JOURNAL OF CLINICAL AND HEALTH SCIENCES

EDITORIAL

Medical Education and Practice in Malaysia, Quo Vadis?

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As of June 2016 there are 28 medical schools [1] in both private and public sectors in Malaysia offering more than twice as many programs [2] with yearly graduates of about 4500 including those that graduated from overseas. This magnitude is beyond the usual capacity of Ministry of Health (MOH) that is entrusted to accord preregistration training posts to the graduates as the whole process of allocation to available places in public hospitals nationwide is painfully slow. It is already a tragedy having to wait 6 months on average for a placement but words that a delay for up to a year can occur is totally unacceptable when the actual training places available at grade DU41 preregistration house officers is said to be more than the graduate number [3]. Delay can be detrimental to the training itself because waiting is a waste of talent and potential, a disincentive to a young aspirant, tacitly is a testimony of system failure and deprives the public of highly trained graduates to serve in our healthcare system that ironically suffers from chronic and ever growing wait but yet we have excess medical graduates. Some of them have taken a simple and quick route out of the mess by migrating to our neighbours near and far, not entirely their faults, but their thresholds to despair seem very low indeed. The need for a speedy and right solution to the delay is long overdue and this is nothing more than what the public and the young doctors deserve.

How did we get to this? Not unexpectedly but the magnitude stemmed from the unusually large number of *Sijil Pelajaran Malaysia* (SPM; Malaysia Certificate of Education) leavers that opted to study medicine, in part made easy by the many medical schools in the country and those that have been accredited abroad. This was augmented by the constant reminder of the need for more doctors, parental or hype pressure perhaps for whatever reasons, and also the ease with which scholarships were available to study medicine. The principle driver for the whole mess was money initiated by those who wish to make profits under these "fortunate" circumstances [4]. The resulting deluge of medical graduates clogged the system up and unfortunately created many of the unnecessary challenges that we face today. Paradoxically despite this excess our doctor population ratio is still lower than the Organization for Economic Cooperation and Development (OECD) average and our more prosperous neighbour in the south. These veiled and unscrupulous drivers are addressing the gap in ratio with such a speed that it strains the system to almost breaking point and had somewhat ruffled both Ministry of Higher Education (MOHE) and MOH.

The doctor number that we need should ideally be planned or rather managed at this point and this can only be done by addressing all the factors that had led us to this. For a start we should look at the basic question of what the country needs in the future (2020 and beyond) and then work backwards. This sounds simple enough but in practice this is where the challenge lies. Two ministries MOH and MOHE are both looking at the issue albeit with different focus but inevitably with some overlapping jurisdiction. The MOH concerns with the nation's health issues and MOHE deals with medical education and consequently doctor number, although seemingly separate but in actual fact they will converge. Whatever the number of medical students approved at Malaysian Qualifications Agency (MQA) / Malaysian Medical Council (MMC) or sponsored by *Jabatan Perkhidmatan Awan* (JPA; Public Services Department) /MOHE the final tally in five years will be the medical graduates that will have to be allocated to training places. Too many medical

graduates too soon appear to be the main problem and therefore it is high time that we try to regulate the number that goes into training. Immediate actions are required too to restore public confidence in the light of unsympathetic media comments. This includes policies that require hard choices such as derecognizing some foreign medical schools in the archaic list of schedule 2 and introducing the right to practice examination for those who have graduated from abroad. Both can regulate number and consequently emphasize quality.

The next challenge is the specialist number now that doctor number at lower grades will address the gap in ratio in time. Although a lot has improved but by most estimates the number of specialists must double to take up the challenges of a developed nation status and we need to add to this the question of disparity (uneven number by specialty) and geographical mal-distribution, unfortunately the issues remain despite numerous incentives introduced by MOH over the years. An easier question of churning up specialist number can be addressed rather immediately because we have a robust, economical, and internationally respected system within our midst that is the Master in Medicine (MMED). But when the issue of increasing the specialist number is debated, the discourse mystically takes a pathetic course to the times when postgraduate medicine began in the country in the 60s, a return to our colonial ancestry for training opportunities and supervision. When postgraduate medicine first started we indeed relied heavily on the hospitals in the United Kingdom (UK) and their college exams but these are things of the past. Except for stated and specific niche areas for training and education, or occasional exception, by and large we have existed and trained our specialist independently from the system in the UK for more than three decades. For the record, to date more than 8000 specialists have graduated from MMED system and for a rapidly growing Malaysia this number is huge. Especially so for the surgical based specialties that are the most challenging to train and in all domains the surgeons have been at par with the very best in the world. In fact from our own survey, MMED trained specialists are the backbone of doctors that service the public hospitals and clinics in Malaysia.

Despite this apparent regression, the universities that offer MMED are in the process of institutionalizing the training pathway and system to maintain the quality and improve the process further. Steps are taken to formalize the training pathway via MQA and MOHE to reinforce public perception of the system and in preparation for soon to be implemented trade and economic liberalization in ASEAN. For practical purposes the MMED system essentially has two types; one that is based on the presence of the faculty's own teaching hospital and the other on the absence of one and thus reliance on the state hospital as the faculty's affiliated teaching hospital. Both models have achieved success and maintained the quality and competency required by a robust comprehensive assessment system that includes standardized examinations attended by a wide selection of examiners in the country and abroad. In the next 5 years or so, the training environment to some extent the MMED will undergo a significant change with the completion of another 7 teaching hospitals and the incorporation of a consortium of university teaching hospitals. With an estimated number of nearly 10000 tertiary care beds at peak activity this will provide an excellent opportunity to train more specialists and partake in subspecialty training. This includes research and teaching activities that will enhance the return on investment to the public.

Based on the cumulative years of experience and a much more organized MQA the future of medical education for both undergraduate and postgraduate looks very promising indeed but the main lingering issues in both must be addressed. For undergraduate medicine the need to maintain a robust and stringent control on quality is paramount and data shows that the emphasis of this is mainly on graduates from some foreign medical schools because the local ones are subject to very stringent accreditation exercise and compliance audit, therefore quality is assured. Another strategy to achieve this is the introduction of fitness to practice examination for foreign medical school graduates. Both will help control number. The main issue that is affecting postgraduate education is the need to institutionalize the MMED for the future and the creation of teaching hospitals consortium by working closely with MQA and MOHE. This will ensure the best deal for the public. The future is in our hands.

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JOURNAL OF CLINICAL AND HEALTH SCIENCES

ORIGINAL ARTICLE

Potassium Aluminium Sulphate (Alum) Inhibits Growth of Human Axillary Malodor-Producing Skin Flora in Vitro

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Received
5th February 2016
Received in revised form
27th April 2016
Accepted
23rd May 2016

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ABSTRACT

Introduction: Axillary malodor is caused by microbial biotransformation of non-smelling molecules present in apocrine secretions, into volatile odorous molecules. This study aimed to determine the antimicrobial activities of potassium aluminium salts (alum) against four malodor-producing axillary bacterial flora, as an alternative natural product for reducing axillary malodor. **Methods:** The antimicrobial activity of alum against axillary bacterial flora [*Micrococcus luteus* (ATCC 49732) (*M. luteus*), *Staphylococcus epidermidis* (ATCC 14990) (*S. epidermidis*), *Corynebacterium xerosis* (ATCC BAA-1293) *C. xerosis* and *Bacilus subtilis* (ATCC 19659) (*B. subtilis*)], was tested in vitro using broth dilution method for different concentrations (0.937 – 20mg/mL) on Luria-Bertani broth. Subculture was done to determine colony-forming units (CFUs) and the minimum inhibitory concentrations (MICs). **Results:** Alum showed excellent inhibitory effects on all tested bacteria. The lowest MIC of alum was against *C. xerosis*, at 1.88 mg/mL. *M. luteus*, *B. subtilis* and *S.epidermidis* showed a higher MIC of 3.75, 5.00 and 7.50 mg/mL, respectively. All of the tested bacteria were completely inhibited at a concentration of 7.50 mg/mL. **Conclusions:** This study revealed that alum has excellent antimicrobial effects against axillary malodor -producing bacteria and is recommended to be used either directly by topical application or as an active ingredient in deodorants and antiperspirants.

Keywords: Antimicrobial, Potassium aluminium, Alum, Malodorous, Axilla

INTRODUCTION

Body odors especially in axilla and foot are unique scents of adults. The eventual source of axillary odor is apocrine sweat which is naturally odorless and sterile [1]. The human scent is genetically controlled and systemically influenced by dietary and medicinal intake [2]. Generation of malodor on axilla of the human body is caused by the microbial biotransformation of odorless volatile fatty acids secreted by apocrine glands into volatile odorous molecules. This results in unpleasant smell which might cause social embarrassment and reduce self-confidence [3]. Excessive sweating and moisture at axilla makes the environment optimal for sustained growth and proliferation of bacteria and this contributes to unpleasant odor [1]. Axillary flora was found to be a stable mixture of gram-positive bacteria like *Micrococcus* spp., coagulase negative staphylococci, *Corynebacterium* spp., and *Bacillus spp*. [4]. Different bacteria produce different odors according to their sugar digestion. *Bacillus subtilis* and *S. epidermidis* contribute to foot odor, while *S. epidermidis* and *Corynebacterium* spp. contribute to underarm odor [5,6]. Although higher bacterial densities were associated with higher malodor intensities in axilla, there was no association between odor intensities and any particular microorganism [7]. Alum (molecular formula: $KAl(SO_4)_2.12H_2O$) is a colourless, odorless crystalline solid that turns white in air [8]. The medical uses of alum in mouth rinses, vaccines development, haemostasis and inhibition of *V. cholerae* growth in water have been described [9-12]. However, to date there is no study on the effect of

alum salt against bacterial skin flora. Therefore, the aim of this study was to evaluate the inhibitory effects of alum solution against certain bacterial skin flora namely *Micrococcus luteus*, *Staphylococcus epidermidis*, *Corynebacterium xerosis* and *Bacilus subtilis* that cause axillary malodor.

METHODS

Bacterial strains

Four standard bacterial strains which cause axillary malodor were used in this study. All bacteria were obtained from Institute of Medical Molecular Biotechnology (IMMB), Faculty of Medicine, Universiti Teknologi MARA (UiTM). Bacterial strains used in this study were *Micrococcus luteus* (ATCC 49732) (*M. luteus*), *Staphylococcus epidermidis* (ATCC 14990) (*S. epidermidis*), *Corynebacterium xerosis* (ATCC BAA-1293) *C. xerosis* and *Bacilus subtilis* (ATCC 19659) (*B. subtilis*). All bacterial strains were inoculated in blood agar and incubated for 24 hours at 37°C. The bacterial suspension was prepared by inoculating two bacterial colonies in Luria-Bertani broth (LB - broth) for 3 hours at 37°C and the turbidity was adjusted in phosphate buffered saline to 0.5 McFarland's scale.

Preparation of alum solutions

Pure aluminum potassium sulfate (Sigma-aldrich, KL, Malaysia) was used in this study. Alum crystals were completely dissolved in hot sterile distilled water at 100 °C, to obtain a final concentration of 1 g/mL, at pH 3.6. Broth dilution method was used to assess the antimicrobial activity of alum against previously mentioned strains. Different concentrations ranging from (20, 15, 10, 7.5, 5, 3.75, 2.5, 1.875, 1.25, 0.937 mg/mL) of alum broth media were prepared aseptically. Positive control LB - broth without alum crystal was used to confirm the growth of the tested bacteria. For negative control a non – inoculated LB - broth was used to exclude contamination.

Evaluation of antimicrobial activity of the alum solution

The 0.5 McFarland standard (1×10^8 CFU/mL) of overnight pure culture bacterial suspensions were made in LB - broth. Ten µL of each suspension (1×10^6 CFU/mL) was inoculated in five mL of different concentrations of alum broth media and incubated at overnight 37ºC [13]. Subsequently, 100 µL of each inoculated alum broth media was streaked evenly onto blood agar plate to obtain uniformly distributed growth. The streaked plates were incubated aerobically at 37ºC and inspected after 24 hours. The broth cultures showing heavy growth were serially diluted with sterile broth before being incubated onto blood agar as mentioned. After incubation, the number of bacterial colonies was counted and expressed as colony forming unit per mililiter (CFU/mL).

RESULTS

The antimicrobial effects of alum against different malodour -producing bacteria are summarized in Table 1. Alum solution showed excellent inhibitory effects on all bacterial strains at various concentrations (7.5–1.875 mg/mL). All tested bacteria showed no growth with alum at concentrations of 7.5, 10, 15 and 20 mg/mL. The lowest MIC of alum was against *C. xerosis* 1.875 mg/ mL (Figure 1). While those for *S. epidermidis*, *B. subtilis* and *M. luteus* were 7.5, 5 and 3.75 mg/mL, respectively. Positive control samples showed growth of all tested bacteria in all groups, while, negative control samples showed no bacterial growth in all tested samples.

DISCUSSION

Antibiotic resistance is a major clinical and public health problem which forces researchers to look for alternatives choices. Natural chemical compounds are among these alternatives. In this study, alum salt was tested against axillary normal bacterial flora which produces unpleasant smell. To the best of our knowledge, this is the first study on antimicrobial effects of alum against malodor - producing bacteria in Malaysia. The preliminary results from this study could lead to future effort to investigate how alum salt inhibits growth of the bacteria and potential use of alum salt. The results showed that alum had potent inhibitory effects against *M. luteus*, *S. epidermidis*, *C. xerosis* and *B. subtilis* at different concentrations.

Based on the broth dilution assays, the MIC of 7.5 mg/mL appeared as optimal concentration of alum against four major bacteria responsible for axillary malodor.Previous studies have revealed that alum is effective against a wide variety of microbial pathogens [16, 17] including *Staphylococcus aureus*, *Escherichia coli and Klebsiella pneumoniae* [14, 15].. In 2014, Bnyan et al. also observed a significant bactericidal effect of alum against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli* and *Klebsiella pneumoniae* [15]. However, the mechanism of bactericidal effect of alum is not well known [18]. Some assumptions attribute the antibacterial effect of alum to reduction in acidity or deleterious effects on bacterial cell wall. Furthermore, histological studies confirm the safety of alum salt for mammalian consumption [19].It cannot be directly absorbed due to its negatively charged molecule, which are unable to pass through the cell membranes and therefore alum remain a harmless substance [8]. However higher concentration of alum might cause nephrotoxicity and intestinal bleeding [15]. Alum salt is used in cosmetics as antiperspirant to reduce axillary odor by blocking sweat ducts and preventing sweat secretion [20]. Alum crystals are highly soluble in water and when used under arm, they are dissolved by the body's sweat leaving a dry thin layer on the skin's surface which prevents sweat to come in contact with odor-causing bacteria [21]. Further studies are required to investigate the safety, allergy and efficacy of alum on human skin when used as antiperspirant. According to this study a concentration of 7.5 mg/mL could be considered appropriate for formulation of deodorant lotion, cream and gel.

Since, no previous studies have been done to investigate the effects of alum salt on axillary flora, the results from this study, although preliminary, could lead to future efforts to investigate how alum salt inhibits growth of the bacteria and its potential uses.

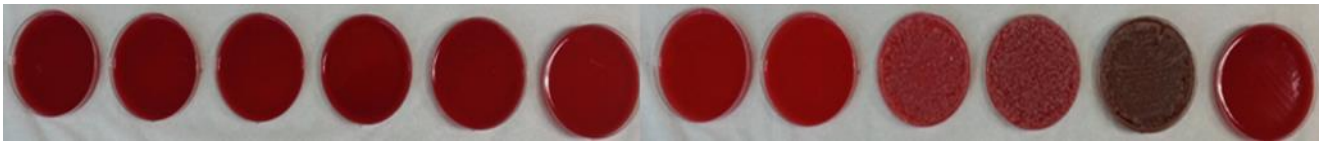

Figure 1 Antimicrobial effects of alum crystals on *Corynebacterium xerosis*.

Table 1 Antimicrobial effects of alum crystals against malodor-producing bacteria.

Alum concentrations (mg/mL)	Tested organisms (CFU/mL)			
	B. subtilis	*M. luteus*	*S.epidermidis*	*C. xerosis*
20	0	0	0	0
15	0	0	0	0
10	0	0	0	0
7.5	0	0	0	0
5	0	0	66	0
3.75	210	0	102	0
2.5	full	9360	540	0
1.875	full	1.05×10^4	2328	0
1.25	full	1.31×10^4	1.51×10^4	1.25×10^4
0.937	full	1.91×10^4	full	1.58×10^4
Positive control	full	full	full	full
Negative control	0	0	0	0

CONCLUSION

From this study it can be concluded that alum has excellent antimicrobial inhibitory effects on malodor-producing skin bacteria. It can therefore be used as either natural deodorants or as an alternative to other existing chemicals, currently used as active ingredients in deodorants.

Conflicts of interest

Authors declare none.

Acknowledgements

This study was supported by the Faculty of Medicine Universiti Teknologi MARA (UiTM). We would like to thank Institute of Medical Molecular Biotechnology, Faculty of Medicine (UiTM) for their support. And we would like to thank all technicians in multi-disciplinary laboratory for their help and support.

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