African Journal of Pharmaceutical Research & Development

Vol. 7 No.1; pp. 45-49 (2015)

Microbial assessment of some pharmaceutical products sold in Benin City: Public health implication

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ABSTRACT

The study was carried out to evaluate the microbial quality of some pharmaceutical products sold by vendors in Benin City metropolis and to determine the level of contamination of the drugs. The drug samples examined were sealed and unsealed products of chloramphenicol, tetracycline, ampicillin, metronidazole and paracetamol. The bacterial density were as follows:1.0×103 ± 2.2 cfu/g tetracycline (unsealed); 1.8×103 ± 1.0 cfu/g ampicillin (sealed); 2.3×103 ± 2.6 cfu/g metronidazole (sealed); 3.0×103 ± 4.2 cfu/g metronidazole (unsealed), 4.1×103 ± 1.0 cfu/g parecetamol (sealed) and 4.8×103 ± 1.0 cfu/g parecetamol (unsealed). Total coliform count was observed in only sealed metronidazole samples as 1.0×103 ± 2.2 cfu/g. The bacteria isolated were identified as *Bacillus subtilis, Proteus mirabilis, Staphylococcus epidermidis and Klebsiella pneumonia*. The bacteria density obtained in the sampled drugs is worrisome as this could impair treatment outcomes. Also, the pathogenic bacteria such as *Proteus mirabilis* and *Staphylococcus epidermidis* isolated s from some drugs samples are a potential risk to public health.

KEYWORDS- Drugs, Quality control, Pathogenic bacteria, Public health hazard

INTRODUCTION

Pharmaceutical products or drugs are chemical compounds that are administered to humans or animals to aid in the treatment or prevention of disease. They can also be used for the relief of pain of some abnormal medical situation or to control any physiological or pathologic conditions. In other words, any chemical substance capable of producing effect upon the body, product that is used or intended to be used to modify and explore physiological systems or pathological state for the benefits of the recipient can be referred to as a drug [1, 2]. Pharmaceutical products can be classified in various ways either by chemical properties, route of administration, biological system affected, or therapeutic effects [2, 3]. An elaborate and widely used classification system is the Anatomical Therapeutic Chemical Classification System.

The World Health Organization keeps a list of essential medicines. A sampling of classes of medicine includes; antipyretics, analgesics, antimalarial drugs, antibiotics, antiseptics, mood stabilizers, hormone replacements, oral contraceptives (Enovid), stimulants (methylphenidate), tranquilizers (meprobamate, chlorpromazine, reserpine, chlordiazepoxide, diazepam, and alprazolam), statins (lovastatin,

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pravastatin, and simvastatin) [4]. Medical drugs of various forms are susceptible to contamination by a variety of microorganisms during manufacturing, market handling and use. Such products are considered microbiologically unsafe; if pathogenic and opportunistic pathogens are found present, persistence of toxic microbial metabolites after removal of all microorganisms present, detectable physical and chemical changes have occurred in the products [1, 5]. The use of such products, even where the level of contamination is low may present potential health hazards to patients [1, 6].

The manufacturing environment especially the air influences the microbiological quality of the drugs and the materials used in their formulation [7,8]. With the exception of preparations, which are terminally sterilized in their final containers, the microflora of the final products may represent contaminants from raw materials, from process operating personnel and packaging of the final product [8]. Furthermore, some pathogenic and non-pathogenic microorganisms may grow in the presence of preservative and cause spoilage of the products [9]. This study was aimed at evaluating the microbial quality of some pharmaceutical product drugs marketed by vendors in Benin City, Edo State, Nigeria.

MATERIALS AND METHODS

Sources of samples

Drugs samples were purchased from patent medicine stores in Benin City. The following pharmaceutical products were purchased:- (chloramphenicol, tetracycline, ampicillin, metronidazole and paracetamol). Purchased items were transported to the laboratory for analysis.

Determination of bacteria population density and Identification of isolates

The pour plate method was used for the determination of the total heterotrophic bacterial and coliform counts. Ten gram of each sample was weighed and carefully homogenized in 90 ml of sterile distilled water. The samples were serially diluted, thereafter; aliquot of 0.1 ml of the appropriate dilution was use for pour plate on Nutrient agar and McConkey agar. Agar plates were incubation at 37ºC for 24 - 48 h. After the incubation period, typical colonies of microbial growth were counted using Stuart colony counter. Pure cultures were obtained using the streak technique on fresh media. The purified isolates were identified by cultural, morphological and biochemical reactions using standard methods [10, 11].

RESULTS & DISCUSSION

The microbiological analysis performed on the various purchased pharmaceutical products from drug vendors in Benin-City reveals presence of medically important bacteria. This serves as an indication of drug contamination possibly from contact with hands in the case of unsealed drugs, improper or unhygienic packaging process and poor storage environment. Our finding revealed that in unsealed drugs, bacterial density was highest in paracetamol with a total bacterial count of 4.8×103 ±1.0 cfu/g and lowest density occurred in unsealed tetracycline which recorded a bacterial population of 1.0×103 ± 2.2 cfu/g (Table 1). Bacterial density obtained for unsealed metronidazole was 3.0×103 ± 4.2 cfu/g (Table 1). No count was obtained in the case of unsealed chloramphenicol and ampicillin. The absence of bacterial count in some of the unsealed drugs indicates that these unsealed drugs meet the microbiological standard.

Bacterial population density for sealed drugs showed that highest count was obtained in paracetamol with a count of 4.1×103 ± 1.0 cfu/g while lowest count for sealed drugs occurred in ampicillin with bacteria load of 1.8×103 ± 1.0 cfu/g; unsealed metronidazole had bacterial count of 2.3×103 ± 2.6 cfu/g (Table 1). For chloramphenicol and tetracycline, no bacterial counts were recorded. Overall total coliform counts revealed the absence of coliform in all the drug samples with the exception of sealed Metronidazole whose total coliform count (cfu/g) was 1.0×103 ± 2.2 cfu/g (Table 1). It has been well established that microorganisms have a vital role to play in the degradation and spoilage of pharmaceutical products [12, 13]. Microorganisms are extremely versatile in their ability to synthesize the degradable enzymes that contributes largely in spoilage of pharmaceutical products [14].

Table 1: Bacterial density (cfu/g) of the drugs samples

Sample products	Bacterial density (cfu/g) ± S.D	Total coliform density (cfu/g) ± S.D
Chloramphenicol (sealed)	NG	NG
Chloramphenicol (unsealed)	NG	NG
Tetracycline (sealed)	NG	NG
Tetracycline (unsealed)	$1.0\times10^3 \pm 2.2$	NG
Ampicillin (sealed)	$1.8\times10^3 \pm 1.0$	NG
Ampicillin (unsealed)	NG	NG
Metronidazole (sealed)	$2.3\times10^3 \pm 2.6$	$1.0\times10^3 \pm 2.2$
Metronidazole (unsealed)	$3.0\times10^3 \pm 4.2$	NG
Paracetamol (sealed)	$4.1\times10^3 \pm 1.0$	NG
Paracetamol (unsealed)	$4.8\times10^3 \pm 1.0$	NG

Legend: NG – No Growth Values; Means are the count of three independent expriments

Proliferation of bacterial contaminants can lead to product spoilage, recalls and outcomes that are detrimental to health and business [14, 15]. Emphasis should be placed on contamination, degradation and stability studies of drugs because improper storage and distribution of pharmaceuticals can lead to their physical deterioration and chemical decomposition resulting in reduced activity and occasionally, in the formation of toxic degraded products [15, 16].

Morphological characteristics and biochemical reactions of bacterial isolates revealed the absence of *Bacillus subtilis* in chloramphenicol (sealed and unsealed), tetracycline (sealed and unsealed), ampicillin (sealed and unsealed), metronidazole (unsealed only) and paracetamol (sealed and unsealed). *Proteus mirabilis* was absent in all drug samples (sealed and unsealed) with exception of unsealed paracetamol and sealed metronidazole (Table 2). *Staphylococcus epidermidis* was present in unsealed paracetamol, unsealed tetracycline and sealed ampicillin. *Klebsiella pneumonia* was present in unsealed metronidazole and absent in all other sealed and unsealed drugs. The manufacturing environments which consist of unsterile and polluted air and source water could be possible means of contamination. Also, the manufacturing equipment may be handicapped by a number of designed faults [1]. Products made in these conditions might reasonably be expected to be contaminated with aerial microorganisms such as aerobic spore bearers and Gram-positive cocci. The presence of microorganism in some of the drugs sampled renders the drug hazardous for human consumption [1]. The presence of these microorganisms in some of the drugs could be attributed to unhygienic practices and non-adherence to good manufacturing practices. The poor state of the manufacturing environment, dirty filling equipment, unhygienic handling of the products and lack of microbiological in-house control may have also contributed to the high microbial load in some samples [17, 18]. The strict compliance to these practices will consequently reduce the incidence of contamination and guarantee good quality products [1, 18]. The quality of pharmaceuticals cannot be compromised as these constitute a group of products ingested into the human and animal systems by routes such as oral, parenteral, topical and others [16]. These groups of products therefore have direct bearings on human wellbeing and therefore an absolute need to guarantee their quality, safety and efficacy. Drugs have to be designed and produced such that when patients receive them for

management of their ailments, they do not produce any adverse side reactions on such patients [16].

It is also recommended that proper attention should be given to maintenance of hygienic conditions; stability testing and manufacturing processes; adhere to guidelines given by relevant government authorities such as the National Agency for Food, Drug Administration and Control (NAFDAC). Conclusively, home users should be adequately educated or informed on usage and storage of products to minimize the introduction of contaminants.

Table 2: Occurrence and distribution of the bacterial isolates

Sample	*Bacillus Subtilis*	*Proteus mirabilis*	*Staphylococcus epidermidis*	*Klebsiella pneumonia*
Chloramphenicol (sealed)	-	-	-	-
Chloramphenicol (unsealed)	-	-	-	-
Tetracycline (sealed)	-	-	-	-
Tetracycline (unsealed)	-	-	+	-
Ampicillin (sealed)	-	-	+	-
Ampicillin (unsealed)	-	-	-	-
Metronidazole (sealed)	+	+	-	+
Metronidazole (unsealed)	-	-	-	-
Paracetamol (sealed)	+	-	-	-
Paracetamol (unsealed)	+	+	+	-

Legend: + =Present; - = Absent

DISCLOSURE STATEMENT

The authors have no conflict of interest to declare

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