artificial intelligence-based diagnostic models using acoustic and linguistic features from NPTs have been developed.

The Framingham Heart Study (FHS) has been recording NPTs since 2005, and the recordings have been used to build diagnostic tools. Previously, the study's authors applied natural language processing (NLP) techniques on recordings to place individuals across the dementia spectrum.

About the study

In the present study, using speech data, researchers developed a method to predict AD progression within six years. The FHS monitored a cohort of 166 people with cognitive complaints. Each individual underwent an hour-long NPT that was digitally recorded and stored. Education information, health risk factors, and apolipoprotein E (*APOE*) alleles were available.

The study focused on MCI-to-AD progression and not on normal cognition to MCI or AD because of the limited utility of NPTs in predicting cognitive decline without (signs of) cognitive deterioration.

The team developed a tool to transcribe voice recordings in their previous work automatically. This tool was used to transcribe subjects' audio files. Each sentence was labeled according to the specific sub-test.

Different vector embeddings were obtained for NPTs based on specific segments of each transcript. The Universal Sentence Encoder, a deep learning-based model, generated vector embeddings.

Training data were increased by randomly sampling from transcripts to generate abbreviated versions, which were subsequently encoded. Besides, sub-test content was separately encoded, creating eight specific embeddings.

A logistic regression model was trained on the quantitative data associated with each sub-test

content. Embeddings from abbreviated versions were used as independent input, generating multiple scores for each transcript.

A transcript average score (TAS) was generated from these multiple scores. An ensemble logistic regression model was generated using sub-test scores and TAS to predict the likelihood of MCI to AD progression within six years.

Model performance was evaluated using a stratified group k-fold cross-validation approach. Besides, an internal cross-validation was performed for feature selection and dimensionality reduction.

Performance metrics included the area under the receiver operating characteristic curve (AUC), accuracy, precision, sensitivity, and specificity.

Findings

Of the 166 subjects with MCI, 90 progressed to AD dementia within six years. AD dementia included mixed dementia and AD with/without stroke. The mean time to AD was 2.7 years.

Older females with lower education and those carrying the APOE ε4 allele were more likely to progress to AD. Besides, females who progressed to AD were 1.4 years older, on average, than males.

The model incorporating demographics, APOE carrier status, health factors, and text features (viz., NLP model) achieved an F1 score of 79.9% and an AUC of 78.5%.

The corresponding figures for the model with only text features were 79.4% and 77.8%, respectively. The model with text and demographic features had an AUC of 77.5% and an F1 score of 79.6%.

The model with only NPT scores had an F1 score of 75.5% and an AUC of 71.3%. The AUC and F1 scores of the model with only demographic features were 68.8% and 71.1%, respectively.

A model based on a mini-mental state examination had an AUC of 60.7%. The model with only health factors achieved an AUC of 66.2%.

Conclusions

In sum, the researchers illustrated the potential of automated speech recognition and NLP in

predicting progression to AD among people with MCI. The proposed model predicted AD progression with a sensitivity of 81.1, specificity of 75%, and accuracy of 78.2%.

This approach allows for an accessible and non-invasive AI-based prediction without involving genetic or laboratory tests or imaging, making it ideal for remote assessments.

Further large-scale studies are required to corroborate these findings and validate their generalizability, given that the cohort was predominately White.

Journal reference:

- Amini S, Hao B, Yang J, et al. (2024) Prediction of Alzheimer's disease progression within 6 years using speech: A novel approach leveraging language models. *Alzheimer's & Dementia*,. **doi:** 10.1002/alz.13886. https://alz-journals.onlinelibrary.wiley.com/doi/10.1002/alz.13886

Written by

Tarun Sai Lomte

Tarun is a writer based in Hyderabad, India. He has a Master's degree in Biotechnology from the University of Hyderabad and is enthusiastic about scientific research. He enjoys reading research papers and literature reviews and is passionate about writing.

Disrupting the Flow: Dr. Naseri's Revolutionary Approach to Empowering Women's Health

Interview conducted by Lily Ramsey, LLM

Mar 4 2024

Welcome to our International Women's Day series, where we shine a spotlight on women who are forging paths and making significant impacts in the field of medicine, particularly in women's health.

Today, we are honored to introduce Dr. Sara Naseri, CEO and Co-Founder of Qvin, a trailblazing company at the forefront of women's health technology. In our conversation, Dr. Naseri shares insights into the inspiration behind Qvin, the groundbreaking Q-Pad™ technology, and how their work contributes to this year's theme of inspiring inclusion in healthcare.

Join us as we delve into the challenges and triumphs of innovating in women's health, and learn how Qvin's technologies are empowering women and people who menstruate, especially in underrepresented communities, to take control of their health in unprecedented ways.

Firstly, please introduce yourself and outline your career to date. More specifically, could you share with us what inspired you to co-found Qvin and delve into the realm of women's health technology?

I was passionate about enabling people to be more preventative about their health and wanted to find a way that would allow patients to obtain clinically relevant information about their health regularly and non-invasively.

When I was in medical school, I identified menstrual blood as a simple way to gain health insights non-invasively and regularly for half of the world's population - females. I led a

research team that in 2019 published one of the first peer reviewed studies on the clinical relevancy of menstrual blood, previously considered waste, in the Journal of Clinical and Laboratory Medicine in 2019.

My team and I proved that essential health information can be gleaned from menstrual blood and I then went on to Co-Found Qvin and its pioneering Q-Pad™for women globally.

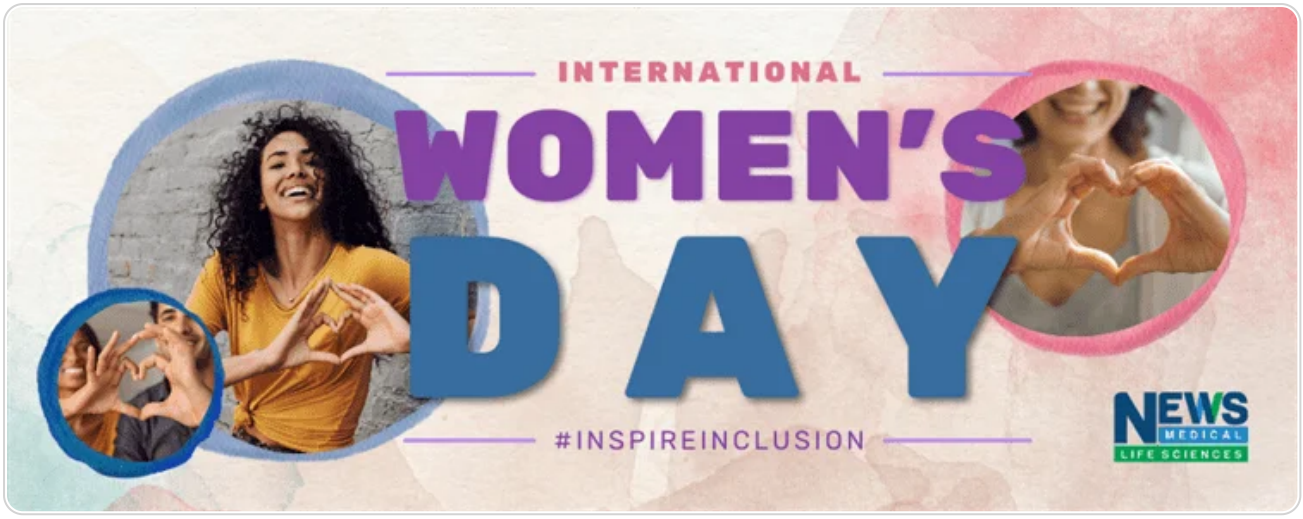
70% of medical decisions are made based on blood testing and lab work. The traditional methods of blood testing require invasive procedures administered by medical professionals, which are time-consuming and expensive. And yet, menstrual blood - a monthly cycle of blood release - has never been explored as a diagnostic source for health information. Qvin published never-been-done-before research that menstruation contains significant and clinically relevant health information.

This International Women's Day focuses on inclusion and equality. How does Qvin's work contribute to these goals in the healthcare sector?

At Qvin our goal is to make health care accessible for all females as well as close the gender data gap that exists in women's health. Not everyone has the time, access and financial means to get laboratory results for blood work, however, billions of people globally bleed every single month and can get access to important health information simply by using the Q-pad.

At the same time, there is a gender gap in medicine and science. Women's health research has been overlooked, underfunded and most importantly, stigmatized. It was not until 1993 when women and minorities were, by law, included in clinical trials.

However, there continues to be an ongoing lack of female representation and participation in medical research. 70% of chronic pain patients are female, yet women only represent 20% of chronic pain research. By utilizing menstrual blood that billions of people throw away monthly, Qvin will help close the medical gender data gap.



Dr. Naseri, for our audience who may not be familiar, could you explain how the Q-Pad technology works and what makes it a groundbreaking development in menstrual health monitoring?

Qvin's Q-Pad is the first and only FDA cleared diagnostic menstrual pad that is a convenient, no needle alternative to traditional lab blood testing using period blood.

Testing menstrual blood with the Q-Pad eliminates common barriers to traditional laboratory testing such as lack of access, anxiety, invasiveness, time, or financial means. Removing these barriers to care can lead to better and more accurate diagnoses and management of our health.

The Q-Pad allows women to leverage their natural period for regular insights about their bodies so that we can enable early detection and be truly preventative.

Not only does the Q-Pad provide women with an easy, non-invasive way to track their health, but by utilizing menstrual blood that billions of people throw away monthly, Qvin will help close the medical gender data gap. Qvin believes menstrual blood is a superpower for women and for women's health research.

How it works

The Q-Pad is used just like any other menstrual pad available on the market. We recommend you use two Q-Pads during your monthly cycle.

- Download the Qvin app and register your kit.
- To use, simply unwrap the Q-Pad and affix it to your underwear.
- Wear it until the oval (marked on pad) saturated with blood.
- Remove the novel dry blood collection strip from inside the pad, put it into the pre-paid

packaging that comes with your Qvin kit and mail back to the CLIA-Certified Qvin Lab.

- Drop the pre-paid packaging in the mail within 72 hours with your two collection strips.
- You will receive your results in the Qvin app within 5-10 days after shipping, in the form of a secure, digital lab report you can also share with your physician.

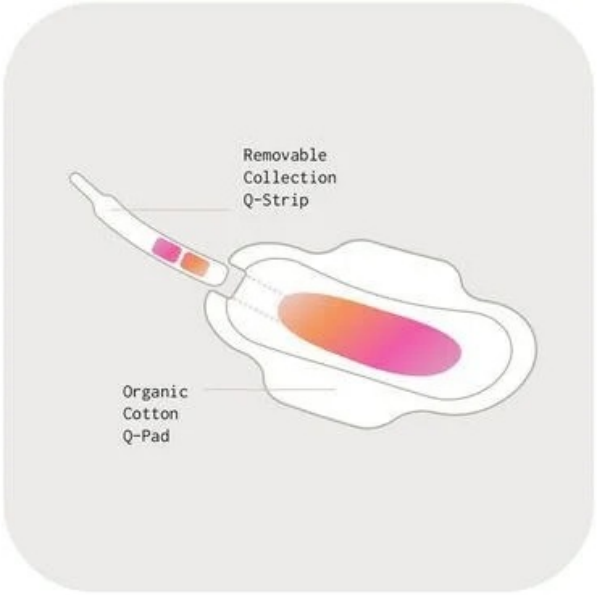


Image Credit: Qvin

How does the Q-Pad compare to traditional methods of health monitoring and diagnostics in terms of accuracy, convenience, and user experience? Additionally, beyond diabetes monitoring, what other health conditions could potentially be diagnosed or monitored effectively using the Q-Pad technology?

The Q-Pad Kit marks a significant innovation in healthcare diagnostics as the first and only FDA-cleared diagnostic menstrual pad that captures menstrual blood for critical health testing, akin to traditional lab tests.

This pioneering product allows individuals to collect samples in the comfort of their own homes without the need for lab visits, finger pricks, or venous blood draws. Designed with organic cotton and a removable collection strip, the Q-Pad offers a seamless experience during menstruation. After collection, the strip is mailed to a lab for clinical testing, avoiding the hassle of returning the entire pad.

Empowering women to take charge of their health, the Q-Pad Kit is a vital tool for informed discussions with healthcare providers, backed by routine, preventative health screenings. Its

accuracy aligns with traditional testing standards, undergoing rigorous validation in CLIA/CAP certified laboratories.

The Q-Pad's reliability is further underscored by its adherence to the highest validation standards, including NGSP for the A1c test and comparison to venous blood for other tests, ensuring results are as dependable as those from conventional diagnostic methods.

The overwhelming acceptance of the Q-Pad is evident from a 2023 research study where 94% of 614 respondents favored the concept, and a clinical trial with 285 participants revealed a strong preference for the Q-Pad over traditional Pap smears, with 91% favoring the Q-Pad and 99% endorsing it for HR-HPV screening.

Created by the Qvin team and myself, the Q-Pad aims to offer a global solution for earlier HR-HPV screening, a critical factor in preventing cervical cancer deaths. It also provides access to a range of biomarkers important for monitoring various health conditions, including thyroid health, diabetes and pre-diabetes management, inflammation, anemia, ovarian reserve, and other fertility and perimenopause indicators.

Our research has validated the concordance between venous and menstrual blood for cholesterol and lipids, with plans to expand the list of biomarkers through further validation. This innovative approach facilitates easier access to essential health screenings and opens new avenues for preventive healthcare.

How significant is the FDA clearance for the Q-Pad and A1c Test, and what does it mean for the future of menstrual blood testing in the healthcare industry?

Qvin is the first and only healthcare service that collects menstrual blood samples as an alternative to traditionally collected venous blood draws. The FDA clearance makes it possible for the millions of women in America who live with diabetes to receive monitoring of A1c, using laboratory tests performed on the Q-Pad.

More broadly, this marks an opportunity for testing important biomarkers for the more than 80 million people who menstruate in the U.S. The traditional methoblood testing methods require invasive procedures administered by medical professionals, which are time-consuming and expensive.

Not everyone has the time, access, and financial means to get laboratory results for blood work; however, billions of people globally have their period every single month. And yet, menstrual samples had never previously been explored as a diagnostic source for health

information. Removing these barriers to care can lead to better and more accurate diagnoses and health management.

Qvin proved the clinical relevancy of menstrual blood for a number of important biomarkers.The Q-Pad was initially created to identify biomarkers for HPV and has expanded and identified additional biomarkers to test for, including pre/diabetes, anemia, fertility, perimenopause, endometriosis, and thyroid health.

Why is it essential to prioritize women's health in public health agendas, and what are the broader societal impacts of doing so?

Women's health research has been overlooked, underfunded and most importantly, stigmatized. Female biology has not been studied equally since the beginning of medical research. It was not until 1993 when women and minorities were, by law, included in clinical trials. The data used to guide clinical diagnosis today is biased to male biology.

So, when women are not included in research, medical diagnosis may not be accurate for women. There continues to be an ongoing lack of female representation and participation in medical research. And we want to change that.

We believe menstrual blood is a superpower for women and for women's health research. By utilizing menstrual blood that billions of people throw away monthly, it is our goal to help close the medical gender data gap.

Image Credit: ESB Professional/Shutterstock.com

What were some of the most significant scientific challenges you faced in developing the Q-Pad, and how did you overcome them?

The biggest roadblock was proving the clinical relevancy of menstrual blood. My team and I will continue research to scientifically prove women can get access to additional biomarkers on the Q-Pad.

In what ways do you believe Qvin's technology empowers women and people who menstruate, particularly in underrepresented communities?

Our goal with Qvin and our novel Q-Pad and educational technology is to revolutionize healthcare and change how we care for ourselves. First and foremost the, the Q-Pad provides an accessible way to screen the population in the comfort of their own home, giving them regular insights that them become more preventative when it comes to their health.

One of the biggest opportunities we see with Qvin and our Q-Pad Kit technology is granting access to non-invasive and convenient testing to millions of people in the US and around the world who do not have immediate access to a healthcare provider.

In the future, I can see a time when a gynecologist recommends a Q-Pad Kit to patients, especially those at higher risk for preventable diseases like cervical cancer.

Looking forward, what emerging technologies or trends do you believe will further revolutionize women's health in the next decade?

Technologies that provide easy, convenient and clinically relevant information will be key in revolutionizing women's health. Women are eager to take control of their health and they want their health information but they are busy with carriers and family life and do not have time to go into a lab/hospital/doctor's office regularly.

We need technologies that allow women to continue their lives as busy and critical members of our work force and family unites without missing important early signs of health.

Lastly, as we celebrate International Women's Day, what advice would you give to young women aspiring to enter the field of medical technology and entrepreneurship?

For women's health issues to become a priority we need more females (in addition to males) to want to join this field and contribute to its enhancement. There is a massive opportunity to capture because it is an area of health care that has been overlooked.

It is incredible to work in an area of health where there are still major questions to be answered and to be part of helping find those answers for such a big part of the world's population.

Where can readers find more information?

Website: Qvin - Empowering women. Period.

Press release: FDA clearance press release

Peer reviewed publications:

- A cross-sectional study comparing the inflammatory profile of menstrual effluent vs. peripheral blood
- Comparative Assessment of Serum versus Menstrual Blood for Diagnostic Purposes: A Pilot Study
- Screening for High-Risk Human Papillomavirus Using Passive, Self-Collected Menstrual Blood

- Novel use of menstrual blood for monitoring glycaemic control in patients with diabetes: a proof-of-concept study
- Concordance of HbA1c and reproductive hormone levels in menstrual and venous blood

About Dr. Sara Naseri

Dr. Sara Naseri, CEO and Co-Founder of Qvin, a global women's healthcare service leveraging menstrual blood for early diagnostics, graduated from Aarhus University, Denmark, in 2019.

Her extensive involvement in medical research spans prestigious institutions like Yale, Kyoto University, and Stanford University, where she focused on women's health and cervical cancer screening technologies.

Early in her career, at 16, Naseri co-founded Bucky'o'Zun, developing a UV-absorbing compound to protect against skin cancer, earning her the nickname "Ozone Girl" and numerous awards, including first place from the European Parliament in Intel Challenge Europe and Denmark's Female Entrepreneur of the Year in 2013.

Naseri, who has contributed to education and technology innovation advisory groups, is also a recognized speaker and was the youngest participant in Singularity University's Graduate Studies Program. Fluent in Danish, English, and Persian, her work aims to advance medical solutions and health standards globally.

Written by

Lily Ramsey

Lily holds a distinguished academic background, having earned a first-class degree in Microbiology from the University of Nottingham in 2021. Her pursuit of knowledge continued as she completed her LLM in Medical Law and Ethics at the University of Edinburgh. During her master's studies, Lily dedicated her research to the field of public health ethics, with a specific passion for health equity and justice, with a specialized focus on the ethical aspects of antibiotic resistance.

UK's first robotic genomic testing facility for cancer patients launches

From Automata Sep 6 2024

For the first time in the UK, robotic technology is being used to support genomic testing for cancer patients following a partnership between The Royal Marsden NHS Foundation Trust and Automata Technologies, a leading automation company powering automation in life sciences labs.

Image Credit: Automata

The innovative installation will double the Trust's genomics testing capacity and expand the range of tests it can perform within its existing laboratory space. Patients from the hospital and beyond will benefit from increased access to genomic testing, which can help identify potential risk of cancer, diagnose the disease, and personalise treatments. By automating repetitive and time-consuming tasks, it will also give laboratory technologists and scientists more time for vital development work.

Through Automata's LINQ platform, sample pathways for saliva, tissue biopsies, blood and bone marrow are being automated. LINQ is a 'smart' laboratory bench that houses and connects equipment using robotic and digital technology. Equipped with six robotic arms, the

specialist cancer center's installation will substantially increase the throughput of the cancer testing lab without compromising on accuracy.

As the cancer testing laboratory for the North Thames Genomics Laboratory Hub – one of seven hubs in England – The Royal Marsden currently provides somatic testing for North London, Hertfordshire and Mid and South Essex. This form of genomic testing identifies genetic changes in cancer cells that drive tumour growth and provides a target for personalised cancer treatment.

With increased capacity thanks to automation, the hospital will not only be able to process more somatic tests but also launch new genetic – or cancer germline – testing. This type of genomic testing identifies inherited genetic changes that can increase risk of cancer and, for patients with the disease, can also be used to identify the right treatments. It will primarily test for mutations in the BRCA genes, which can impact risk of various cancers including breast and ovarian.

The new testing capability will support research into genetics and cancer, such as the BRCA-DIRECT mainstreaming pilot. Led by Dr Clare Turnbull, Professor of Translational Cancer Genetics at The Institute of Cancer Research, London, and Consultant in Clinical Cancer Genetics at The Royal Marsden NHS Foundation Trust, with funding from the NHS Cancer Programme Small Business Research Initiative (SBRI) the project is aiming to boost BRCA gene testing access for breast cancer patients and their family members through a simple, digital pathway.

The new robotic facility is housed in the Sharjah Clinical Genomics Laboratory in the National Institute for Health and Care Research (NIHR) Centre for Molecular Pathology (CMP) at The Royal Marsden. The NIHR CMP is supported by funding from the National Institute for Health Research Biomedical Research Centre at The Royal Marsden and The Institute of Cancer Research, London, and The Royal Marsden Cancer Charity.

"Over 90 % of our genomics samples will pass through the new automated laboratory, which blends new and existing equipment to make the best use of space. Our highly qualified laboratory staff are delighted with the facility which has freed them up from repetitive and time-consuming tasks to focus on quality and service development.

The robots are flexible, efficient and fun to work with too. Excitingly, this system also has the potential to one day reduce costs and turnaround times which will benefit patients and the wider NHS. We are incredibly excited to be the first laboratory in the country to use this technology for genomic cancer testing and look forward to further developments in the future."

Professor Michael Hubank, Scientific Director of Clinical Genomics at The Royal Marsden NHS Foundation Trust and Professor of Translational Genomics at The Institute of Cancer

Research, London

> *We are proud that our partnership with The Royal Marsden has delivered the UK's first fully automated system for clinical cancer genomic testing. This collaboration marks just the beginning of what automation can achieve for the NHS and within healthcare more widely.*
>
> *By using end-to-end lab automation to increase genomic testing capacity, we're not only streamlining processes but also elevating national cancer care. Together, we're pioneering solutions that will redefine the standard of care and positively impact patient outcomes."*
>
> *Mostafa ElSayed, CEO, Automata*

About The Royal Marsden NHS Foundation Trust

The Royal Marsden opened its doors in 1851 as the world's first hospital dedicated to cancer diagnosis, treatment, research and education.

Today, together with its academic partner, The Institute of Cancer Research (ICR), it is the largest and most comprehensive cancer center in Europe seeing and treating over 59,000 NHS and private patients every year. It is a center of excellence with an international reputation for groundbreaking research and pioneering the very latest in cancer treatments and technologies.

The Royal Marsden, with the ICR, is the only National Institute for Health and Care Research Biomedical Research Centre for Cancer. This supports pioneering research work carried out over a number of different cancer themes.

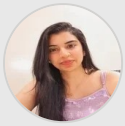
The Royal Marsden Cancer Charity raises money solely to support The Royal Marsden, a world-leading cancer center. It ensures Royal Marsden nurses, doctors and research teams can provide the very best care and develop life-saving treatments, which are used across the UK and around the world.

From funding state-of-the-art equipment and ground-breaking research, to creating the very best patient environments, The Royal Marsden Cancer Charity will never stop looking for ways to improve the lives of people affected by cancer.

Source:

Automata

What Role does Fermentation Play in the Pharmaceutical Industry?



By Arzoo Puri

Reviewed by Lily Ramsey, LLM

Pharmaceutical manufacturing using industrial fermentation techniques is becoming increasingly prevalent. This article discusses the role of fermentation in the pharmaceutical industry.

Image Credit: Gorodenkoff/Shutterstock.com

Introduction to Fermentation in Pharmaceutical Manufacturing

Fermentation is a method in which microorganisms or mammalian cells produce a variety of biomaterials, drugs, and metabolites in a regulated culture environment.[1]

Fermentation adheres to good manufacturing practices (GMP) guidelines for high-quality biopharmaceutical drugs. It involves both downstream and upstream processes.[2]

It can begin with either genetically engineered or untreated cells such as fungi, bacteria, mammals, or plants. Typically, large-scale fermentation activities are carried out in single-use

or stainless steel bioreactors.[2]

The Process of Fermentation and Its Importance

The fermentation process usually employs bacteria, fungi, or yeast to generate a specific therapeutic compound or intermediate, which is subsequently extracted and refined to make the final pharmaceutical drug. It is a low-cost and efficient approach commonly employed in the pharmaceutical sector.[3]

The "upstream process" refers to the microbial growth needed for producing pharmaceuticals or other biomolecules. It includes a series of events such as cell line and media selection, growth parameters, and cell growth condition optimization to attain pharmaceutical production.[4]

The primary purpose of the upstream fermentation process is to convert substrates into desirable metabolic products.[4]

Downstream fermentation processing includes purification methods that separate a biological product from cell culture medium by eliminating contaminants such as DNA, host cell proteins, and process-associated pollutants. It consists of three stages: initial recovery, purification, and polishing, which include centrifugation, filtration, and chromatography.[4]

Fermentation is vital in the production of new-generation products such as antiviral medicines, monoclonal antibodies and therapeutic recombinant proteins. [1]

Fermentation techniques can boost productivity and lower production costs by optimizing physicochemical conditions and improving media composition. [5]

It also provides scalability, allowing for large-scale manufacturing of pharmaceutical drugs with uniform quality.[6]

Applications of Fermentation in Drug Production

Fermentation finds diverse applications in drug production across various therapeutic areas. Examples include anticancer cytotoxic medications and vaccinations, anti-infectious disease antibiotics and hormonal disorder therapy drugs.[7]

Antibiotics: Molds produce the vast majority of commercially available antibiotics. However, gram-positive bacteria secrete certain antibiotic chemicals that have a bacteriostatic impact

on gram-negative bacteria. The first marketable antibiotic was 'Penicillin'.[1]

Vaisala is a biotech company that commercializes Penicillin, an antibiotic manufactured through fermentation. The *Penicillium chrysogenum* strain is grown in huge vessels using all of the necessary carbon and energy sources.[8]

Recombinant Proteins: Recombinant proteins are currently widely used to treat a variety of human disorders, including cancer and infertility. For instance, Tumour Necrosis Factor alpha (TNFa) receptor fusion proteins against rheumatoid arthritis and a range of monoclonal antibodies targeting cancer.[1]

There are various stages to consider, ranging from fabrication to application. This necessitates a genetically modified organism, effective fermentation processes, and a mode of transport into host cells. E.coli has been widely employed to produce recombinant proteins throughout the last few decades.[1]

Antivirals: Antiviral drugs are administered for the treatment of viral infections. Tamiflu, a widely used oral antiviral medication for the treatment and preventive measures against influenza, is produced using complex azide chemistry from shikimic acid, a fermentation product.[1]

Shikimic acid can be generated via microbial fermentation, chemical synthesis, and plant extracts. [9]

Innovations in Fermentation Technology

Fermentation technology advancements have accelerated the pharmaceutical sector's growth, improving process efficiency, output, and quality of the product.

One major advance is the creation of innovative bioreactor models and control systems, which allow for precise management of fermentation variables (parameters) to maximize yield and lower production costs.

GMI's winpact fermentator is a commercial example of fermentation technology advancements, featuring modular design for customization, controlled precision over critical parameters, scalability from laboratory to industrial manufacturing, and extensive storage of data for precise documentation and analysis.[10,11]

The modular architecture enables biotech companies to create fermenters based on their

individual project requirements, enabling flexibility and expansion. Advanced control systems enable ideal fermentation conditions, which are critical for producing high-quality goods at an industrial scale.[10]

Another innovative work used fermentation techniques to increase the yield of gentamicin and its analog, gentamicin C1a. Gentamicin concentrations (titers) increased by 11.5% with improved inorganic and organic salt conditions, resulting in a higher C1a ratio.[12]

Label-free proteomics showed that calcium chloride and sodium citrate impacted critical gentamicin production pathways.[12]

This research paves the way for co-producing gentamicin C1a and gentamicin, potentially advancing antibiotic production via fermentation processes.

The Future of Fermentation in the Pharmaceutical Sector

Fermentation is utilized commercially to produce drugs needed in the fabrication of diagnostic tests, medical devices and drug delivery vehicles. [1]

Stem cell therapy, which is currently in its early phases, might need fermentation technology in the near future to produce therapeutic cells on a massive scale to replace defective cells following surgical implantation.[1]

Another possible field of research is the fermentation of microspheres or biopolymers to create new medication delivery methods.[1]

As pharmaceutical research improve, the need for innovative and adaptive fermentation technologies will only increase.[11]

References

1. Rahman M. Medical Applications of Fermentation Technology. *Adv Mater Res*. 2013;810:127-157. doi:10.4028/WWW.SCIENTIFIC.NET/AMR.810.127
2. Fermentation in the Biopharmaceutical Industry | Eran Yona. https://eranyona.com/fermentation-in-the-biopharmaceutical-industry/. Accessed February 26, 2024.
3. Fermentation in the pharmaceutical industry. https://www.susupport.com/knowledge/fermentation/fermentation-pharmaceutical-industry-complete-guide. Accessed February 26, 2024.

4. Jozala AF, Geraldes DC, Tundisi LL, et al. Biopharmaceuticals from microorganisms: from production to purification. *Brazilian J Microbiol*. 2016;47(Suppl 1):51. doi:10.1016/J.BJM.2016.10.007
5. Carsanba E, Pintado M, Oliveira C. Fermentation Strategies for Production of Pharmaceutical Terpenoids in Engineered Yeast. *Pharmaceuticals*. 2021;14(4). doi:10.3390/PH14040295
6. Du YH, Wang MY, Yang LH, Tong LL, Guo DS, Ji XJ. Optimization and Scale-Up of Fermentation Processes Driven by Models. *Bioengineering*. 2022;9(9). doi:10.3390/BIOENGINEERING9090473
7. Production of pharmaceutical compounds through microbial fermentation. https://manufacturingchemist.com/production-of-pharmaceutical-compounds-through-microbial-fermentation-61614. Accessed February 26, 2024.
8. About us | Vaisala. https://www.vaisala.com/en/vaisala-company. Accessed February 26, 2024.
9. Tamiflu® (oseltamivir phosphate) | Prescription Flu Treatment. https://www.tamiflu.com/. Accessed February 26, 2024.
10. Winpact: Advancements and Innovations in Fermentation Technology | GMI - Trusted Laboratory Solutions. https://www.gmi-inc.com/winpact-advancements-and-innovations-in-fermentation-technology/. Accessed February 26, 2024.
11. About GMI | Global Medical Instrumentation, Inc. | Lab Equipment. https://www.gmi-inc.com/about-us/. Accessed February 26, 2024.
12. Yang P, Lin H, Wu X, Yin Y, Li J, Chen D. Proteomic Analysis of the Effect of CaCl2 and Sodium Citrate on Gentamicin Biosynthesis of Micromonospora echinospora SIPI-GM.01. *Fermentation*. 2023;9(12):997. doi:10.3390/FERMENTATION9120997/S1

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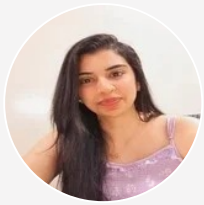

Written by

Arzoo Puri

Ms. Arzoo Puri has a Master's degree in biomedical sciences and believes that science is constantly advancing thereby creating new discoveries each day. She likes to utilize her skills and experience to contribute to the astounding medical advancements that take place every day. In 2022, she completed her master's dissertation and research training from Nanobios Lab, IIT-Bombay, India, and has finished her position as a scientific writer at Eureka, which she had undertaken while pursuing her masters. Her core interests lie in nanotechnology-based research, biomedical science and cannabis science. Her research goals are mainly directed toward the field of biosensors, point-of-care testing devices, bioimplants, drug delivery, medical diseases, and nanomaterials such as Graphene quantum dots.

Accelerate Your Research: Dispen3D Harnesses the Power of 3D Models

Sponsored Content by SEED Biosciences

Jul 12 2024

Reviewed by Lily Ramsey, LLM

In this interview, we speak with Charlotte Broennimann, Product Manager at SEED Biosciences, about their latest innovation, Dispen3D. This groundbreaking product revolutionizes single-particle isolation and dispensing, offering unprecedented precision and efficiency in cell culture techniques.

Charlotte explains how Dispen3D is setting new standards in single-cell biology, enabling researchers to conduct high-precision experiments that drive advancements in drug discovery, personalized medicine, and regenerative therapies. Discover the key benefits and transformative potential of Dispen3D in improving research outcomes and laboratory workflows.

Please introduce yourself; tell us about SEED Biosciences and your role as the Product Manager.

My name is Charlotte Broennimann. I hold an Engineering degree in Regenerative Medicine from the Swiss Federal Institute of Technology in Lausanne (EPFL). I am currently the Product Manager at SEED Biosciences, a biotechnology company specializing in developing innovative technologies for single-particle isolation and dispensing.

Our ambition is to set new standards in single-cell biology to accelerate the translation of precision medicine from research to personalized therapies. At SEED Biosciences, our goal is to simplify and democratize access to single-particle technologies, enabling researchers to perform high-precision experiments with greater ease and efficiency and tackle challenges in drug discovery, personalized diagnostics and medicine, gene and cell therapies, tissue engineering, and regenerative medicine.

SEED Biosciences recently launched its new product, Dispen3D, a single spheroid and organoid dispenser. Can you provide an overview of Dispen3D and explain why it is a significant advancement for researchers in cell culture techniques?

Dispen3D is an innovative single-particle dispenser that revolutionizes handling 3D cellular models. Intuitive and compact, it has been designed for fast, gentle, and traceable single-particle isolation and dispensing.

Using impedance-based dispensing technology together with advanced data analysis software, Dispen3D stands out as an ideal platform for precisely selecting and isolating individual spheroids, organoids, and tumoroids. It is a game-changer in drug screening and various other applications, marking a transition away from conventional animal models to advanced 3D models.

This innovative platform expands our range of single-cell dispensing solutions, allowing for the isolation and manipulation of cellular aggregates, encompassing spheroids, organoids, and tumoroids.

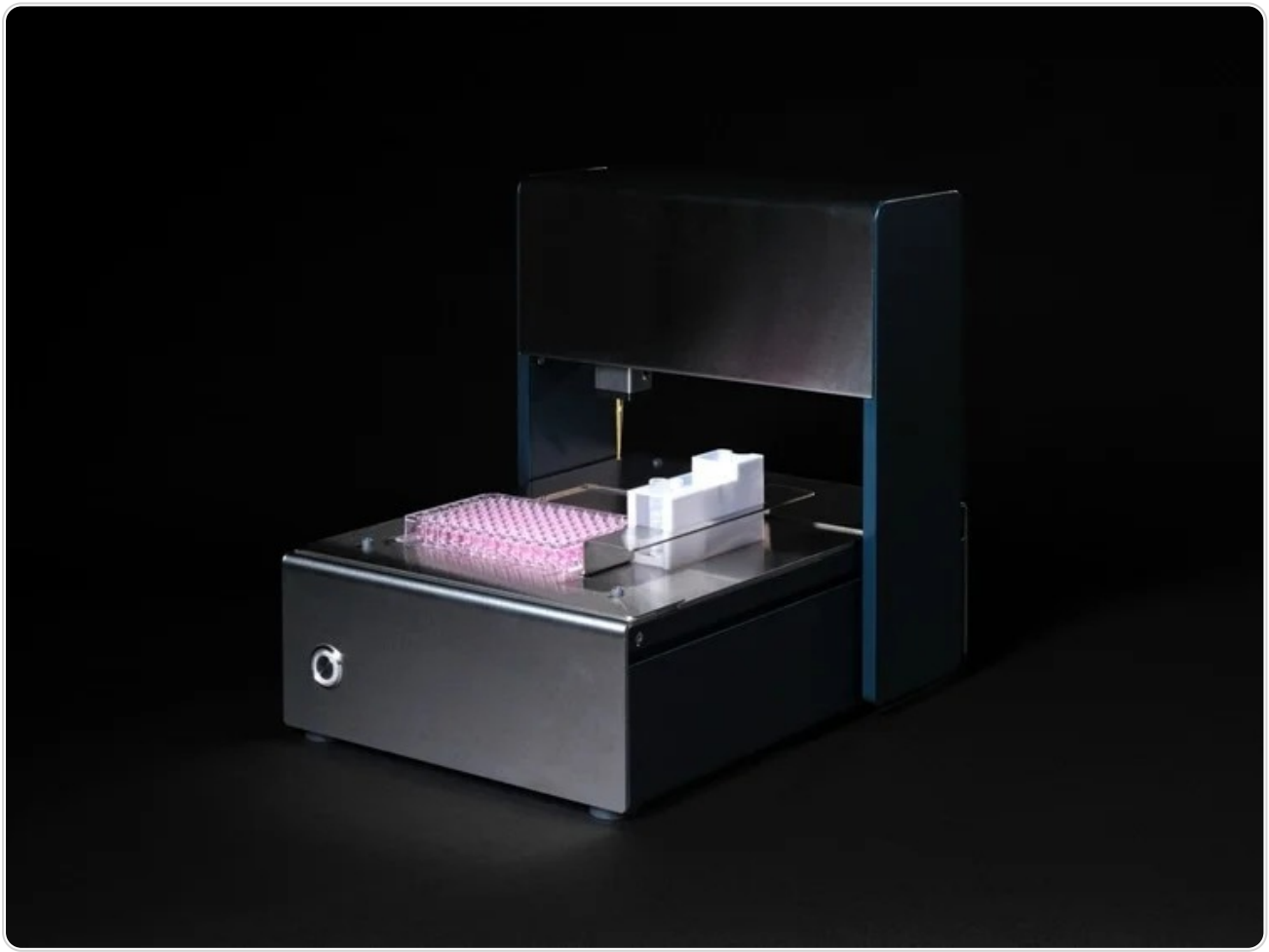

Image Credit: SEED Biosciences

What are the key benefits of Dispen3D that make it stand out from other products in the market?

Dispen3D is an intuitive and compact pipetting solution that allows scientists to isolate single spheroids and organoids three times faster and costs 10 times less than solutions currently on the market. The market opportunity for organoids and spheroids is significant and rapidly expanding.

These three-dimensional cellular structures, mimicking the complexity of human tissues more closely than traditional two-dimensional cell cultures, offer immense potential in various fields such as drug discovery, personalized medicine, and regenerative medicine.

Given their inherent clinical significance, 3D models such as spheroids and organoids are gaining importance. However, accessible solutions for manipulating and isolating them remain limited. Achieving consistent assay outcomes necessitates the capability to pre-select spheroids based on their size, shape, and internal structure and isolate them in all sorts of plates.

Currently, the industry standard for handling organoids and spheroids involves manual processes that are cumbersome and not very efficient in throughput, hardly reproducible and slow. On the other hand, complex, specialized equipment may not be readily accessible or scalable and is highly expensive. What sets Dispen3D apart is its ability to democratize access to advanced cell culture techniques.

Dispen3D provides a user-friendly and versatile platform that enables researchers across various disciplines to harness the power of organoids and spheroids without requiring extensive or specialized equipment.

The introduction of Dispen3D marks a groundbreaking shift in this landscape. It allows scientists to isolate spheroids and organoids efficiently, reliably, and cost-effectively in a plug-and-play manner, thus gaining considerable time and money.

How does Dispen3D integrate with existing laboratory workflows, and what advantages does this integration offer to researchers?

Dispen3D is designed to be compatible with a wide range of existing laboratory equipment, such as imaging systems, microplate readers, and automated workstations. This ensures that labs do not need to overhaul their existing setups to incorporate the technology. The software

controlling Dispen3D often comes with APIs and drivers that can interface with popular laboratory management systems and automation software.

This enables seamless data exchange and process synchronization. Its compatibility with the H_2O_2 sterilization process, ergonomic design, and traceable data allow Dispen3D to integrate smoothly into highly regulated industrial GMP workflows. Dispen3D enhances laboratory workflows by providing precise, efficient, and reliable liquid handling capabilities.

Its integration with existing lab equipment and software, combined with its numerous advantages, supports researchers in achieving high-quality, reproducible results while saving time and resources.

One of Dispen3D's highlighted benefits is its automation capability. How does this feature contribute to the efficiency and reliability of isolating large particles?

Unlike traditional methods, which may be labor-intensive and prone to inconsistencies, Dispen3D offers precise, automated dispensing of cellular aggregates.

This level of automation increases efficiency and reduces the potential for human error, ensuring reproducibility and reliability in experimental results.

Precision is crucial in scientific research. How does Dispen3D ensure versatile isolation and provide unambiguous proof of monoclonality?

Dispen3D ensures versatile isolation and unambiguous proof of monoclonality through a combination of precise dispensing technology, advanced detection, single particle traceability capabilities, and rigorous documentation. By leveraging these advanced features, Dispen3D supports researchers in achieving high standards of precision and reliability, which are crucial for scientific research.

Dispen3D is fitted with a sensing tip that acts as a Coulter counter. Particles that pass through the Coulter aperture to flow into the well leave electrical signatures that appear as peaks and are immediately recorded.

A single unique peak indicates that there is only one particle in the well — several peaks mean multiple cells and a small peak is a mark of debris. Dispen3D's tip is disposable, which ensures no cross-contamination.

Another major advantage mentioned is reproducibility. Can you discuss how Dispen3D helps reduce human error and ensures reliability in the research process?

Automated dispensing ensures that every sample is treated identically, enhancing experiment reproducibility. This is particularly important for validation and regulatory compliance in research and development. By automating the liquid handling process, Dispen3D reduces the potential for human error, leading to more reliable data.

Inconsistent handling of spheroids can lead to variability in experimental results. Ensuring that spheroids are handled gently and consistently is important for reproducibility and reliability of data.

Can you share any success stories or case studies where Dispen3D has significantly impacted research outcomes?

Spheroids offer several advantages over traditional 2D cultures, including better mimicking the in vivo environment of tissues. In recent years, it has become evident that spheroids are indispensable tools for both research and industry.

While structurally simple, high-throughput (HTP) production of spheroids for drug screening can be a challenge. Indeed, the commonly used processes can be labor-intensive and often lead to heterogeneous spheroids. This and the difficulty of seeding a single sphere per well hinder robust drug screening.

Thanks to microfluidics instruments from Live Drop, a specialist of droplet biology, and the SEED Biosciences Dispen3D dispenser, highly homogenous spheroids of the desired size can easily be manufactured at high speed and precisely seeded down to one spheroid per well. This collaborative work introduces a robust approach to efficiently producing and then isolating single homogeneous miniaturized spheroids.

The LiveDrop OneFlow is capable of generating 20,000 spheroids in just 10 minutes, while the Dispen3D can then seed these spheroids individually into wells at a rate of less than 7 minutes per 96-well plate.

The incubation of cells in nanoliter-scale droplets promotes cell contact, facilitating cell aggregation and accelerating spheroid formation. The Dispen3D's automated peak analyzer ensured a controlled seeding of the spheres with > 90% reliability, demonstrating the instrument's robustness. The Dispen3D software reports provide the time per plate, the number of elements seeded per plate, and the plate-filling rate.

Thanks to its robustness and simplicity, this unique workflow has the potential to explore new therapeutics and personalized medicine applications reliably.

Looking ahead, what are SEED Biosciences' plans for further innovations or improvements to the Dispen3D or other products in your lineup?

SEED Biosciences is focused on continuous innovation and improvement. By enhancing Dispen3D with advanced automation, facilitated workflow integration, and expanded capabilities; SEED Biosciences aims to remain at the forefront of scientific research and technological advancement.

Strategic collaborations and partnerships will further support SEED Biosciences' mission to drive progress in biotechnology and life sciences, ultimately leading to significant improvements in research outcomes and clinical applications.

On a personal note, what excites you the most about the advancements Dispen3D brings to the field of cell culture techniques?

The advancements brought by Dispen3D in cell culture techniques are exciting because they fundamentally improve the precision, efficiency, reproducibility, and versatility of laboratory workflows.

These improvements enhance the quality and reliability of research and enable new and innovative approaches to studying and manipulating cells. For researchers, these advancements represent a significant step forward in their ability to conduct cutting-edge research and make impactful scientific discoveries.

Where can readers find more information?

- www.seedbiosciences.com
- https://ch.linkedin.com/company/seedbiosciences

About Charlotte Broennimann

Charlotte Broennimann holds an Engineering degree in Regenerative Medicine from the Swiss Federal Institute of Technology in Lausanne (EPFL).

She has 7+ years of experience in microfluidics and impedance technology for single-cell isolation techniques. She conducted her research project, "Microfluidic generation of bilayered human mammary epithelial ducts," at the Lawrence Berkeley National Laboratory in California, gaining invaluable experience in 3D cell culture technology and cancer Biology.

After 5 years' experience in Business Development and Strategy, Charlotte is Product Manager at SEED Biosciences, an innovative Swiss company that provides single-particle isolation solutions to tackle challenges in drug discovery, personalized diagnostics and medicine, gene and cell therapies, tissue engineering, and regenerative medicine.

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Rheological Insights for Pharmaceutical Formulation Development

By Bhavna Kaveti

Reviewed by Megan Craig, M.Sc.

Rheology, the study of material flow and deformation, is a crucial aspect of pharmaceutical formulations. It provides important information on a formulation's physical characteristics, stability, structure, and drug release rate, which is necessary for determining the best administration route.

Image Credit: paulista/Shutterstock.com

What is Rheology?

Rheology is a branch of science that focuses on studying matter flow and deformation, which are often observed in fluids. The field of rheology traces its origins back to Ancient Greek, with the term "rheo" meaning "flow" in English.

While rheology has primarily focused on the flow of liquids, it has since been expanded to encompass the deformation of solids and the behavior of viscoelastic materials, which are materials that display the characteristics of both solids and liquids, depending on the forces or deformations they are subjected to.

Rheology, which is the study of material flow, is typically used for materials that display a time-dependent response to stress, and the flow is generally assessed using shear. The parameters of strain rate (γ) and stress (τ) are calculated from torque and flow rate measurements. Viscosity (η), which is the resistance of fluid to deformation, is given by the ratio of stress to strain rate, $\eta = \tau/\gamma$.

Rheology characterizes the consistency of various products based on two key factors: viscosity and elasticity. Viscosity generally signifies a substance's resistance to flow or thickness, whereas elasticity indicates its stickiness or structure.

Various flow behaviors exist, including Newtonian behavior, which exhibits a straight-line relationship between stress and strain rate, with no stress present at zero strain rate, similar to the elastic behavior in solids.

Other behaviors include plastic behavior, which only commences at a specific stress level, and pseudoplastic behavior, where viscosity diminishes as the strain rate increases. Occasionally, thickening occurs in the suspensions, but this was not observed.

Rheology in Life Sciences and Biomedical Sciences

Rheology, which is the study of the flow and deformation of matter, has become increasingly important in biology, enabling researchers to investigate molecules, cells, tissues, and organs. It has also helped address cardiovascular disease, cancer, and digestive and reproductive biology questions.

Rheology plays a vital role in vascular biology, including hematology. However, crucial rheological control problems also arise in digestive and reproductive biology. Studying rheologically induced structural or phase transitions in other biological flows is another key scientific area bridging the gap between the physical and life sciences. Examples of such flows include the blood, cytosol, mucus, saliva, synovial fluid, and tissue buckling.

Biological materials are typically referred to as viscoelastic materials because they exhibit both elastic and viscous responses. These materials are often highly anisotropic and exhibit distinct viscoelastic properties when subjected to deformation in various directions. The shape and growth pattern of cells and multicellular structures are significantly influenced by the viscoelasticity of the relevant external or internal matrices.

Rheology in the Pharmaceutical Industry

The pharmaceutical industry frequently deals with intricate substances and materials that exhibit complex flow behavior. This is due to the demand for various drug administration routes, which require a wide variety of consumables. Rheology is frequently employed to understand the mechanical behavior of these consumables.

To maintain the quality and authenticity of pharmaceutical products, it is crucial to verify their purities and identities. In the pharmaceutical industry, rheological methodology is often used to establish benchmarks against predefined standards. Additionally, consistency in manufacturing is critical for drug production, as it ensures that each batch is reproducible and identical.

Rheology is also used in cases where the solubility of pharmaceuticals must be carefully assessed, often to determine the appropriate transport mechanisms for the drug product. Using rheology, important flow properties can be evaluated to ensure the superiority of the final product.

Image Credit: Gorodenkoff/Shutterstock.com

Rheology in the Pharmaceutical Formulation Development

Rheological characterization instruments, including viscometers, play a crucial role in drug manufacturing by allowing manufacturers to directly influence the formulation and

development of drugs by analyzing the parameters and conditions that affect quantifiable product characteristics.

This capability to characterize rheological properties is crucial for determining the quality of raw materials, drug effectiveness, and, ultimately, the quality of the final product. Rheological techniques can offer valuable information, such as the overall cost of prescription healthcare, which is essential for ensuring the effectiveness of the product.

Measuring viscosity involves applying stress and inducing flow and then determining viscosity based on shear stress. This method is essential for evaluating the characteristics of a molecule, which can make it feasible to create reformulations using alternative ingredients.

Rheometers

A rheometer is an instrument commonly used in pharmaceutical industries to gauge the response of a liquid to an applied force. Viscosity measurements are frequently employed to gauge the resistance of a fluid, and a rheometer is employed to evaluate fluids for which a single viscosity value is insufficient.

There are two types of rheometer: shear and extensional. Shear rheometers use controlled instruments, such as a rotational cylinder of pipe, to induce stress. On the other hand, extensional rheometers are used to monitor the applied stress of hydrogen on a liquid.

Conclusion

In conclusion, rheology is a critical area of study in investigating substance flow and deformation, providing deep insights into the physical characteristics, stability, and structural behavior of materials. Its significance is particularly pronounced in life and biomedical sciences, where it is essential to comprehend the flow and deformation of biological materials.

In the pharmaceutical industry, rheology is central to handling complex substances and materials that exhibit intricate flow behaviors. Diverse drug administration routes necessitate a comprehensive understanding of rheological properties to ensure product quality, consistency, and authenticity.

Rheological characterization instruments, including viscometers and rheometers, are crucial in drug manufacturing, allowing for analyzing parameters that influence product characteristics. The ability to measure viscosity and evaluate molecular characteristics

enables the formulation of drugs with alternative ingredients, thereby impacting the overall cost of prescription healthcare.

As technology continues to advance, rheology remains a dynamic field that has influenced various scientific and industrial domains. The insights gained from studying material flow and deformation contribute not only to the fundamental understanding of substances but also to practical applications in fields ranging from pharmaceuticals to biomedical research, shaping the future of these disciplines.

See More: Optimizing a Drug's Pharmacokinetics

References and Further Reading

Wilson D. I. (2018). What is rheology? *Eye*, 32(2), pp. 179–183. doi.org/10.1038/eye.2017.267

How is Rheology Applied to Pharmaceuticals? Accessed on 12 January 2024

Rheology 101 – Learning the Basics Accessed on 12 January 2024

Schaefer, C., *et al.* (2022). Theme issue on complex rheology in biological systems. *Interface Focus*, 12(6). doi.org/10.1098/rsfs.2022.0058

Janmey, P. A., *et al.* (2007). Basic rheology for biologists. *Methods in cell biology*, 83, pp. 1-27. doi.org/10.1016/S0091-679X(07)83001-9

Further Reading

- All Drug Discovery Content
- Exploring the Structure-Activity Relationship (SAR) of Drugs
- Hit to Lead (H2L) Process in Drug Discovery
- Hot Melt Extrusion in the Pharmaceutical and Food Industries
- How is Additive Manufacturing Used in the Pharmaceutical Industry?

More...

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Written by

Bhavna Kaveti

Bhavna Kaveti is a science writer based in Hyderabad, India. She has a Masters in Pharmaceutical Chemistry from Vellore Institute of Technology, India, and a Ph.D. in Organic and Medicinal Chemistry from Universidad de Guanajuato, Mexico. Her research work involved designing and synthesizing heterocycle-based bioactive molecules, where she had exposure to both multistep and multicomponent synthesis. During her doctoral studies, she worked on synthesizing various linked and fused heterocycle-based peptidomimetic molecules that are anticipated to have a bioactive potential for further functionalization. While working on her thesis and research papers, she explored her passion for scientific writing and communications.

A Comprehensive Guide to Microwave Digestion Systems

By Damilare Adedeji

Reviewed by Megan Craig, M.Sc.

In the field of life sciences, preparing samples correctly and efficiently is critical. Microwave digestion systems play a key role in this preparation process, ensuring samples are broken down uniformly and quickly for accurate analysis. These devices heat and degrade various materials, including metals, plants, and medications, using microwave energy to prepare them for in-depth examination.

Image Credit: Vladimir Borovic/Shutterstock.com

These systems are divided into open and closed vessel types, catering to different sample sizes and processing requirements. Open vessel systems are better for larger samples but take longer, while closed vessel systems handle smaller samples more quickly. Constructed from materials like fluoroplastics and quartz, these systems are designed to withstand high temperatures and corrosive substances.

Microwave digestion systems, pivotal in life sciences, facilitate diverse analyses, including

elemental, protein, DNA/RNA, metabolite, and drug studies. Here, we explore their functionality, varied applications in life sciences, and notable commercial models.

How Microwave Digestion Systems Work

See our full range of equipment.

Microwave digestion is a simple yet powerful process. It heats samples in a sealed vessel using microwave radiation, quickly raising the temperature and pressure. This rapid heating breaks down the samples much faster than traditional methods like a hot plate or an oven.

A standard microwave digestion system includes a generator to produce the microwaves, a special cavity for placing the samples and a system to control temperature and pressure. The samples, typically mixed with a suitable solvent or acid and placed in vessels made of materials like Teflon or quartz, are then exposed to microwave energy.

Exciting water molecules and adding acids or bases homogenizes samples, making them ready for analysis. It is preferred over methods like ashing, which can lose analytes, or fusion decomposition, which is labor-intensive and suffers from interference. Microwave digestion is versatile, applicable across various industries, and works with a broad range of samples. The key to its effectiveness often lies in the choice of acid, with nitric acid being a common choice for organic samples.

Applications and Use Cases

With its many uses ranging from elemental analysis to forensic research, microwave digesting systems have established themselves as essential tools in the life sciences. These systems have a reputation for effectively preparing samples for various analytical methods.

Microwave digestion systems play an essential role in elemental analysis. They determine the concentration of elements in biological samples such as tissues, blood, and food, which is crucial for understanding biological processes and nutrient compositions. These systems also analyze environmental sample data, focusing on heavy metal contamination detection. This application is essential for maintaining the safety and health of the environment by monitoring contaminants and their effects on ecosystems and human health.

Another application for microwave digestion systems is protein analysis. They make quantifying total protein concentration in tissues and cells possible, which is critical for biochemistry and disease diagnostic studies. Furthermore, these systems investigate protein

changes, including phosphorylation and glycosylation. These modifications are crucial for understanding protein function and regulation, making an essential contribution to molecular biology and pathological research.

Microwave digestion is a crucial stage in extracting DNA and RNA nucleic acids from tissues and cells. This process is necessary to prepare samples for polymerase chain reaction (PCR) and other analytical techniques, which will progress genetic research and diagnostic studies.

These systems are essential for metabolite analysis as well. They make it easier to extract metabolites from tissues and cells, which is necessary for understanding metabolic pathways and their consequences in health and disease. These systems also help to measure specific metabolite concentrations, providing information about the organism's metabolic condition.

Furthermore, these systems are employed in drug discovery to degrade tissues and cells in preparation for drug screening assays. They also aid in analyzing drug metabolism and pharmacokinetics, allowing for faster development and testing of new pharmaceuticals.

Finally, microwave digesting systems are essential in forensic studies. They break down bones and tissues for DNA analysis, an important element of forensic identification. They are also employed in forensic toxicology to identify drug residues in hair and nails.

Image Credit: Matej Kastelic/Shutterstock.com

Commercial Examples

Microwave digestion systems are at the forefront of modern laboratory processes, with several key players in the industry developing sophisticated equipment.

CEM Corporation stands out with its innovative microwave digestion systems like the MARS 6 and recently introduced the BLADE, a game-changer in elemental sample preparation. Blending speed, simplicity, and performance, the BLADE epitomizes CEM's commitment to transforming sample prep. This system, designed by chemists for chemists, offers the fastest digestion. It features high-purity quartz vessels and snap-on caps for quick setup and a barcode scanner for efficient sample tracking.

Anton Paar has been a significant contributor to this field as well, especially with their Multiwave PRO system, which excels in flexibility, accommodating various microwave digestion and sample preparation methods. Their expertise spans over 40 years, offering instruments like the compact Multiwave GO Plus for routine samples and the versatile Multiwave 5000 for a range of applications from digestion to synthesis. The Multiwave series, with user-friendly features and efficient designs, caters to diverse laboratory needs, ensuring precision and convenience in sample processing.

Milestone Inc. has set the bar high with its ETHOS UP system, a standout in the microwave digestion market since 1988. Known for its high performance and user-friendliness, ETHOS UP brings precision to sample digestion, vital for accurate metals analysis in laboratories. This system operates at higher temperatures and pressures than traditional methods, allowing it to handle a wider range of samples with minimized cross-contamination and volatile loss. ETHOS UP exemplifies Milestone's commitment to effective, safe, and productive microwave sample preparation.

SCP SCIENCE has also made significant advances with its EasyPREP series, which offers a blend of automation and simplicity. Their systems, including the high-throughput NovaWAVE and the convenient DigiPREP graphite Block Digestion Systems, cater to a diverse range of applications. NovaWAVE stands out for its exceptional sample processing speed and ability to handle multiple samples simultaneously with independent methods.

Sources:

Santamaría, *et al.* (2013) Application of microwave digestion and ICP-MS to simultaneous analysis of major and trace elements in aerosol samples collected on quartz filters. dx.doi.org/10.1039/c2ay25724f

CEM Corporation. *CEM Introduces the Future of Microwave Digestion*. Available at: https://cem.com/uk/cem-introduces-the-future-of-microwave-digestion

Anton Paar. *Microwave Digestion Systems*. Available at: https://www.anton-paar.com/uk-en/

Labcompare. Microwave Digestion System / Microwave Digester. Available at: www.labcompare.com/.../

DEPALMA, A. PHD (2020). *How to Achieve Consistency with Microwave Digestion*. Available at: www.labmanager.com/how-to-achieve-consistency-with-microwave-digestion-21854

Raykol Group. Principle and Application of Microwave Digestion INSTRUMENT. Available at: www.raykolgroup.com/...lication-of-microwave-digestion-instrument.html

Milestone Srl. Quality analysis starts with great sample preparation. Available at: https://www.milestonesrl.com/products/microwave-digestion

CEM. *Microwave Digestion System*. Available at: cemcontenttype.s3.amazonaws.com/.../brochure-blade-b171-english.pdf

PerkinElmer Inc. *MPS 320 Microwave Digestion System*. Available at: www.perkinelmer.com/.../mps-320-w-16-mr-50-vessels-and-1dpc-n3136005

Daniel, C., et al. (2004) The nail and hair in forensic science. *Journal of the American Academy of Dermatology*, 50. pp. 258-61. doi.org/10.1016/j.jaad.2003.06.008

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Written by

Damilare Adedeji

Damilare is a seasoned content writer who brings stories to life with words. She has a knack for creating engaging and informative content tailored to diverse audiences. Whether it's a blog post, an article, or web content, Damilare's versatile writing style resonates with readers, driving meaningful engagement. She consistently deliver content that is both relevant and impactful. Outside of writing, Damilare enjoys playing chess and reading.