

Status of Hydrogen Peroxide Solution 10 V in Commercialized Samples

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Abstract

Hydrogen peroxide (H_2O_2) is one of the most powerful oxidants used in many sectors. Analytical method such as titration by permanganometry is used to maintain the quality of products containing H_2O_2 . Thus, the objective of this work was to evaluate commercial samples of H_2O_2 10 V by permanganometry. A difference of almost 3 volumes was found in the analysis of the samples. These results can be real or assigned to the potassium permanganate solution, not automation of the results and/or instability of the H_2O_2 solutions, for example. The main issue is, in addition to alerting the consumers to adequate storage of H_2O_2 solutions, to alert the scientific community to the need for concomitant analysis methods for unstable products such as H_2O_2 10 V solutions in order to avoid doubts on the results and make the manufacturers aware of these quality tests.

Keywords: Hydrogen peroxide; Titration by permanganometry; Potassium permanganate; Commercial samples

Introduction

Hydrogen peroxide (H_2O_2) is one of the most powerful oxidants. Its use must be conducted safely and responsibly to avoid risk of burns and explosions [1].

The first commercialization of H_2O_2 dates back to 1800 and it is used in various sectors such as odor control, textile industries, medical area, food, pharmaceutical, water and sewage treatment [2-5].

Product quality must be monitored using analytical methods during the production process and before being released to the consumer market. They must meet the required specifications and follow good manufacturing practices [6].

Considering the importance of hydrogen peroxide on the global scene in the treatment of disinfecting wounds, partly because of its low cost and prompt availability compared to other antiseptics, the development of practical, economical and reliable analytical methods, which can be used in the quality control of this substance, is essential and highly relevant, seeking the therapeutic efficacy, patient's safety and also benefits for the pharmaceutical industries and compounding pharmacies.

Analytical methods are tools to evaluate the level of quality and suitability of products and materials. They include titration, spectrophotometry, chromatography, spectroscopy, among others.

Titration is a quantitative analysis method used to determine the concentration of many active pharmaceutical ingredients such as tetraphenylborate sodium, phenothiazine compounds, acetaminophen, captopril, ascorbic acid, albendozole, sparfloxacin, salbutamol sulfate, montelukast sodium, phenylephrine hydrochloride, candesartan cilexetil [7-17].

When titration is by oxide-reduction reactions there is the transfer of electrons from one species to another. The methods of oxidationreduction volumetric are given specific names, depending on the substance used for the determinations [18].

Iodimetry=reactions involve the oxidation of iodide to iodine

Iodometry=reactions involve the reduction of iodine, reducing it from I0 to I-1

Permanganometry=reactions involve the reduction of manganese, reducing it from Mn^{+7} to Mn^{+2}

In this context, the objective of this work was to evaluate commercial samples of H_2O_2 10 V by permanganometry and discuss their status.

Materials and Methods

Material

Seven samples of H_2O_2 10 V, named A, B, C, D, E, F and G, commercially available from Araraquara city (Brazil) were used.

Method

The H_2O_2 analysis was performed by the permanganimetric method, in which the dosage is made directly in the sample, using titration of 0.1 M potassium permanganate solution (KMnO₄) [19].

To determine the H_2O_2 concentration, 1 mL of H_2O_2 solution to be analyzed was added to conical flasks A to G adding 100 mL of purified water, to facilitate titration, and 5 mL of sulfuric acid solution (H2SO₄) 1:5.

The contents of the Erlenmeyer flasks were titrated with 0.1015 M $KMnO_4$ solution, previously standardized with oxalic acid, until the color changes to the first permanent pink for 30 seconds. This procedure was performed 3 times for each sample.

Calculations for the determination of H_2O_2 content in the samples were based on the following Correspondences

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Real volume of $\rm KMnO_4$ used in the analyzes considering the concentration of $\rm KMnO_4~0.1015~M$

Consider the correspondence

1 mL KMnO₄ 0.1 M=1.701 mg H_2O_2

Consider the correspondence 3 %=3 g H₂O₂=100 mL sample

3 %=30 mg H₂O₂=100 mL sample

Consider the correspondence

34.02 g H₂O₂=16 g O₂

Consider the correspondence

1 mL O₂=0.0014301 g O₂

Results

The results of H_2O_2 determination in the seven analyzed samples are presented in Table 1.

Sampl e	Volume of the 0.1 M KMnO ₄ solution (mL)*	RSD (%)	Content (%)	Content (V)
Α	17.56	0	2.99	9.82
в	14.21	0.5	2.42	7.95
С	17.46	0.41	2.97	9.77
D	17.36	0	2.95	9.71
E	16.24	0.44	2.76	9.08
F	19.49	0.37	3.32	10.9
G	14.31	0	2.43	8.01
*Volume (mL) of 0.1 M KMnO ₄ solutions - blank volume (0.1 mL)				

Table 1: Titration results of $\rm H_2O_2$ 10 V samples using 0.1 M $\rm KMnO_4$ solution.

Discussion

Quality Control is a very important step in the process of drug manufacturing, as it ensures its safety and efficacy. Thus, research on quality control of pharmaceutical products to identify the content of active and the study of physical and chemical characteristics of the drug are essential to ensure the quality of the final product.

Titration is a simple, low cost, accessible and precise method and there is no need of using reference standards. It is used in the analysis of diverse products by laboratories, research centres and even chemical-pharmaceutical industries. However, large amounts of sample (mg), non-automation of results, low specificity and substances with evaporative capacity can be disadvantages of titration [20-22].

In this context, titration stands out. It is a technique which can use low toxicity organic solvents and, although it is formally accepted for the identification of individual compounds, it also allows the quantitation of substances. In addition, the titration is a simple, fast, and economical method, making it a widely employed and extremely versatile technique [23-25]. The titration technique using KMnO₄ is widely used in the analysis of H_2O_2 content. The permanganimetric method is used to determine H_2O_2 content using the oxide-reduction principle. Manganese is the oxidizing species and peroxide is the reducing agent.

As the most used unit of concentration for H_2O_2 is the volume it was necessary to calculate the volume concentration (V) of the H_2O_2 solutions under analysis.

The tests of contents are necessary and important in the logistics of total quality and maintenance of the suitability of products in general. They also reveal the level of quality of process.

Seven samples of H_2O_2 10 V were analyzed for their content by the permanganimetric method. Results ranged from 7.95 (sample B) to 10.90 (sample F), a difference of almost 3 volumes. This represents almost 30% of content in volumes.

However, a broader discussion about $\rm KMnO_4$ solution, not automation of the results and/or instability of the $\rm H_2O_2$ solutions is valid.

It should be considered that potassium permanganate, although inexpensive, does not have characteristics of a primary standard, requiring prior standardization, as well as self-decomposition when exposed to light, reducing the concentration of the solution used as standard.

When the results are obtained based on the visualization of the color change, this can lead to differences and values that are significantly different from one analyst to another and the lack of automation of the results can impart false conclusions.

 $\rm H_2O_2$ decomposes very easily. This fact coupled with the suitability to the expiration date can lead manufacturers to work higher concentrations, aiming that until the end of the expiration date the concentration is that indicated in the label.

The association of methods for quality control of H_2O_2 10 V can also be considered when there is doubt about a result or procedure [26].

Therefore, the standardization of some factors that can interfere with the analysis and consequently the results should be fixed. This ensures the reliability of methods and processes. It is part of the rigor of quality that each establishment prizes for its products [27].

The disclosure of results like these are important for the current quality awareness of $\rm H_2O_2$ 10 V marketed widely and used by numerous people for various procedures ranging from disinfection to oral antiseptic.

This work is also a warning for any other product that contains $\rm H_2O_2$ in its formula. The same parameters cited in this study should be considered and evaluated.

So, the main issue is, in addition to alerting the consumer to adequate storage of H_2O_2 solutions, to alert the scientific community to the need for concomitant analysis methods for unstable products such as H_2O_2 10 V solutions in order to avoid doubts on the results and make the manufacturers aware of these quality tests.

Conclusion

The quality of H_2O_2 10 V samples was evaluated and they showed almost 30% less content (in volumes). This academic research is an alert to the scientific community to the need for concomitant methods

of analysis for this type of product and to make manufacturers aware of these quality tests. Moreover the importance of good storage to keep the quality of product and as well as the guaranty the stability of pharmaceutical products should be a concern.

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