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ENCAPSULATION OF WATER INSOLUBLE MATERIALS

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ABSTRACT OF THE DISCLOSURE

Discrete particles comprising a water insoluble material enveloped or encapsulated in a protective matrix derived from an amylose product. A method for preparing such particles which comprises the steps of dissolving an amylose product in water, admixing the resulting solution with a water insoluble material so as to form a homogenized emulsion, and thereafter drying the emulsion by any suitable means in order to form dry, discrete particles. Depending upon the nature of the particular material which is being encapsulated, such particles may be used in food, cosmetic, detergent and pharmaceutical applications, etc.

BACKGROUND OF THE INVENTION

It is well known in the art that discrete particles containing water insoluble oils, molten solids, or oil solutions of water insoluble materials entrapped therein may be produced by preparing aqueous emulsions of such materials in the presence of a congealable, film-forming colloid which, upon drying and solidification, will form a matrix around the minute oil droplets. Many advantages are derived from the use of water insoluble materials when they are prepared in this form. Thus, for example, encapsulated liquid substances may be handled more conveniently without the fear of spillage or leakage. In addition, the use of volatile flavoring oils and perfumes in food and cosmetic applications is not hampered by rapid volatilization and consequent loss of such volatile components. Moreover, certain substances, such as vitamin A, which are susceptible to deterioration upon their exposure to air or atmospheric oxygen may be shielded from such exposure and thereby be maintained without any reduction in their activity and effectiveness. These solid particles may be readily converted into tablet form. Liquids and solids which are toxic or corrosive may also be embedded in the protective matrix in order to eliminate the potential hazards which are inherent in the use of such materials when they are in their conventional form. The ease and uniformity with which such materials as insecticides are applied is also greatly facilitated when they are in the form of dry, free flowing particles.

Among the prior art water dispersible protective colloids are included gelatin, gum acacia, pectin, gum tragacanth, starch and dextrin, etc. Although gelatin is characterized by its rapid gelling ability, its excellent film properties and the oxygen impermeability of its films, it is also characterized by high cost, limited availability and variations in properties from batch to batch. On the other hand, although conventional starches and dextrins are not subject to the latter disadvantages, they do not provide the desirable tough, pliable, oxygen impermeable matrices of the type derived from gelatin. Thus, such starch products either do not congeal with sufficient rapidity and/or they do not exhibit the adequate film integrity or continuity which is necessary in order to provide impermeable films or matrices.

SUMMARY OF THE INVENTION

It is, thus, the prime object of this invention to provide novel protective colloids for use in the encapsulation of water insoluble materials.

It is a further object to provide novel protective colloids which are generally superior in their encapsulating ability to the other materials heretofore employed for this purpose.

Various other objects and advantages of this invention will become apparent to the practitioner from the following detailed description.

We have found that the use, as encapsulating agents, of certain amylose products, as hereinafter defined, results in the preparation of encapsulated water insoluble materials which exhibit markedly superior characteristics. Thus, the films or matrices which are derived from these amylose products and which serve to provide the protective shell for the encapsulated water insoluble materials of this invention are characterized by their ability to congeal rapidly as well as by their toughness, strength and impermeability. It is the presence of each one of the latter characteristics to a high attainable level that defines the unexpected superiority, as encapsulating agents, of the amylose products of this invention. This is to be contrasted wtih conventional, low amylose starches and dextrins wherein the desired properties, if present at all, are exhibited only to a minimal level. Furthermore, the use of these amylose products as encapsulating agents enables the practitioner to encapsulate a vast number of water insoluble materials while the encapsulated products derived from the use of these novel encapsulating agents are, in all cases, dry, conveniently handled products.

DESCRIPTION OF THE PREFERRED EMBODIMENT

It is well known that starch is generally composed of two fractions, one a linear fraction known as amylose, and the other a branched fraction known as amylopectin. Each starch type contains these two fractions in a specific ratio characteristic of that particular starch, typical amylose concentrations ranging from about 18 to 30%, by weight. Since the amylose molecules are linear and contain hydroxyl groups, they have a tendency to be attracted to each other and to align themselves by the association, as, for example, by hydrogen bonding, through the hydroxyl groups on neighboring molecules. This phenomenon of molecular association through hydrogen bonding is commonly referred to as retrogradation and is generally manifested by crystallization from aqueous dispersions and the formation of rigid gels. On the other hand, the highly branched structure of amylopectin keeps its molecules from approaching each other closely enough to permit the extensive hydrogen bonding necessary for retrogradation to occur. As a result, aqueous dispersions of amylopectin exhibit good solution stability and do not gel.

The superior encapsulating ability of the amylose products utilized as encapsulating agents in this invention is believed to result from the presence therein of this increased concentration of linear molecules and the corresponding increase in the association and the alignment thereof. Thus, as a result of such increased association, these amylose products exhibit more rapid rates of setting and congealing as well as the ability to provide strong, impermeable films or matrices.

It is to be noted that when we use the term "amylose product" for the purposes of this invention, we refer to the amylose resulting from the fractionation of whole