CHAPTER 1

INTRODUCTION

1.1 Research Motivations

Oral diseases are the most common of the chronic diseases and are important public health problems because of their prevalence, their impact on individuals and society, and the expense of their treatment. The determinants of oral diseases are the risk factors common to a number of chronic diseases: diet and dirt (hygiene), smoking, alcohol, risky behaviors causing injuries and stress and effective public health methods are available to prevent oral diseases. Oral health affects people physically and psychologically and influences how they grow, enjoy life, look, speak, chew, taste food and socialize, as well as their feelings of social well-being (Locker, 1997). In Thailand, 74% of 35–44-yearolds had daily performances affected by their oral state: 46% reported their emotional stability was affected (Adulyanon, Vourapukjaru et al., 1996). Chronic diseases such as obesity, diabetes and caries are increasing in developing countries, with the implication that quality of life related to oral health, as well as general quality of life, may deteriorate. Oral bacteria include *Streptococci*, *Lactobacilli*, *Staphylococci, Coryne bacteria*, and other various anaerobes in particular bacteria (Roger, 2008). With the appearance of the teeth during the first year colonization by *Streptococcus mutans* and *Streptococcus sanguinis* occurs as these organisms colonies the dental surface and gingiva. Other strains of streptococci adhere strongly to the gums and cheeks but not to the teeth.

Streptococcus mutans is a Gram-positive organism that is the primary causative agent in the formation of dental cavities in humans. This is based on the physical properties of their cell walls, as opposed to gram-negative bacteria, which cannot retain the crystal violet stain. *Streptococcus* is a genus of spherical Gram-positive bacteria belonging to the phylum *Firmicutes* and the lactic acid bacteria group. *S. mutans*, a member of the human oral flora, is widely recognized as the main etiological agent of dental cavities (Biswas, and Biswas, 2011). It implicated in the pathogenesis of certain cardiovascular diseases, and is the most prevalent bacterial species detected in extirpated heart valve tissues, as well as in athermanous plaques, with an incidence of 68.6% and 74.1%, respectively (Nakano, et al., 2006).

Practice of good oral hygiene including daily brushing, flossing and the use of appropriate mouthwash can significantly reduce the number of oral bacteria and inhibit their proliferation. Oral bacteria often live in plaque; a kind of biofilm, hence mechanical removal of plaque is the most effective way of getting rid of harmful oral bacteria, as bacterial biofilms are notoriously resistant to antibiotics and antimicrobial rinses (Finkelstein et al., 1990). However, there are some remedies used in the treatment of oral bacterial infection in conjunction with mechanical cleaning by both chemicals and herbal antimicrobial agents used in dentistry such as fluoride, chlorhexidine, green tea extract, tea tree oil, and barley tea.

Most microbiologists distinguish two groups of antimicrobial agents used in the treatment of infectious disease: antibiotics, which are natural substances produced by certain groups of microorganisms, and schemo therapeutic agents, which are chemically synthesized. A hybrid substance is a semisynthetic antibiotic, wherein a molecular version produced by the microbe is subsequently modified by the chemist to

achieve desired properties. Furthermore, some antimicrobial compounds, originally discovered as products of microorganisms, can be synthesized entirely by chemical means. In the medical and pharmaceutical worlds, all these antimicrobial agents used in the treatment of disease are referred to as antibiotics, interpreting the word literally (Waksman, 1947).

An antibiotic is an agent that either kills or inhibits the growth of a microorganism. This definition excludes substances that kill bacteria but that are not produced by microorganisms (such as gastric juices and hydrogen peroxide). It also excludes synthetic antibacterial compounds such as the sulfonamides. Most modern antibacterial are semisynthetic modifications of various natural compounds in medicinal chemistry. These include, for example, the beta-lactam antibiotics, which include the penicillin, cephalosporin, and carbapenem. The classification system is based on biological activity; such as, antibacterial are divided into two broad groups according to their biological effect on microorganisms: Bactericidal agents kill bacteria, and bacteriostatic agents slow down or stall bacterial growth (Nussbaum et al, 2006).

Antibacterial are used to treat bacterial infections. The toxicity to humans and other animals from antibacterial is generally considered low. However, prolonged use of certain antibacterial can decrease the number of gut flora, which may have a negative impact on health. However, antibacterials are also among the drugs commonly misused by physicians, such as usage of antibiotic agents in viral respiratory tract infections. The inevitable consequence of widespread and injudicious use of antibacterial has been the emergence of antibiotic-resistant pathogens, resulting in a serious threat to global public health. The resistance problem demands that a renewed effort be made to seek

antibacterial agents effective against pathogenic bacteria resistant to current antibacterial (Levy, 1994).

Antifungals are used to kill or prevent further growth of fungi. In medicine, they are used as a treatment for infections such as athlete's foot, ring worm and thru hand work by exploiting differences between mammalian and fungal cells. They kill off the fungal organism without dangerous effects on the host. Unlike bacteria, both fungi and humans are eukaryotes. Thus, fungal and human cells are similar at the molecular level, making it more difficult to find a target for an antifungal drug to attack that does not also exist in the infected organism. Consequently, there are often side effects to some of these drugs. Some of these side effects can be life-threatening if the drug is not used properly. Sodium Bicarbonate (Baking soda) blasted on to surfaces acts as an antifungal. Another popular, professional antifungal (Serum) is often applied after or without blasting by soda and is a mix of Hydrogen Peroxide and a thin surface coating that neutralizes mold and encapsulates the surface to prevent spore release. Some paints are also manufactured with an added antifungal agent for use in high humidity areas such as bathrooms or kitchens. Other antifungal surface treatments typically contain variants of metals known to suppress mold growth e.g. pigments or solutions containing copper, silver or zinc. These solutions are not usually available to the general public because of their toxicity (Fleming, 1980).

Antiviral drugs are a class of medication used specifically for treating viral infections. Like antibiotics, specific antivirals are used for specific viruses. They are relatively harmless to the host and therefore can be used to treat infections. Many of the antiviral drugs available are designed to treat infections by retro viruses, mostly HIV. Important anti-retroviral drugs include the class of protease inhibitors. Herpes viruses,

best known for causing cold sores and genital herpes, are usually treated with the nucleoside analogue acyclovir. Viral A-E is caused by five unrelated hepatotoxic viruses and is also commonly treated with antiviral drugs depending on the type of infection. Influenza A and B viruses are important targets for the development of new influenza treatments to overcome the resistance to existing neuraminidase inhibitors (Waksman, 1947).

Many natural herbals compose of many kinds of antibiotic agents. Thirteen chemical structures were found in natural antibiotic agents including; Alkaloids, Acetylenes, Coumarins, Flavonoids and isoflavonoids, Iridoids, Lignans, Macrolides, Phenolic, Polypeptides, Quinones, Steroidal Saponins, Terpenoids, Xanthones, and Miscellaneous compounds. Many essential oils included inpharmacopoeias supposedly possess antimicrobial activity, including: Cinnamonoil, Cloveoil, Eucalyptusoil, Garlic, Oregano oil, Lavender oil, Lemonoil, Lemon myrtleoil, Mintoil, Nigella sativa (black cumin) oil, Onionoil, Peppermintoil, Sandalwoodoil, Tea tree oil, and Thyme oil (Nussbaum *et al.*,2006).

Streptococcus mutans was potentially impacted as a plaque forming bacterium, effect of dental carries in animals and humans. The activities of S. *mutans* was sticking on tooth surfaces in the presence of sucrose, releasing of acids from fermentation of various dietary sugars, and inducing of dental carries (Hamada et al., 1984; Oh et al., 2003). There are many elimination techniques of S. *mutans* especially natural antibiotic agents.

Many researches have been studied on the antibacterial activity (Hwang et al., 2004), anti-allergic activity and anti-inflammatory effect of *Boesenbergia Pandurata* (*B. pandurata)* (Tewtrakul et al., 2009). *B. pandurata* or finger root or Chinese ginger

is one of traditional culinary and medicinal herbs in Southeast Asia. *B. pandurata* was in Zingiberaceae and treated on abdominal pain, sputum laxative, wounds and diarrhea colic disorder (Atun et al., 2013; Tewtrakul, Subhadhirasakul et al., 2009). The chemical compounds of *B. pandurata* consisted of many Flavonoids such as Boesenbergin A, Boesenbergin B, Panduratin A, Cardomin, and Cardomonin, especially. Their Flavonoids have scientifically proved as the antibacterial agents (Patoomratana el al., 2002).

Various Natural antibiotic agents from medicinal plants have been selected for antibacterial activity by extraction techniques. The methanol extracts of Baeckea frutescens, Glycyrrhiza glabra, Kaempferia pandurata, Physalis angulata and Quercus infectoria exhibited noticeable antibacterial activity against S. *mutans* causing dental caries at all concentrations tested. The bactericidal test showed that the methanol extracts of G. glabra, K. pandurata and P. ngulata conferred fast killing effect against S. *mutans* in 2 min at 50 mg/ml Concentration. This fast bactericidal activity is of practical importance, since application toothpaste or mouthwash should be effective within a few minutes (Hwang, J.-K., J.-Y. Chung, et al., 2004).

Tooth care product classified two types including toothpaste and mouthwash. Thai folk toothpaste commonly produced in powder form. The common powder toothpaste ingredients contain many dried herbal plants mixing with binder compounds for example calcium carbonate, sodium bicarbonate, and alumina, perlite (Joiner, 2007). The compositions of mouthwash were surfactant, drug extract, astringent antiseptic agent, flavor, and color (Yigit et al., 2008). The antibacterial agent was added into all tooth care products for decreasing of biofilm and reducing of occurrence of dental carries (Verkaik et al., 2011; Dalirsani et al., 2011).

1.2 Research Objective

The main purpose of this study is to develop mouth care product mixing with *B. pandurata.* The specific objectives are to find the optimal condition of two *B. pandurata* extraction processes, to evaluate the inhibition efficiency of *S. mutans* in mouth care products mixing with *B. pandurata* extractions, and to educate the mouth care products technologies to local community.

1.3 Scopes of Study

This study was divided into three parts. The first part was the study of optimal extraction condition of *B. pandurata* by solvent extraction and hydrodistillation techniques. The second part studied on the development of mouth care product from *B. pandurata* extract for inhibition *S. mutans* causing tooth decay. The final part was the mouth care product technology transfer to local community.

The first part contained of raw materials analysis, the finding of optimal condition of solvent extraction and hydrodistillation process, and the determination of inhibition of *S. mutans* by both *B. pandurata* extracts. The inhibition of *S. mutans* was analyzed by disc diffusion method and broth Microdilution method. The *S. mutans* ATCC 25175 was used in this study as dental carries microorganism. The ethanol was used in solvent extraction and the hydrodistillation applied water in process. The *B. pandurata* samples were randomly collected from Talat Thai in Bangkok, Thailand.

The second part concentrated on the analysis of inhibition of *S. mutans* in mouth care products. The development of mouth care product considered on two kinds of product including toothpaste and mouth wash. Both product recipes were applied Thai local herbal knowledge. The toothpaste product was produced into dry and powder

packaging. Both product were measured the attitude test by sensory test. The quality control test of both products was judged by the efficacy of inhibition of S. *mutans* activities.

The final part related with the transfer technology into community. The study area was in Phitsanulok province. The target group of this study was local people near sugar factory because this research was partially funded by the company. The company required to increasing of occupational opportunities for company officer and people who live around the sugar manufacturing plants. The results from part I and Past II were adapted to an educational instrument such as presentation and poster. The interview and questionnaire were used for evaluation of understanding of audiences.