



Microbiological Evaluation of some Oral Antacid Suspensions Sold in Delta State, Nigeria

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ABSTRACT: Pharmaceutical products (non-sterile) are faced with the challenges of not exceeding the minimum limit of microbial presence tolerated for the respective formulations. Antacid suspensions which are multi-dose drug products that are utilized in the neutralization of gastric acid. This drug with neutral pH makes them to be liable to microbial contamination. This study was conducted to evaluate antacid suspensions marketed in Delta State, Nigeria based on their microbial quality. Six different brands of antacid suspensions were collected from different Pharmacies in Delta state and were analysed microbiologically to isolate and quantify the implicated bacteria and fungi using conventional cultural and biochemical techniques. The microbiological evaluation of these samples was determined using the agar-well diffusion method. Five out of the six brands evaluated were found to be populated with a huge number of bacteria (2.5×10^2 to $> 2.2 \times 10^2$ CFU/ml) and fungi (2×10^2 to 8×10^2 CFU/ml). *Staphylococcus aureus* was absent in any of the antacids brands studied. However, there were presence of objectionable microorganisms, *Escherichia coli* and *Candida albicans* in three of the six brands. The results of this study reveal the microbial contamination level of some of the antacid (suspensions) marketed in Delta State which may be due to poor adherence to current good manufacturing practice by the manufacturers.

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Suspension as a dosage form is formed by dispersing solid particles in an aqueous or oily liquid in which the particles are poorly soluble or completely insoluble (Billany, 1999). Some drugs such as kaolin, magnesium carbonate and magnesium silicate are required to appear in the gastrointestinal tract in a finely divided form. When these drugs are formulated as suspensions, the desired high surface area is produced (Okafo and Chukwu, 2017). Antacids in suspension forms are utilized to neutralize hydrochloric acid in gastric secretions (Khan et al, 2014). The neutral pH of antacid suspensions makes them to be liable to microbial contamination and growth. Also, pH may influence the effectiveness of the preservative by producing changes in its ionization state which may distort the balance between the dissociated and un-dissociated forms. This could stop the activity of preservative from reaching a satisfactory protective concentration due to different inherent antimicrobial strength of the two forms (Aulton and Taylor, 2013). Some pharmaceutical products especially the oral drugs such as suspensions are usually not sterilized and are abound to have presence of various types of microbes as a result of non-ideal manufacturing condition (Stan, 2015). This may result in the deterioration of the pharmaceutical product. The extent of the microbial spoilage will

depend on the chemical structure of the ingredient, type and quantity of contaminating microbes, concentration of preservative if present, pH and presence of sweeteners (Emejuru *et al*, 2014; Biraima *et al*, 2016). Consumption of contaminated pharmaceutical products has resulted in untoward health condition to the users and cases of drug-borne infections of man exists globally. The level of contamination by microorganisms depends on various factors that include availability of nutrients, microbial presence and oxygen. The effect of the drug-borne infection is determined by factors such as type and extent of contamination by microbes, route of administration and the immune system condition of the patient (Adeshina *et al*, 2009). The quality of drugs especially non sterile pharmaceuticals such as suspensions is of great concern and should be monitored from the acquisition of raw materials through the production process to testing of the final product. The final product must meet high microbiological standard, though not sterile, but the microbial content must not be above a minimum limit Biraima *et al*, (2016). Evaluation of microbiological quality of medicinal products is one of the major control measures in assessment of pharmaceutical products (Ratajczak *et al*, 2015). Factors that are considered in microbiological evaluation of

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pharmaceutical products include; the source and incidence of microbes in the product, the effect of such contamination on the stability of the product and patients' health, the levels and types of microbes that may be tolerated (Parker, 1999). The evaluation of such microbial quality is based on qualitative and quantitative tests that are employed to determine the microbial content as well as detection of specified objectionable ones (Biraima et al, 2016). The objective of this study is to evaluate the microbiological status of the six different brands of antacids (suspension) sold in various towns of Delta State, as this will inform the prescribers in this environment the conditions of these antacids sold in this area.

MATERIALS AND METHODS

Sampling and sample processing: Six samples of antacid suspensions (coded AT1-AT6) with valid manufacturing and expiry dates were collected between November and December 2019. These oral suspensions were collected from different community pharmacies in Obiaruku, Asaba and Warri in Delta State, Nigeria and were taken to the laboratory to establish microbiological quality these antacids. The total bacterial and fungal loads as well as presence of

specific pathogens were determined following the standard methods Ratajczak *et al.*, (2015)

Enumeration of total viable bacterial and fungal count: For enumerating the total viable bacterial and fungal load, on Nutrient agar (NA) and Sabouraud Dextrose agar (SDA) was spread 0.1 ml of individual antacid suspension (Dafale et al, 2014). Nutrient and SDA plates were incubated for 24 hours at 37°C and at 25°C for 48 to 72 hours respectively.

Enumeration of specific pathogens: From each sample, 0.1 ml of suspension was spread onto MacConkey agar and mannitol salt agar (MSA), for the isolation and enumeration of *Escherichia coli* and *Staphylococcus spp.* respectively. The plates were then incubated for 24 hours at 37°C. The isolated strains were further identified by following confirmative biochemical tests (Dafale et al, 2014; Emejuru et al, 2013).

RESULTS AND DISCUSSION

Six (6) brands of antacids (suspension) from different pharmaceutical companies in Nigeria were evaluated physically and microbiologically. The results are shown on Tables 1 and 2.

Table 1: Physical assessment and microbial count for the different brands of oral antacid suspensions

Sample code	Active ingredients	Production date	Expiration date	Total Viable Bacterial Count	Total Fungal Count
AT1	Magnesium trisilicate	May 2019	June 2022	5.5x10 ²	4.5x10 ²
AT2	Magnesium trisilicate	July 2018	June 2020	2.5x10 ²	4.0x10 ²
AT3	Magnesium trisilicate	August 2018	Sept. 2021	NG	NG
AT4	Magnesium trisilicate	April 2019	Feb. 2021	3x10 ²	4.0x10 ²
AT5	Magnesium trisilicate	Aug. 2019	July 2022	1.2x10 ³	2.0x10 ²
AT6	Magnesium trisilicate	May 2019	May 2021	2.0x10 ³	2.5x10 ²

Table 2: Specific pathogens isolated from the different brands of the oral antacid suspensions

	AT1	AT2	AT3	AT4	AT5	AT6
<i>Staphylococcus Aureus</i>	NG	NG	NG	NG	NG	NG
<i>Staphylococcus Epidermidis</i>	NG	NG	NG	3 x 10 ²	1.2 x 10 ³	2.0 x 10 ³
<i>Micrococcus Spp.</i>	5.5 x 10 ²	NG	NG	NG	NG	NG
<i>Escherichia coli</i>	TNTC	NG	NG	NG	2.15 x 10 ³	NG
<i>Yersinia spp.</i>	NG	TNTC	NG	NG	NG	NG
<i>Streptococcus spp.</i>	NG	2.5 x 10 ²	NG	NG	NG	11 x 10 ²
<i>Penicillium notatum</i>	NG	NG	NG	NG	2 x 10 ²	2.5 x 10 ²
<i>Aspergillus spp.</i>	NG	NG	NG	4 x 10 ²	NG	NG
<i>Candida spp.</i>	4.5 x 10 ²	8 x 10 ²	NG	NG	NG	NG

Antacid (suspensions) usually are extremely susceptible to contamination by microorganisms mainly due to their neutral pH. The study was carried out to ascertain whether some antacid suspensions sold in Delta State, Nigeria complied with the compendia microbiological standards particularly the USP specifications. It was observed that five out of six brands of the antacid suspensions (AT1, AT2, AT4, AT5 and AT6) tested exceeded the USP limit for total microbial content (10² CFU/ml). It was observed that none of the six (6) brands contained *S. aureus*, an objectionable microorganism. However, either one or two objectionable microorganisms (*E. coli* and

Candida albicans) were found in brands AT1, AT2 and AT5. Studies before now on microbiological quality of antacid suspensions carried out in Bangladesh Moniruzzaman et al., (2012) showed that some of the antacids sample were contaminated with *S. aureus* and *P. aeruginosa*. In a study carried out in Nigeria by Udeze et al (2012), *Staphylococcus aureus* was detected in the three samples evaluated. It looks from these results that amongst the offensive microorganisms, *Staphylococcus aureus* is the commonest which indicate that either inadequate personal hygiene as the *Staphylococcus aureus* is considered as part of the normal flora of human skin or

production environment could also participate as a source of contamination with *Staphylococcus aureus*. In contrast to the study from Bangladesh and previous study from Nigeria, this study showed no presence of *S. aureus* which may suggest good personal hygiene of the workers. The presence of *Candida albicans* in two samples out of the six (6) antacid brands is indication of poor personal hygiene. The detection of *E. coli* in two of the brands indicates the presence of faecal contamination that may be as a result of poor water or raw materials sources. Brands AT1, AT2 and AT5 contained objectionable microorganisms and even TNTC quantity of some other organisms. This revealed low level of compliance to current good manufacturing practice (cGMP). Contaminations of finished pharmaceutical products are usually caused by poor hygiene by factory workers, poor environmental hygiene, contamination of raw materials and or machineries Khanom et al., (2013). Regulatory authorities should caution them to avoid endangering the health of end-users (patients). Brand AT3 did not show growth of any of the microbes used in the evaluation. This may be due to strict adherence to cGMP or due use of good preservatives. It has been said that the use of adequate preservative, hygienic manufacturing processes/environment and sterilization could be employed to inhibit or eliminate microbial growth in pharmaceutical preparations (Udeze et al, 2012).

Conclusion: This study results and other similar studies conducted in other areas of the globe on the microbiological quality of oral antacid suspensions, it looks like the producers of these antacids do face problem with the microbiological quality of these pharmaceutical products, this may as a result of the failure to implement efficiently all principles of GMP or failure to achieve effective preservation system. Regulatory bodies should also live up to expectation by monitoring strictly the activities of the manufacturers to avoid jeopardizing the health status of their citizens.

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