



Meeting Report

Practical Workshop on Replacing Fetal Bovine Serum (FBS) in Life Science Research: From Theory into Practice

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In life science research, cells and tissues are still mostly cultured using FBS (fetal bovine serum). Having just three unimpressive letters, the term FBS does not instantly give away any hints on the controversial issues that surround its use. FBS is collected from fetuses of slaughtered pregnant cows, raising ethical concerns about animal welfare (Weber et al., 2021). FBS use is further attributed with introducing problematic scientific issues into cell and tissue culture experiments, as FBS is associated with quality and reproducibility concerns (e.g., unknown components that vary from batch to batch) (van der Valk et al., 2018). In addition, FBS raises severe concerns relating to regulatory and legal issues as well as manufacturing and distribution aspects, which have been discussed controversially for decades (Hodgson, 1991, 1993; Jochems et al., 2002; Gstraunthaler et al., 2013). Hence, FBS still presents a substantial bottleneck in life science research, hindering the move to truly animal-free alternatives to animal experiments (van der Valk, 2022).

While FBS is still widely used for cell and tissue culture today, Hayashi and Sato already demonstrated in 1976 that serum can be replaced by hormones to promote growth and stimulate differentiation (Hayashi and Sato, 1976). Recently, issues related to FBS use are being discussed more broadly, approaches to transitioning to animal component-free cell cultures have been described (Weber et al., 2022), and an FBS-free database¹ with a modular approach to the development of serum-free media is available (van der Valk et al., 2010). However, scientists and lab technicians still receive no or very limited training in techniques to transition to FBS-free media. For this reason, the practical workshop on “Replacing Fetal Bovine Serum (FBS) in Research & Testing” was conducted in May 2022 by the Animal Welfare Academy of the German Animal Welfare Federation in collaboration with cellasys GmbH and kindly sponsored by the *Renate Bentlin-Stiftung für Nutztierschutz*. Thanks to the generous financial support, two separate full-day workshops were organized at the Animal Welfare Academy in Neubiberg (Germany). The practical workshop was initially planned in conjunction with the symposium on “Replacing Fetal Bovine Serum (FBS) in Research and Testing” in November 2020 (Weber and Wagner, 2021) but had to be postponed due to the COVID-19 pandemic.

The practical workshop started with a presentation by Dr **Joachim Wiest** (CEO of cellasys GmbH) on how to use micro-

physiometry to identify suitable serum-free cell culture medium (CCM) formulations. Microphysiometry enables *in vitro* measurement of the functions and activities of life or living matter, such as cells, tissues and organs, and of the physical and chemical phenomena involved on a micrometer scale (Brischwein and Wiest, 2018). Dr Wiest introduced the cellasys #8 test, which is an automated and standardized testing scheme to identify cellular changes in metabolism and morphology when cells are cultured in serum-free CCM. Whereas widely used weaning experiments take weeks or months, the cellasys #8 test identifies promising serum-free CCM formulations within 24 hours and thus reduces time and costs for scientists. Dr Wiest introduced case studies where FBS was successfully replaced with serum-free media. In addition, he presented the FBS-free database, which provides an overview of serum-free alternatives for specific cell lines with literature references.

Next, Dr **Sebastian Eggert** (CSO of cellasys GmbH) conducted three practical sessions in the cell culture laboratory with the participants. Participants were introduced to the hardware and software as well as the detailed handling steps of the cellasys #8 protocol. After learning all protocol steps, participants conducted them on their own to support future adoption. These hands-on demonstrations fostered compelling discussions about how FBS is still used in the participants’ labs and on participants’ efforts to transition to serum-free CCM. Participants exchanged knowledge about animal-free cell culture products and how they are using them in their laboratories. These discussions demonstrated that the workshop is not only informative to the participants, but also has a high potential to result in the subsequent replacement of animal-derived products directly after the workshop in the participants’ labs. The discussion confirmed that scientists are still not sufficiently trained on how to discover and utilize animal-free products for life science research. To make the protocol with its handling steps publicly accessible to the community, a video has been made available².

Finally, **Tilo Weber**, scientific officer at the Animal Welfare Academy of the German Animal Welfare Federation, gave a presentation titled “Towards the Truly Non-Animal Lab”. He summarized the current scientific and ethical issues with animal-derived reagents in cell culture, ranging from enzymes and cell attachment factors to media supplements and antibodies. Next, he

¹ <https://fcs-free.org>

² <https://www.youtube.com/watch?v=eSDCS2FMsPo>

presented available solutions and recommendations on how to move away from animal-based to animal-free products in cell culture. Mr Weber also highlighted the global survey on “The Use of Animal-Derived Materials and Reagents in Scientific Experimentation”, which studied commonly used animal-derived materials and reagents as well as the main issues perceived with the use and knowledge of non-animal replacements among 551 respondents from 52 countries. The study was conducted by Oltre la Sperimentazione Animale (OSA) in collaboration with the Joint Research Centre (JRC) of the European Commission (EC), the Technical University of Denmark, Eurogroup for Animals, the German Animal Welfare Federation, and the Centre for Predictive Human Model Systems. While the full publication provides in-depth insights into the landscape of animal-derived products used worldwide (Cassotta et al., 2022), a poster at the 11th World Congress on Alternatives and Animal Use in the Life Science already reported that serum is still the most used animal-derived product (Cassotta et al., 2021).

Taken together, the practical workshop equipped participants with practical skills to transit from serum-based to serum-free CCM and provided informative resources to support the transition phase. Moreover, the workshop connected scientists, mostly in their early career, who share the same problems with FBS, thus increasing their motivation to transit to animal-free products along with their next career steps. The organizers are convinced that such workshops are of paramount importance to draw attention to this topic, to increase awareness, and to offer practical hands-on support to foster the acceleration towards truly animal-free science in the near future. This requires the community and the stakeholders to work together with open eyes and open minds. As demonstrated by the introduction of the microphysiometry technology to identify suitable serum-free media, the community benefits from embracing and driving innovations, while knowledge and experiences are shared openly. The organizers will continue to host practical workshops on FBS replacement to perpetuate the paradigm shift towards a laboratory environment that is truly free of animal suffering. The authors are looking forward to receiving expressions of interest for future workshops.

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Conflict of interest

Dr Sebastian Eggert and Dr Joachim Wiest are employees of cellasys GmbH. Dr Joachim Wiest is a stakeholder of cellasys GmbH.

Sebastian Eggert¹, Joachim Wiest^{1,2}, Jessica Rosolowski³ and Tilo Weber³

¹cellasys GmbH, Kronburg, Germany; ²Technical University of Munich, Heinz-Nixdorf-Chair of Biomedical Electronics, Department of Electrical and Computer Engineering, TranslaTUM, Munich, Germany; ³Animal Welfare Academy of the German Animal Welfare Federation, Neubiberg, Germany