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The Chemometric Approach for Verification of Paracetamol Level in Pharmacies Products Using Spectrophotometer UV-Vis

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The objective of this study is to inspect paracetamol levels in Indonesian pharmacies and whether the level of paracetamol is matched the label given. The verification of paracetamol level using a chemometric approach such as partial least squares (PLS) and principal component regression (PCR) after measured with spectrophotometer UV. The outcome of this study showed the absorbance at 242 with an R^2 (0.9991) and the linear range at 1.0 – 6.0 $\mu g \cdot mL^{-1}$. The accuracy was satisfactory and obtained at 99.18%. The satisfactory outcomes revealed the identification method has a good potential to be used in inspecting the paracetamol level in pharmaceutical products. Furthermore, the chemometric method used as a statistical measurement showed that there was no specific distinction to the validated approach. Thus, this approach can be applied in pharmacy industries specifically for small industries to ensure the medicine's safety before being distributed to the pharmacies.

Keywords: Chemometric; Paracetamol; Spectrophotometric

I. INTRODUCTION

In this era, the pharmaceutical sector becomes a potential sector that contributes to the worldwide economy. It happens because the demand for fast medicines is increasing. Every year, there are new medicines with their advantages are distributed to the pharmacies. Nevertheless, several industries only think about the profit but sometimes they forget to study the quality of the products. Nowadays, it is normal to read a report about drug poisoning owing to the drug not being properly produced. Because of this issue, many stakeholders such as consumers, researchers, and even the government are interested to study the quality of the pharmacy products before distributing them to the pharmacies (Thanacoody & Anderson, 2020). Furthermore, a pharmaceutical product that has been manufactured should hand in hand with product quality. Thus, a perfect and fast technique must be found so the patient feels safe when applying for the medicines (Yaguchi-Saito *et al.*, 2021). One of the most popular drugs used without a prescription is paracetamol is known as acetaminophen and is even familiar with the term Over-The-Counter (OTC) (Bloukh *et al.*, 2021).

Paracetamol as presented in Figure 1 has many effects such as analgesic, antipyretic, and anti-inflammatory. Paracetamol can impede cyclooxygenase (COX) 1 & 2 productions (Garcia-Lopeze *et al.*, 2021). Paracetamol causes a light impact on COX 1 & 2 in peripheral tissues and because of this, the drug is dissimilar to other non-steroidal anti-inflammatory drugs (NSAIDs). Furthermore, several studies reported that paracetamol can increase blood clotting time (Pathan *et al.*, 2018). Thus, it can be applied to several ailments such as arthritis, fever, toothache, and muscle pain (Saroj *et al.*, 2022).

Started 2019 until now, the coronavirus-19 has become a huge issue in the world. The disease is very deadly with several symptoms, light or heavy, such as cold, fever, and

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breathing problems. Nevertheless, people with good immunity can handle the issue caused by COVID-19, and in order to tackle the symptoms they need an efficient drug and paracetamol is their choice. Moreover, several users combine the application of paracetamol with other pharmaceutical products as illustrated in Figure 2 (Saroj *et al.*, 2022).

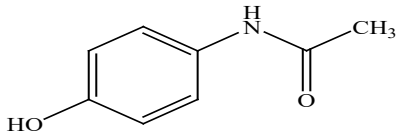

Figure 1. The chemical structure of paracetamol

Somehow, the inspection of a pharmaceutical product with several active compounds is a challenge for every researcher to rectify the medication system in pharmacy industries. It is also important for stakeholders to access the pharmaceutical products prior to distributing the pharmaceutical products to the pharmacies (Alshargabi, 2021). Furthermore, finding a modest, inexpensive, and swift technique is very important and at the same time, ensuring the technique does not disturb the accuracy, reliability, and precision of the outcomes. Several studies have reported the pharmaceutical products analysis (Aly & Nahed, 2017; Inayatullah *et al.*, 2021; Mohamed *et al.*, 2018). However, the application of HPLC and UV approaches are promising to do the verification of paracetamol level in pharmaceutical products (Dang *et al.*, 2020; Dave & Mashru, 2022; Alkhafaji & Mahood, 2019; Munir *et al.*, 2021; Palur *et al.*, 2020).

According to their studies, chromatographic methods are time-consuming and require too many solvents which is not suitable for quality control laboratories. Furthermore, analytical experts are required to operate the instruments. Meanwhile, spectrophotometric techniques are considered inexpensive and fast. This instrument is not only can be purchased and easily found in most labs but also can be operated by anyone who is not an expert in analytical instruments. The spectrophotometers offer substitute resolutions for complex mixtures of analytes with the requirement of prior separation or extraction (Tantawy *et al.*, 2021; Mohamed *et al.*, 2021; Munir *et al.*, 2022).

Finding a selective and sensitive method to analyse paracetamol in tablets and syrups using a modest technique has encouraged us to develop a spectrophotometric approach that can be applied for the determination of the various combination. This technique applied a handy procedure with slight modification and does not apply sophisticated tools. Furthermore, the solvent used should be an eco-friendly product such as the use of double-distilled water. The destination of this study is to stipulate a spectrophotometric method supported by a chemometrics technique to increase the selectivity of this study (Mishra *et al.*, 2021; Liu *et al.*, 2021; Kalogiouri & Samanidou, 2021; da Costa *et al.*, 2021). The application of chemometric techniques offers several advantages when applied for the verification of pharmaceutical products such as being free from disturbances and the determination being more accurate. Furthermore, the PLS application can improve the selectivity owing to the capability of PLS such as the errors can be minimised and the processing of data is faster with several absorbances and concentrations of analytes (Agrawal *et al.*, 2021; Chen *et al.*, 2021), whereas the least significant principal substances can be deleted by the PCR technique. The PLS and PCR models are specified by several parameters such as (1) root mean square error of calibration (RMSEC), (2) predicted residual sum of squares (PRESS), (3) root mean standard error of prediction (RMSEP), (4) root mean square error of cross-validation (RMSECV), and (5) merit figures that can be described into several parameters such as selectivity, sensitivity, detection limit, and quantification limit (Purwanto & Sudargini, 2021; Cheah *et al.*, 2021).