

Short Communication

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High-Performance Liquid Chromatography applications and challenges in developing countries: A short communication

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Abstract

Over the years, developing countries have utilized High-Performance Liquid Chromatography (HPLC) to conduct extensive research on local and global health-related issues. However, challenges such as scarce service engineers, lengthy shipment procedures for spare parts, and other factors hinder HPLC from working at full capacity. This brief communication discussed HPLC research in developing countries, identified challenges, and proposed beneficial strategies for users and potential buyers.

Keywords: HPLC, developing countries, maintenance

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High-Performance Liquid Chromatography (HPLC) is a vital analytical technique used to separate, identify, purify, and quantify components from a heterogeneous mixture or solution. It is utilized in various fields, including disease diagnosis, drug discovery, drug monitoring, bioequivalence research, and forensic toxicology [1]. It is widely used in developing countries for pharmaceutical and research purposes, but its costly maintenance and servicing can lead to instrument malfunctions. The disparity between developed and developing countries in terms of the availability of consumables, operation, and engineering with respect to bioanalytical equipment, particularly HPLC, has not yet been published in any scientific journal. Therefore, this communication provides suggestions for both users and manufacturers, aiming to improve research in developing countries. Over the years, developing countries have utilized HPLC to conduct extensive research on local health issues (Figure 1). Africa's tropical location, harsh climate, and poor agriculture practices expose agricultural products to mold contamination, leading to the production of toxic

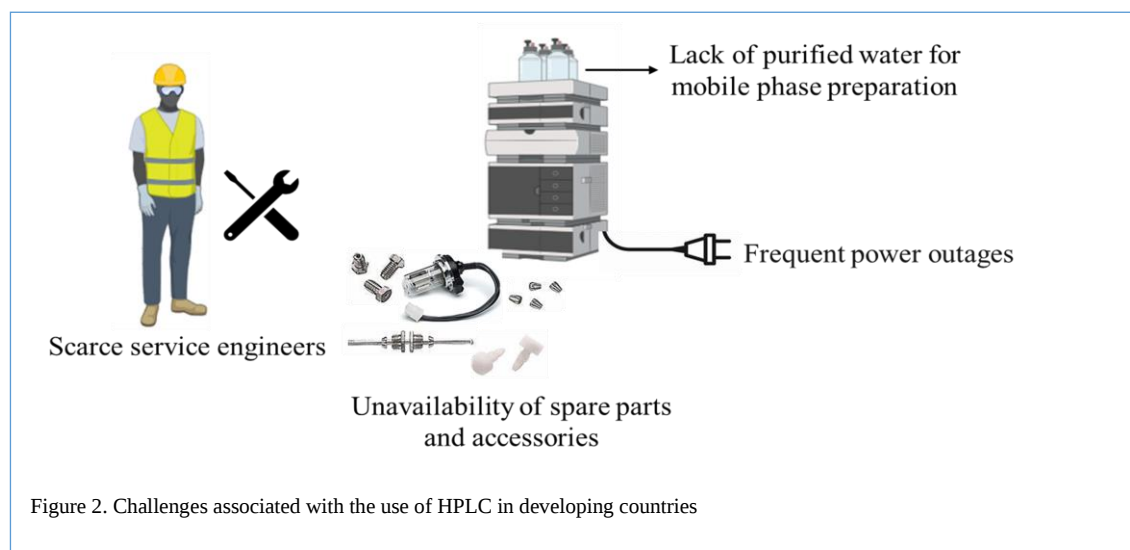
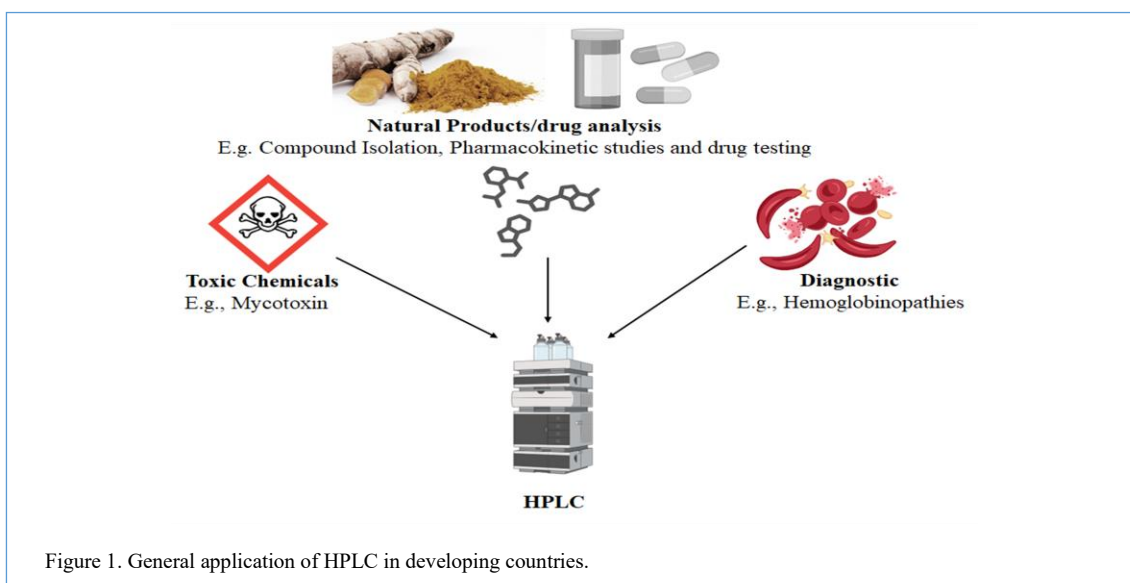
chemicals by fungi [2,3]. HPLC is used for quantitative analysis of mycotoxins like aflatoxin, ochratoxin and other toxins due to its widespread use. In addition, it is used to analyze pollutants such as pesticide residues [4], polyaromatic hydrocarbons [5], and other toxic chemicals that are significant in developing countries. Drug discovery, primarily natural product research, has become an important area in developing countries, where most people rely on traditional medicine for their primary healthcare needs [6]. The HPLC is utilized in checking for adulterants in herbal preparations, drug monitoring, compound isolation, and pharmacokinetics [8,9]. Cation-exchange HPLC is used in some laboratories to diagnose sickle cell haemoglobin variants and glycated haemoglobin due to its sensitivity and specificity, especially in sub-Saharan Africa, where most of the global burden of sickle cell anaemia occurs [7]. Despite the advancement in the application of HPLC in developing countries, there are critical setbacks, which include scarce service engineers, the availability of spare parts and consumables, and other factors such as poor quality water for mobile phase preparation, erratic power supplies, and limited laboratory space (Figure 2). HPLCs are largely manufactured in the USA, Europe, and Japan. Few of these manufacturers have

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agents in developing countries. This usually requires trans-continental travel by engineers for both installation and servicing at the client's expense. In Ghana, the main HPLC service engineers are Wagtech Ghana Limited and MES Equipment Limited, whereas in Nigeria, the primary engineers are Synapse Technologies and Labstock Nigeria Limited. Due to their high workload and limited availability of spare parts, HPLCs can be abandoned or malfunction for years, causing costly maintenance. In addition, most developing countries lack service contracts with manufacturers or contractors due to the high cost of such contracts, thus presenting a huge burden on research. Therefore, it is important for institutions to train technicians or HPLC users to perform software and basic hardware servicing, which may not require an expert. HPLC users could be trained in replacing lamps, fixing columns, tubing, and fittings, as well as pump seals and general

troubleshooting. It is also imperative for the institution to purchase supplementary parts while the equipment is functioning. Manufacturers of HPLC equipments should, therefore, critically assess this end-user need to expand their boundaries across developing countries and improve the quality of their products. Meanwhile, manufacturers such as Agilent, for instance, have a training university that renders both classroom training at Agilent facilities and online training for live e-learning, as well as on-site training at the customer's facility [8] that developing countries can access to build capacity in their staff to improve the performance of their equipment. Although developing countries' infrastructure has lately improved, further development is still required to enable equipment to operate at full capacity. Access to electricity has received little attention in developing countries [9]. Damage to equipment caused by powder fluctuation is common in developing



countries. HPLCs, like any other laboratory equipment, need a stable power supply during operation. A sudden power outage during HPLC operation can cause electrical damage and retain molecules in the system, requiring thorough purging afterwards. Hence, a voltage-uninterruptible power supply (UPS) is recommended for temporary system operation. Some laboratories have reliable UPSs, while others have UPSs with weak batteries or rely on ordinary voltage regulators, which may not be sufficient for the system's operation. Institutions should invest in a stable power supply to prolong the lifespan of their HPLCs, as it is costly to acquire or repair. The hazard of dust in developing nations, particularly in Africa, is terrible because the Sahara Desert, the world's largest dust source, contributes more than half of worldwide dust emissions [14], and this can have a great negative impact on HPLC. A clean laboratory space, free of dust, can significantly improve the performance of the equipment. The average higher temperatures in most developing countries, coupled with global warming, pose outrageous impediments [15] and could play a major role in the performance of high-precision laboratory equipment such as HPLC. For instance, a warm temperature can affect the temperature of the mobile phase and the overall performance under warm conditions; in this case, good air conditioning is needed to enhance optimal performance. Water is one of the basic solvents that is widely used in the preparation of the mobile phase for reverse-phase RP-HPLC. Buffers and other solvents that are not HPLC-grade could be filtered through microfilters.

Due to the low quality of water supply in developing countries, the purification of water to meet HPLC requirements is cumbersome. In some cases, the water purification system in some laboratories gets clogged with dirt frequently, and this requires filter changes, which, in the end, incur additional costs. Some laboratories rely on other laboratories that have water purification systems for distilled water. Low-quality distilled water can clog HPLC tubing and columns, increasing system pressure, detecting elevated backgrounds, and reducing tubing and column lifespan. Ghost peaks, also known as artifacts or erroneous peaks, are caused by unknown impurities, such as impure water [10]. It is, therefore, crucial to consider a sustainable source of purified water supply when purchasing HPLC. In summary, developing countries have utilized HPLC to address a wide range of relevant areas despite the challenges associated with its usage. Institutions should, therefore, enhance staff maintenance capacity and consider quality water and a stable power supply when purchasing it. HPLC manufacturers should prioritize the needs of HPLC users in developing countries.

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EOA conceptualized and drafted the manuscript.

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REFERENCES

1. Coskun O (2016) Separation techniques: chromatography. *North Clin Istanbul*. 3:156.
2. Anthony M, Ojochenemi A, Yemi A, Tahir N, Okechukwu O, Saidu M, Ayobami O (2014) Determination of Aflatoxins in Sesame, Rice, Millet and Acha from Nigeria using HPLC. *Chem Sci Trans*. 3:1516-1524
3. Hussin MS (2023) Detection Aflatoxin on the Imported Maize (*Zea mays* L.) Using HPLC in the Areas of Baghdad. *South Asian Research Journal of Biology and Applied Biosciences* 5:55–59.
4. Dione MM, Djouaka R, Mbokou SF, Ilboudo GS, Ouedraogo AA, Dinede G, Roesel K, Grace D, Knight-Jones TJD (2023) Detection and quantification of pesticide residues in tomatoes sold in urban markets of Ouagadougou, Burkina Faso. *Front Sustain Food Syst* 7:1-11
5. Ofosu IW, Larbi EA, Alale D, Ankar-Brewoo GM, Lutterodt HE (2022) Cooked rice products (Kwenkwen, Jollof, Fried-rice, Angwamo and Kanzo) as sources of polycyclic aromatic hydrocarbons and a potential public health concern. *J Food Nutr Res*, 10:467-475.
6. Amewu RK, Amoateng P, Arthur PK, Asare P, Asiamah I, Boamah D, Darko OI, Dzidzor AC, Ekuadzi E, Chibale K, Farrell SJ, Appiah-Opong R, Osei-Safo D, Read DK, Hugh GI, Yeboah-Manu D (2022) Drug discovery research in Ghana, challenges, current efforts, and the way forward. *PLoS Negl Trop Dis* 16:e0010645.
7. Adeyemo T, Ojewunmi O, Oyetunji A (2014) Evaluation of high performance liquid chromatography (HPLC) pattern and prevalence of beta-thalassaemia trait among sickle cell disease patients in Lagos, Nigeria. *Pan African Medical Journal* 18:.
8. Agilent University Equipment Training (chem-agilent.com).
9. Meles TH (2020) Impact of power outages on households in developing countries: Evidence from Ethiopia. *Energy Econ* 91:104882.
10. Wang Q, Gu J, Wang X (2020) The impact of Sahara dust on air quality and public health in European countries. *Atmos Environ* 241:117771.
11. Williams S (2004) Ghost peaks in reversed-phase gradient HPLC: a review and update. *J Chromatogr A* 1052:1–11