



Evaluation of the Paper Quality of Antibacterial Discs Commercially Available in Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author COE designed and supervised the study. Authors PME and EEA managed the laboratory analyses. Author PME managed the literature searches and data analysis. All authors read and approved the final manuscript.

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ABSTRACT

Aim: A wide range of antibacterial discs are commercially available in Nigeria that are either manufactured locally or imported. The quality of papers used in the manufacture of these discs can play a considerable role in their performance during antibiotic susceptibility testing, as there may be variations in the quality and characteristics of papers used by different manufacturers. This study was undertaken to evaluate and compare the quality of papers used in the manufacture of six brands of commercially available antibiotic discs in Nigeria.

Methodology: In the evaluation of the disc-paper qualities of the brands under study, parameters like paper thickness, weight, diameter, and water absorbability were used in comparing the various brands.

Results: Variations were observed in the thicknesses, weights, water absorbabilities and diameters of the disc-papers of all the brands of antibiotic discs under study. These variations will grossly affect the results of antibiotic susceptibility tests when different brands of antibiotic discs with different paper qualities are used.

Conclusion: It is imperative that the use of a specified disc paper is necessary for standardizing the performances of the products of various manufacturers and also,

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regulatory agencies should establish specifications for which manufacturers must comply as to the nature and quality of papers used in the manufacture of antibiotic discs.

Keywords: Antibiotic susceptibility test; antibacterial (antibiotic) discs; disc-paper; quality.

1. INTRODUCTION

With the introduction of a variety of antimicrobials it became necessary to perform the antimicrobial susceptibility test as a routine. For this, the antimicrobial contained in a reservoir is allowed to diffuse out into the medium and interact in a plate freshly seeded with the test organisms [1]. A variety of laboratory techniques can be used to measure the *In vitro* susceptibility of bacteria to antimicrobial agents. These include disc diffusion, and broth and agar dilution techniques [2].

The disc diffusion method of antimicrobial susceptibility test is the most practical method and is still the method of choice for the average laboratory [1].

The testing of organisms for sensitivity to antibiotics has always presented a problem to the clinical test laboratory. This problem has increased with the introduction of every new antibiotic. The most accurate method of performing this task is by controlled tube dilution tests which unfortunately are time-consuming and can only be used routinely in some specialized hospital laboratories. The use of the dry antibiotic disc seemed a logical solution. It was introduced as a simple and accurate means of screening and has received wide acceptance in hospital laboratories [3].

An antimicrobial susceptibility test disc is described in the FDA regulation, 21 CFR 866.1620(a) as a "device that consists of anti microbic-impregnated paper discs used to measure by a disc agar diffusion technique or a disc broth elution technique the *In vitro* susceptibility of most clinically important bacterial pathogens to antimicrobial agents [4].

The WHO Expert Committee on Antibiotics had recommended that for general clinical use the method for testing microbes isolated from patients for their susceptibility or resistance to various antibiotics should be one in which filter paper discs impregnated with antibiotics are applied to the surface of inoculated culture media in plates. The Expert Committee on Antibiotics had concluded that careful control of the uniformity of antibiotic contents in the discs was of utmost importance to the success of such tests [5].

According to the second report of the WHO Expert Committee on Antibiotics on 'the Standardization of Methods for Conducting Microbic Sensitivity Tests' the antibiotic disc should be made of an absorbent material, usually paper, which has no interfering effect either on bacterial growth or on the action of the antibiotic. It must be capable of absorbing moisture rapidly and the antibiotic should be evenly distributed in it. A diameter of 5-7mm is preferable to a larger diameter. Thickness should be sufficient to ensure rigidity and to permit the complete absorption of an adequate volume, e.g., 0.02mL of antibiotic solution [6].

A wide range of antibiotic discs are commercially available in Nigeria that are either manufactured indigenously or imported. The quality of papers used in the manufacture of these discs play a considerable role in the performance of these products during sensitivity testing, as there may be variations in the quality and characteristics of the papers used by different manufacturers.

Kramer and Kirshbaum [7] showed that differences in performance were observed when discs containing equal concentrations of antibiotics, but prepared from different grades of papers, were used in antibiotic susceptibility testing.

They stated that the use of a specified disc paper is necessary for standardizing the performances of the products of various manufacturers and that reproducible result can be attained with the grade of paper specified. The specifications of these papers vary somewhat as to weight, thickness, and absorbability of water. For this very reason, paper must play a major role in the standardization of discs [7].

It is therefore, imperative that procedures be established for the evaluation of paper grades used by different manufacturers in the manufacture of antibiotic discs. Also, regulatory agencies should establish specifications for which manufacturers must comply as to the nature and quality of papers used in the manufacture of antibiotic discs.

In this study, it was decided to carry out a survey of antibiotic discs on the Nigerian market. Market samples were then obtained and assayed. Parameters used to assess and compare the qualities of papers used in producing antibiotic discs that are used in Nigeria include: weight, diameter, thickness and water absorbability.

2. MATERIALS AND METHODS

2.1 Material

Six brands of antibiotic susceptibility discs were used in this study. Two imported brands (Oxoid and Abtek) and four locally manufactured brands (Optudisc, Polydisc, Maxidisc, and Jirehdisk).

2.2 Method

The six brands of antibacterial discs were evaluated for their disc paper quality by determining and comparing their disc paper characteristics (such as thickness, weight, diameter and water absorbability).

2.2.1 Thickness

Ten (10) pieces of discs from each brand were arranged in stacks and their thicknesses determined using a pair of verniercalipers. The mean thicknesses were calculated by dividing the respective values recorded by discs from each brand by 10.

2.2.2 Weight

The weights, in mg, of 10 discs from each brand were determined using an electronic weighing balance. The mean weights were calculated by dividing the respective values recorded by discs from each brand by 10.

2.2.3 Water absorbability

The water absorbability of the discs was analysed by placing 10 pieces of discs from the respective brands, in different test tubes containing 1mL of distilled water. After about 2 minutes of immersion, the discs were removed and the volume of water remaining in the tubes was measured. The water absorbability of the discs was regarded as the volume of water absorbed by the discs, and this is gotten by subtracting the value volume of water remaining after removing the discs from the tubes, from the value of the initial volume of the water (1mL). The mean water absorbabilities were calculated by dividing the respective values recorded by discs from each brand by 10.

2.2.4 Disc diameter

Using the verniercalipers, the diameters of individual antibiotics discs from the respective brands were measured in triplicate and their respective means calculated and recorded.

To create an equal platform for comparison, discs of all the brands containing the same antibiotics with similar stated antibiotic concentrations/label claims, were used in this study. Gentamicin discs were considered (this was also due to the solubility of gentamicin in water, in regards to the determination of water absorbabilities of the discs).

3. RESULTS AND DISCUSSIONS

3.1 Result

Table 1 shows the product presentation and characteristics of the different brands of antibacterial discs evaluated in this study.

The mean weights of antibiotic disc-papers, water absorbability properties, mean thicknesses of antibiotic disc-papers, and mean disc diameters of antibiotic disc-papers of the various brands of antibiotic discs are shown in Fig. 1-4 respectively.

3.2 Discussion

The laboratory testing of antibiotic susceptibility contributes directly to patient care and data generated from an antibiotic susceptibility test serves as a guideline for deciding therapy [8]. Thus, the antibiotic test report can have a powerful influence on antibiotic usage and hence on the factors that facilitates the emergence of antimicrobial drug resistance. Therefore, it follows that the test has to be a highly standardized one, performed using standard reagents, discs and with appropriate strains as quality control strains. The antibiotic discs themselves serve as one of the key parameters of this test. To obtain accurate and reproducible results, a key point is the quality of the discs [9].

The manufacture of antibiotic discs and their successful use involve a number of considerations: The quality of antibiotic, the composition of the discs (paper, tablet or other construction), test performance, etc. [3].

Table 1. Product presentation and characteristics of the different brands of antibiotic sensitivity discs evaluated

Brand Name	Country of Manufacture	Format and Characteristics of disc	No. of discs per multidisc panel	Spatial Orientation of Discs (Distance Between Discs)(mm)
Oxoid	UK	Single discs.	NA	NA
Abtek	UK	Multidisc with centre cut out for growth control. Neatly cut discs.	8	16
Optudisc	Nigeria	Mutidisc with centre cut out for growth control. Discs are rough and unequal in size.	10	6-8
Polydisc	Nigeria	Mutidisc with centre cut out for growth control. Fairly neatly cut discs.	10	8
Maxidisc	Nigeria	Mutidisc with centre cut out for growth control. Discs are rough and uneven in outline	10	7-10
Jirehdisk	Nigeria	Mutidisc with centre cut out for growth control. Discs are rough and uneven in outline	10	8-10

NA - Not applicable

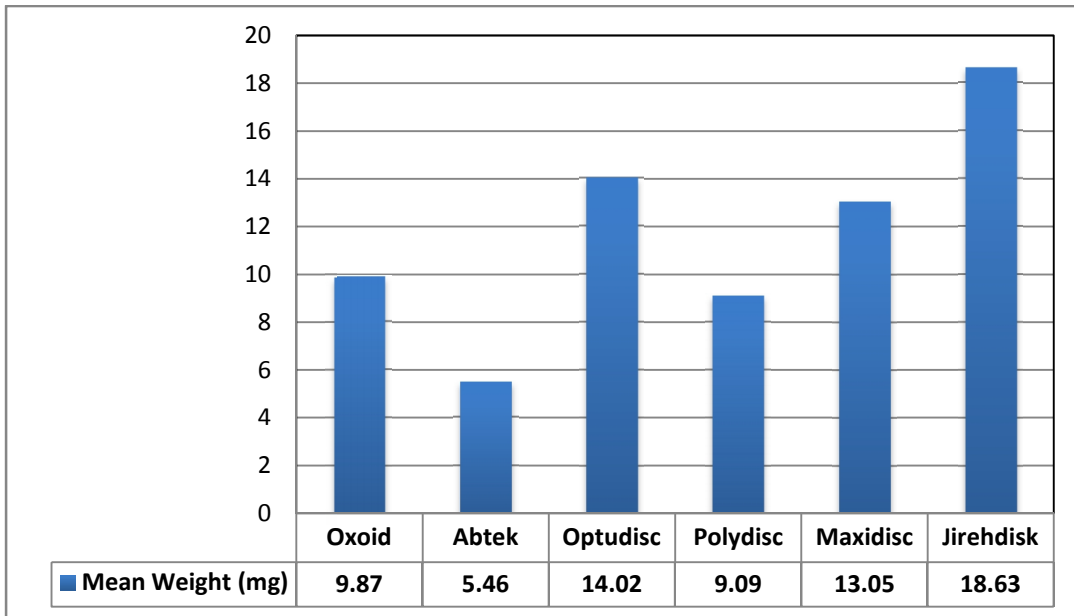


Fig. 1. Mean weights of antibiotic disc-papers of the various brands of antibiotic discs

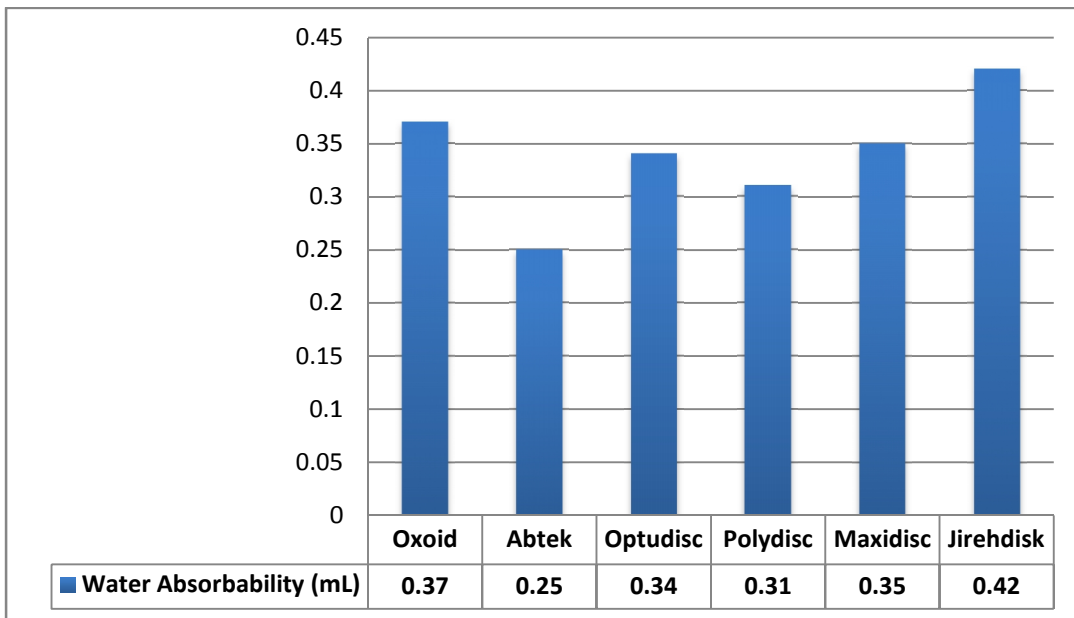


Fig. 2. Mean water absorbabilities of antibiotic disc-papers of the various brands of antibiotic discs

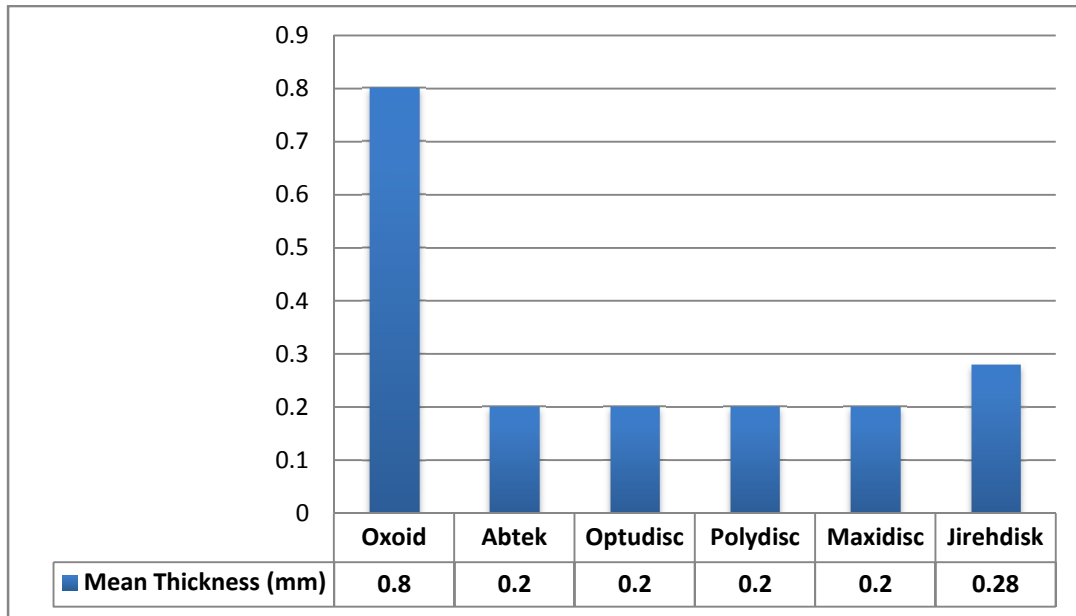


Fig. 3. Mean thicknesses of antibiotic disc-papers of the various brands of antibiotic discs

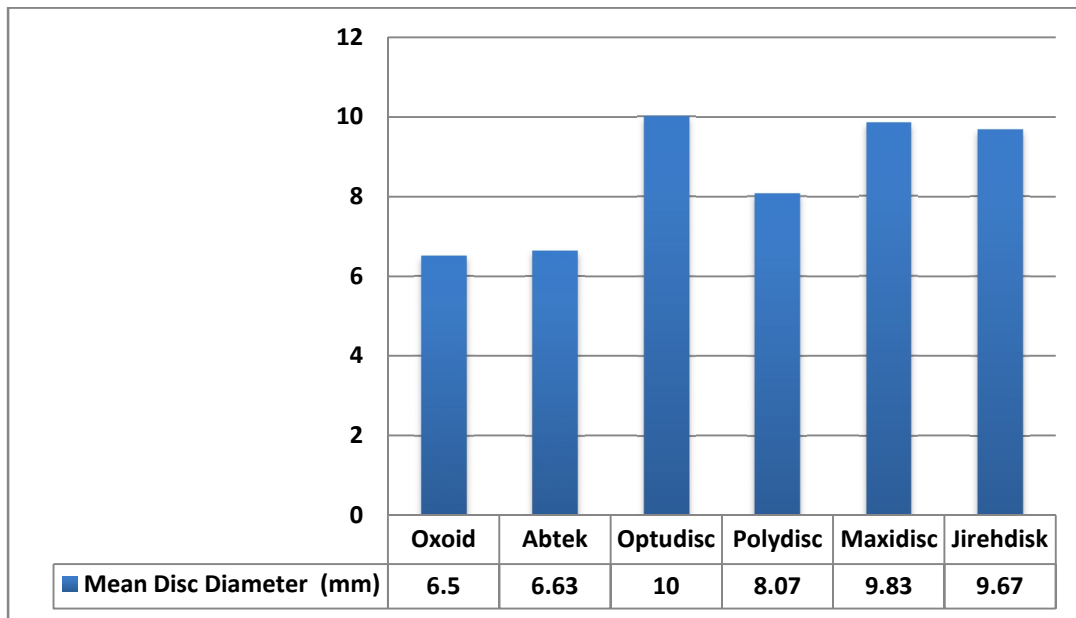


Fig. 4. Mean disc diameters of antibiotic disc-papers of the various brands of antibiotic discs

According to Kramer and Kirshbaum [7], the characteristics of the paper used are an important consideration in the manufacture of sensitivity discs. They observed differences in

performance when discs containing equal concentrations of antibiotics, but prepared from different grades of papers, were used in antibiotic susceptibility testing.

In this study, variations were observed in the thickness, weights, water absorbabilities and diameters of the disc-papers of all the brands of antibiotic discs evaluated. Fig. 1 to 4 shows the differences in weight, water absorbability, thickness, and diameter of discs all brands. Fig. 4 reveals the nonconformity of the brands to the WHO specification which require discs to be within 5-7mm in diameter [6]. Only the Oxoid and Abtek brands, which possess diameters of 6.50mm and 6.63mm respectively, complied with the WHO specification for disc diameter.

Of all the discs evaluated, only the Oxoid brand was presented as single discs which permit its usage according to the WHO recommendation of not more than seven discs per 90 mm plate [10]. The other discs were presented in multidisc panels which contains more than seven discs per panel and the proximity of one antibiotic disc to another may result in the merging of the zones of inhibition produced by the antibiotic discs during susceptibility testing to produce zones of inhibition that are un-interpretable as confirmed by Ekundayo and Omodamiro [11] who evaluated the quality of locally manufactured antimicrobial susceptibility testing discs used in South Eastern Nigeria.

These variations will grossly affect the results of antibiotic susceptibility testing when different brands of antibiotic discs with different paper qualities are used.

4. CONCLUSION

The use of a specified disc paper is necessary for standardizing the performances of the products of various manufacturers and that reproducible result can be attained with the grade of paper specified [7].

It is therefore recommended that the various procedures for the evaluation of paper grades as described in this work, or more standardized and effective procedures be adopted or established for used by different manufacturers in the manufacture of antibiotic discs; and also by national regulatory agencies for the evaluation and verification of antibacterial discs entering the Nigerian market. Also, regulatory agencies should establish specifications for which manufacturers must comply as to the nature and quality of papers used in the manufacture of antibiotic discs.

Furthermore, the number of discs on a multidisc panel for 90 mm Petri dish should conform to International Standard such as the recommendation of the WHO of not more than 7 discs per such plate [10].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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