CHAPTER I

INTRODUCTION

Foods however nutritious are not appreciated without good flavour. Flavour is the most important characteristic property, which governs the acceptability of any food product. Spices form a class of their own in natural flavours. In addition to contributing taste and aroma to foods, they also contain a variety of bioactive substances which are of considerable use from the standpoint of food science and technology. These may be used singly or in combination, and some act synergistically to control spoilage of foods [1].

Garlic (Allium sativum L.) belongs to the Liliaceae family and it has been used widely in many parts of the world as a seasoning, spices or remedies. It is known to possess a vast variety of biological functions and many recent studies have provided strong evidence that most of the biological functions of garlic are attributed to allicin thiosulfinates [2]. The reported biological functions of garlic are anticancer [3], antioxidant [4] and antimicrobial properties [5]. It also improves immunity [6] and exhibits the ability to lower serum lipids and glucose levels [7] and blood pressure [8].

The characteristic flavour of fresh garlic is associated with thiosulfinates and the volatile substances are formed by the action of the enzyme alliinase (E.C. 4.4.1.4) on hydrolyzing S-alkyl-substituted cysteine sulfoxide derivatives to the corresponding alkyl alkane thiosulfinates, ammonia and pyruvic acid [9]. This enzyme is separated from its natural substrates when the garlic tissue is disrupted. Since the non-protein amino acid alliin (S-allyl-L-Cysteine Sulfoxide) is the major substrate in garlic, allicin (diallylthiosulfinate) is the main thiosulfinates and constitutes 60–80% of total garlic thiosulfinates [10].

Solvent-extracted oleoresins exhibit a flavour profile close to the freshly ground spice, which make them an acceptable form of natural flavouring ingredient in a
wide spectrum of food applications. In comparison to the natural form of ground spices, they are hygienic and can be standardized for acceptable flavour levels by blending. Unlike the essential oils, oleoresins contain natural antioxidants which make them more stable. Oleoresins are quite concentrated and have good replacement value compared with ground spices. They provide a better distribution in the finished products and require less storage space than the corresponding spices. However, spice oleoresins being immiscible in aqueous foods, they do not disperse well into the food matrix and also flavour loss occurs when incorporated into dry food mixes during high temperature processing. Besides they are sensitive to light, heat and oxygen, and have short storage life if not stored properly which may be the result of oxidative and polymeric changes involving the fatty oil component and monoterpenic hydrocarbons. Some chemical and organoleptic changes can also occur in the oleoresin during prolonged storage. Destruction of several pigments occurs under exposure to oxygen wherein the hydroxylic groups are converted into unstable ketones. These in turn decompose into colourless compounds with a shorter carbon skeleton [11].

Microencapsulation protects the oleoresin against such destructive changes, and also converts it into a free-flowing powder [12]. There are six reasons behind the application of microencapsulation in food industries: to reduce the core reactivity with environmental factors; to decrease the transfer rate of the core material to the outside environment; to promote easier handling; to control the release of the core material; to mask the core taste; and finally to dilute the core material when it should be used in only very small amounts [13].

Microencapsulation is defined as a process in which tiny particles or droplets are surrounded by a coating or embedded in a homogeneous or heterogeneous matrix, to produce small capsules with many useful properties [14]. The substance that is encapsulated can be called the core, fill, active agent, internal or payload phase. The substance that is encapsulating is often called the coating, membrane, shell, carrier material, wall material, external phase or matrix [15]. The simplest of the microcapsules
(diameter from 1 to 800 µm) may consist of a core surrounded by a wall or barrier of uniform or non-uniform thickness. The core may be composed of just one or several types of ingredients and the wall may be single or double-layered [16].

Microencapsulation has found applications in many fields including pharmaceutical, agricultural, nutritional and therapeutics [17]. In food systems, microencapsulation can be utilized for acids, lipids, enzymes, microorganisms, flavours, vitamins, minerals, growth agents and colorants [18].

Coating materials can be selected from a wide variety of natural or synthetic polymers, depending on the active agent to be coated and the characteristics desired in the final microcapsules, with safety being the other primary consideration. The usual encapsulating agents are proteins (e.g. milk, gelatine), gums (e.g. acacia, alginate), carbohydrates (e.g. sucrose, maltodextrins, modified starch, cyclodextrins, cellulose), lipids, fats, waxes, lecithins (emulsifiers) and fibres. Flow properties and morphology of powders are highly influenced by the composition and physical stability of the encapsulating material used [19].

The encapsulation techniques are classified as physical and chemical methods. The physical methods includes: spray drying, spray chilling, rotary disk atomization, fluidized bed coating, stationary nozzle co-extrusion, multi-orifice centrifugal process, submerged nozzle co-extrusion, pan coating, air- suspension coating and centrifugal extrusion. The chemical methods includes: co-acervation phase separation, solvent extraction, interfacial polymerization, in-situ polymerization, liposome technology, matrix polymerization, simple and complex co-acervation [20].

Spray drying is the most often used encapsulation technique by the food industry [21, 22] and one of the oldest methods, since the 1930s, to encapsulate flavours [13]. This process is cost effective, flexible and produces particles of good quality.
To prepare the microencapsulated free flowing powder, the wall material is dissolved in water and the oleoresin is dispersed therein to obtain a dispersion or emulsion that has a continuous phase containing the film-former, and a discontinuous phase containing the oleoresin. The emulsion is stabilized by using stabilizer and/or emulsifying agents under continuous vigorous agitation. Suitable stabilizers are normally polymers such as gum acacia, dextrinised starch, maltodextrin, pectin, alginate, or a proteinacious material such as gelatin or casein [23]. Alternatively, non-polymeric emulsion stabilizers such as fatty acid partial esters of sorbitol anhydride (sorbitan or “Span”) and polyoxyethylene derivatives of fatty acid partial esters of sorbitol anhydride (“Tween”) are used. The dispersions are then emulsified by using a homogenizer, which can then be spray-dried [24].

When the polymeric stabilizer acts as an encapsulant, no extra encapsulant is required to obtain a stable emulsion. When a nonpolymeric stabilizer is used for stabilisation, an encapsulant among the polymeric stabilizers must be added. All flavour emulsions require only polymeric stabilizers to form stable emulsion. However for oleoresins, polymeric stabilizer alone or in combination does not give a stable emulsion. It requires a combination of non-polymeric and polymeric stabilizer that can act both as an encapsulant and an emulsifier [24].

Many researchers have used the spray drying process to encapsulate oils and flavours such as sunflower oil [25], avocado oil [26], cardamom oleoresin [27], cinnamon oleoresin [28], pepper oleoresin [29], cumin oleoresin [30] turmeric oleoresin [24], peppermint essential oil [31] and l-menthol [32]. The obtained encapsulated powder particles can be more easily handled than the liquid oils. There has been no work done on encapsulation of garlic oleoresin using spray drying technology. Hence, this research work has been carried out on the production of microencapsulated garlic oleoresin powder with the following objectives:
1. To study the physico-chemical properties of core and wall material.

2. To carry out the microencapsulation process with different concentrations of core and wall material by spray drying techniques.

3. To optimize the operating conditions for microencapsulation of garlic oleoresin by spray drying with respect to the product quality.

4. To assess the quality parameters of the microencapsulated garlic oleoresin powder produced at the optimum process conditions.