

CHAPTER I

INTRODUCTION

1. Rationale and background

The Capsicum family belongs to the Solanaceae and is related to eggplants and potatoes (Bosland et al., 1996). They most probably originated in Bolivia and Peru (Purseglove et al., 1981, Bosland et al., 1996) and were distributed after the discovery of America to other parts of the world. They are now being grown in all parts of the world (Somos, 1984) and are the part of many cuisines. Capsicum spp. can be divided into groups based on fruit characteristics ranging from pungency (hotness) and colour to shape, intended use and genetics. The main uses of Capsicums are various according to their pungency and colour. Users range from salads, using capsicum to add flavour, to cooked dishes, using fresh green and red chili to add pungency, to use dried powder spice of paprika and chili to add red colour and pungency (Biacs et al., 1989), to pickles, use for example Jalapeno chili, and to sauces, using for example Tabasco and Habanero chili. Fruit colour can be green, yellow or red; for dried spice production red fruit are used which have ripened from their green unripe form.

The most important quality attributes in chillies are the colour and the pungency. The red colour of chillies is mainly due to the carotenoid pigments (Anu A. and Peter K.V., 2000). The pungency of chillies is due to the compound capsaicin (Purseglove et al., 1981). Therefore, chillies need to be dried quickly without impairing colour and pungency. Traditionally, fresh chillies are preserved by drying the fruits immediately after harvest under the sun without any special treatment. Sun drying of chillies remains the most widely practiced method throughout Asia, Africa, and Central and South America. The chillies are spread out in the sun on a hard dry ground/concrete floor/flat roof of a house in thin layers. The fruits are turned frequently so that drying is uniform and there is no discoloration or mould growth. As

the sun drying method is weather dependent, it generally does not yield a good-quality product due to breakage and loss of seeds.

Chili have become the very important cash crops in Thailand. Thai people use chili in their cooking. A very unique characteristic of chili is the spiciness and the spiciness of the chili comes from a chemical called *capsaisin* in a form of *vanilly amide of isodecyanic acid* in the *placenta*. These chemical will react to every part of the body; for instance digestive system, blood circulation system, articulation system or the temperature control system in the body. Moreover, Chili are the source of vitamin A, C and many more and can also be used as medical drugs or decorative plants. Pepper⁶ is a good source of vitamins A and C, which are important antioxidants(Howard L.R.et al., 1994). It is eaten as a raw and cooked vegetable and also used commonly in making paste, pickle, and sauce. Red ground pepper made by drying and pulverizing the hot red pepper is used as a spice and flavor ingredient in the food industry(Isidoro E. et al., 1995). Also, Bosland(1994) reported its wide range of medical applications, from increasing appetite, relieving pain associated with arthritis, to diuretic effect.

Chili can be grown all year long. Rainy season and cold season, are a very good time to grow chili; during the drying period(November–March), if there is a heavy downpour, the damage to the produce is as high as 70–80%(Lual M.S. et al., 1970). During those times there will be a problem of overflowing chili in the market and the price goes down. Therefore, the idea of making dried chili was introduced. The quality and the stability of price of these chili are the conditions that control the prices of chili. For that reason, making fine quality of chili is a way to increase the price of chili during the overflowing period of chili in the market.

The basic way of making dried chili is to let them dried up in the sun by spreading the chili in a large open space. The duration of time needed depends on the sunlight temperature and the moist in the air around the area which normally Sun drying of chili takes 14–21 days depending on the weather(Lual M.S. et al., 1970). One of the problems when collecting these chili is that they are not dried up at the

same level. Other problems are such as weather problem, fungus, which decrease the length of time that they can be kept. There might also be a contamination in the chili.

Drying is one of the most energy intensive unit operations in food industry. In many applications of drying, dehydration is one of the oldest and most widely used methods of food preservation. In tropical countries, the existing dehydration techniques involve solar and hot air drying methods. Solar drying is now considered, but it generally requires longer drying time. On the other hand, conventional hot air drying involves higher drying temperatures. Drying at high temperatures may cause thermal injury leading to inferior product quality. Both methods have failed to effectively produce good quality product due primarily to the limitation of drying air having an inherent lower capacity to remove moisture. This limitation has led to the idea of development of a low relative humidity dehydration system.

Recent developments of the regime of fluidization and subsequent design modifications have made fluidized bed drying a desirable choice among other dryers. However, like other types of conventional convective drying processes, fluidized bed drying is a very energy intensive process in industry. The efficiency of a conventional drying system is usually low, depending on the inlet air temperature and other conditions. It is, therefore, desirable to improve the efficiency of the drying process to reduce the overall consumption of energy.

Fluidized Bed Drying(FBD) has found many practical applications in the drying of granular solids in the food, ceramic, pharmaceutical and agriculture industries. FBD is easy to implement and has the following advantages(Mujumdar A.S. and Devahstins, 2000): 1. High drying rates due to good gas-particle contact, leading to optimal heat and mass transfer rates; 2. smaller flow area; 3. high thermal efficiency; 4. lower capital and maintenance costs; and 5. ease of control. Some of the food products suitable for FBD include peas, beans, diced vegetables, fruits granules, onion flakes and fruit juice powders(Jayaraman K.S and Das Gupta D.K., 1995)

The aim of this research is to design, develop the chili dryer machine using fluidized-bed technique, study characteristics of red chili after drying, study the method of the continuous drying, develop model for predicting moisture content ratio and study

energy consumption in the drying processes. A fluidized bed reactor has many advantages that provide good solids mixing, high heat transfer, large contact surface area and reduce moisture in short time when compare which the other drying processes.

2. Objective of the Study

- 2.1 To design and construction artificial chili dryer machine using continuous fluidized-bed technique.
- 2.2 To study effective factors of continuous fluidized-bed of chili drying.
 - 2.2.1 To study characteristics of chili drying.
 - 2.2.2 To study the energy consumption.
- 2.3 To develop empirical mathematics model of thin layer chili drying.

3. Scope and simitation of the study

- 3.1 To determine equilibrium moisture content of chili.
- 3.2 To study effect of drying temperature.
- 3.3 To study effect of hot air velocity.
- 3.4 To determine energy consumption in drying process.
- 3.5 To analyze the drying data using computer program.
- 3.6 To simulate behavior of hot air circulation in drying chamber, piping and blowing using computer program.
- 3.7 To develop the empirical drying model of moisture content ratio.
For the model continuous chili fluidized bed drying, following assumptions are made:
 - 3.7.1 Thermal equilibrium exists between moist air and whole chili
 - 3.7.2 The wall of the cabinet dryer is adiabatic.
 - 3.7.3 The internal energy change of the cabinet dryer and whole chili are negligible.
 - 3.7.4 The drying air which exits the dryer has relative humidity less than 100%.

- 3.7.5 The initial and final moisture content of 72.98% and 13% on wet basis is suggested.
- 3.7.6 The interval relative humidity between 50% to 70%.
 - 3.7.7 The ambient air temperature of 30 °C.
 - 3.7.8 The variable parameters were:
 - 3.7.8.1 The hot air velocity varies from 4, 5 and 6 m/s.
 - 3.7.8.2 The drying temperature varies from 50 to 100 °C

4. Anticipated outcomes

- 4.1 Obtain the prototype of continuous fluidized bed dryer machine.
- 4.2 Know the effective factors for thin layer of chili drying.
- 4.3 Acquire the final moisture content of dried chili less than or equal the standard of dried chili in the market(13% on wet basis).
- 4.4 Obtain the empirical mathematics model for predicting moisture content ratio of chili drying.
- 4.5 Know the energy consumption for thin layer chili drying process.