CHAPTER I
INTRODUCTION

1.1 Background

Spirulina spp. was a well known filamentous cyanobacteria. It had a singular rod cell with diameter at about 1-12 micrometer (µm). These single cells had line shape with no branch. *Spirulina spp.* name was derived from Latin word “helix” or “spiral”. This word represented spiral appearance. It can be found in a variety of natural sources such as soils, marshes, fresh water, brackish water and sea water (Citerri, 1983). It was photo microorganisms that had higher capability than other algae because it had photosynthesis rate up to 8-10 percent when compare with other terrestrial plants, such as soybean that had photosynthesis rate only at 3 percent. It also had high protein content up to 60-70 percent of dried weight (Venkataraman, 1983). Furthermore, it had many different pigments, such as chlorophyll a, carotenoids, phycocyanin and beta-carotene. It also had unsaturated fatty acids that were essential nutrients for human health, such as oleic acid, linoleic acid and gamma-linoleic acid (GLA) and other vitamins, especially vitamin B12. These nutrients can used to maintain and improve immune system. In addition, *Spirulina spp.* did not contained cellulose and can easily digest up to 85 percent (Bunsom, 1988). Due to these reasons, *Spirulina spp.* was widely accepted as a valuable protein source and was called “food for the future”.

Spirulina spp. cultivation for biomass production can be operated in open pond and closed photo-bioreactor. Open pond may had low construction cost but it required large space. It also had some drawbacks from low efficient mixing system and incomplete light exposure throughout the system. Liquid evaporation and losing of carbon dioxide to atmosphere were other problems that need to be concern. In addition, contamination from bugs and small aquatic microorganisms can cause problem to the system. Due to these problems from open pond, closed photo-bioreactor had higher production yield. It can be produced high cell concentration up to 2-8 gram per liter. In contrast, open pond had low production yield only at about 0.1-0.2 gram per liter (Tanticharoen, 2012). Closed photo-bioreactor also had another benefit over open pond. Temperature and other environment factors that may affect the production yield can be easily controllable than open pond. By control these parameter, biomass and production yield can increase. Therefore, it was crucial to design the system properly that provide high production yields per area.

The purpose of this research was to develop high performance and low cost system for algae cultivation with that was suitable for environment in Thailand. The design for this system was corresponded with local knowledge. This design was easy for local people to implicate and apply for local production. Both cultivation system and nutrients factor were equally important for efficient algae production. For biotechnological aspect, the media components in cultivation affected production cost and had strong influence on the microorganisms activity. For the cultivation of *Spirulina spp*., Potassium Nitrate Fertilizer (KNO_3) was commonly used as a nitrogen source, but the substitution of urea became an alternative in terms of cost, higher cell growth rate and higher chlorophyll content. (Danesi, et al., 2011). By finding the optimum concentration of using other available fertilizer instead of using chemicals for cultivation will make the system more efficiently because production cost will be reduced and production yield was similar with normal media. Consequently, it will enhance life quality of local people because *Spirulina spp.* was not only a valuable protein source and a supplementary diet, it can be used for chemical extraction to produce medicines. Finally, it will create job, provide incomes and improve local area in sustainable way and cause self-reliance at the community level.

1.2 Research Objectives

1.2.1 To study the effectiveness of using available fertilizer as a nitrogen source on biomass productivity and chemical composition of *Spirulina spp*.

1.2.2 To design a tubular photo-bioreactor for usage in community level.

1.2.3 To test preliminary performance of the design photo-bioreactor was suitable for the community or not.

1.3 Scope of work

1.3.1 Using only available materials for *Spirulina spp.* cultivation.

1.3.2 Feasibility design of photo-bioreactor can be used in community level.

1.3.3 All experiments in this research are operated under outdoor condition (Tropical climate of Bangkok, Thailand).

1.4 Expected Outcomes

1.4.1 Get effective photo-bioreactor design which less expensive and suitable for environment in Thailand

1.4.2 Reduce *Spirulina spp.* production cost and founding from this study can lead to further development of *Spirulina spp.* cultivation with higher efficiency.

1.5 Conceptual Framework

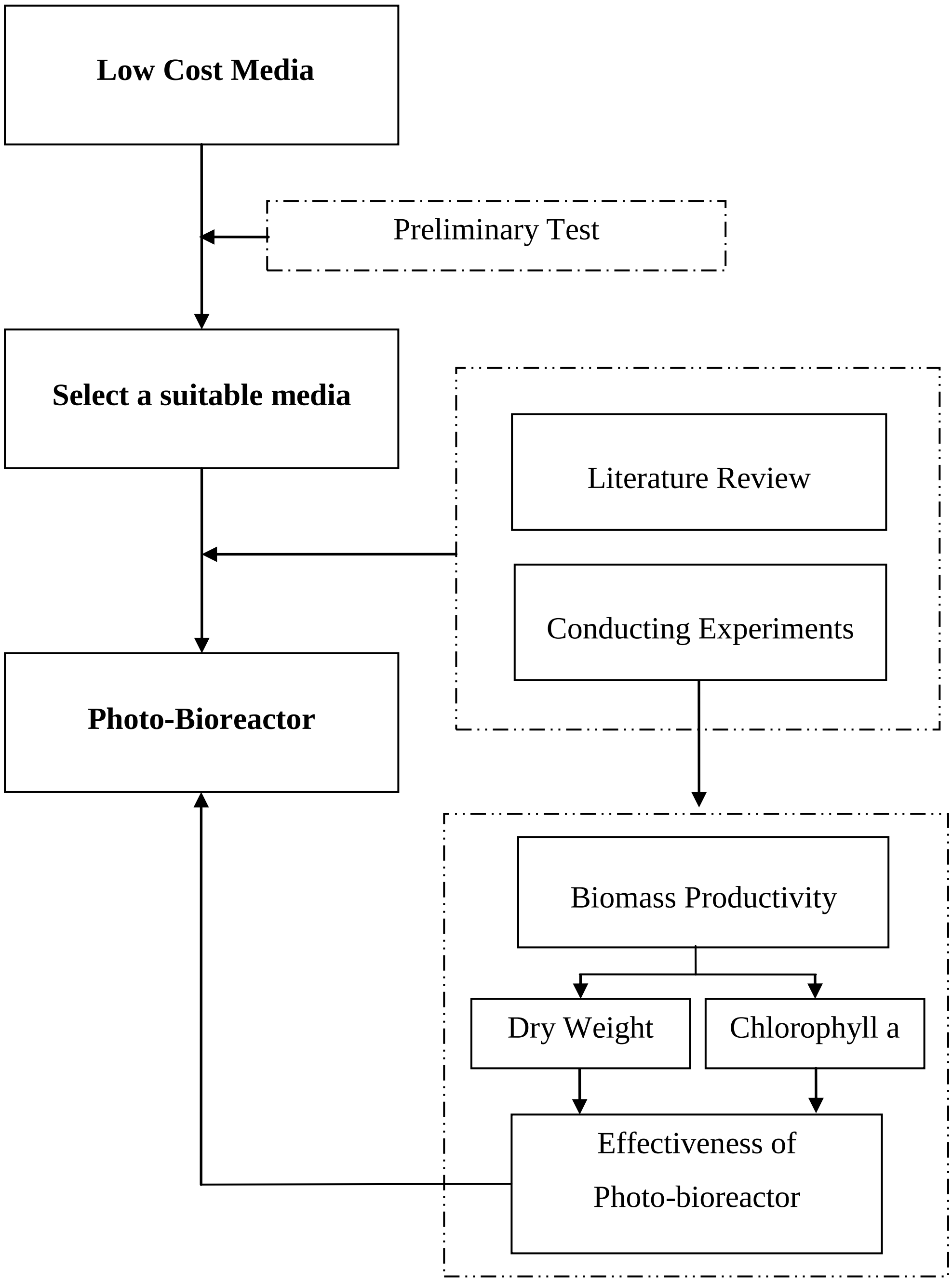

Figure 1.1 conceptual frameworks.