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APPENDICES

APPENDIX I

DETAILS OF *A.paniculata* Nees., GELATIN, ACACIA, SODIUM ALGINATE, CARRAGENAN, PECTIN, XANTHAN GUM AND LOCUST BEAN GUM

***A.paniculata* Nees.** [7-9]

1. Botany

A.paniculata Nees. is a herbaceous genus of the family Acanthaceae. It is an annual herb common in Sri Lanka, India, China and South East Asia. The characteristic features of *A.paniculata* Nees. are described as follow: A perennial herb, rigidly erect, very bitter, 40-90 cm high. Stem acutely quadrangular, manifestly above the nodes. Leaves simple, opposite decussate, elliptic or lanceolate, 3-12 cm long, 1-3 cm wide; petiole 2.5-5 mm long.

2. Ecology

In Thailand, *A.paniculata* Nees. is probably an introduced species, often cultivated on account of its medicinal properties. Some may escape from cultivation. It was found in evergreen and dry evergreen forest at altitudes of 1,000 to 1,130 m in the north part of Thailand. It grows well in wet tropical weather in any season and in any type of soil. However, it grows best in loose soil. The optimum growing area is in the open or in a slightly shaded spot, where there is easy access to water.

3. Ethnomedical use

A.paniculata Nees. is know in Thailand as "Fa thalaai jone" (Bangkok), "Nam lai pangpon" (Bangkok), "Yaa kannguu" (Songkhla), "Fa sang" (Chonburi), "Sam sib dee" (Roy-ed) and "Mekh thalai" (Yala). It has been applied in traditional Thai medicinr for the treatment of fever, sore throat, dysentery and diarrhoea.

In India, the plant is well-known under the name of "Kalmegh". Its bitter leaves are the principal constituent of a household medicine, names Alui which is given to children for the relief of griping, disorders of the bowels and loss of appetite. Through its extremely bitter taste, the Sanskrit name of the plant "Mahatikta" means

"King of bitters". The plant was reported for the treatment of fever, malaria, cough, dyspepsia, diarrhoea, hepatitis, jaundice, skin infection, abscesses and snake bite.

In China, the dried aerial part of *A.paniculata* Nees. is known as "Chuanxinlian". The plant is official in Chinese Pharmacopoeia and used as an anti-inflammatory and antipyretic drug fort the treatment of cold, fever, laryngitis and diarrhoea.

4. Chemistry

Up to now a great number of compounds have been isolated from *A.paniculata* Nees., i.e. terpenoids, flavonoids, phenylpropanoids, steroids, polysaccharides, fatty acid and long-chain hydrocarbons. The main compound of the plant is a bitter substance, andrographolide, which was first isolated by Gorter. It is an *ent*-labdane diterpene containing a γ-lactone ring connected to a decalin ring system via an unsaturated C_2 moiety. It was found up to 2.24% in the aerial part of the plant. The diterpenoids mostly occur in the aerial part of the plant, whereas the flavonoids distribute in the root. However, the root of *A.paniculata* Nees. was reported to produce andrographolide and two flavones, were isolated from the leaf.

Gelatin [37-38]

1. **Synonyms**: Crodyne BY19; gelatine; Pharmagel A; Pharmagel B; Vee Gee

2. Empirical Formular and Molecular Weight

Gelatin is a generic term for a mixture of purified protein fractions obtained either by partial acid hydrolysis (type A gelatin) or by partial alkaline hydrolysis (type B gelatin) of animal collagen. Gelatin may be a mixture of both types. The protein fractions consist almost entirely of amino acids joined together by amide linkages to form linear polymers, varying in molecular weight from 15,000-250,000.

3. Functional Category: Coating agent; film-former; gelling agent; suspending agent; tablet binder; viscosity-increasing agent.

4. Applications in Pharmaceutical Formulation or Technology

Gelatin is widely used in a variety of pharmaceutical formulations although it is most frequently used to form either hard or soft gelatin capsules. Gelatin capsules are unit dosage forms, which are filled with an active drug and generally designed for oral administration. Gelatin is also used for the microencapsulation of drugs, where the active drug is sealed inside a microsized capsule that may then be handled as a powder. Gelatin is also widely used in food products and photographic emulsions.

5. Description

Gelatin occurs as a light-amber to faintly yellow-colored, vitreous, brittle solid. It is practically odorless and tasteless and is available as translucent sheets and granules, or as a powder.

6. Typical Properties

Acidity/alkalinity: for a 1%w/v aqueous solution at 25°C

pH = 3.8-6.0 (type A);

pH = 5.0-7.4 (type B).

Density:

1.325 g/cm^3 for type A;

1.283 g/cm^3 for type B.

Iso-electric point:

7-9 for type A;

4.7-5.3 for type B.

Solubility: practically insoluble in acetone, chloroform, ethanol (95%), ether and methanol. Soluble in glycerin, acids and alkalis, although strong acids or alkalis cause precipitation. In water, gelatin swells and softens, gradually absorbing between

5-10 times its own weight of water. Gelatin is soluble in hot water, forming a jelly, or gel, on cooling to 35-40°C. At temperatures > 40°C, the system exists as a sol. This gel-sol system is heat reversible, the melting temperature being slightly higher than the setting point; the melting point can be varied by the addition of glycerin.

Viscosity (dynamic):

4.3-4.7 mPa s (4.3-4.7 cP) for a 6.67% w/v aqueous solution at 60°C;

18.5-20.5 mPa s (18.5-20.5 cP) for a 12.5% w/v aqueous solution at 60°C.

7. Stability and Storage Conditions

Dry gelatin is stable in air. Aqueous gelatin solutions are also stable for long periods if stored under cool, sterile conditions. At temperatures above about 50°C aqueous gelatin solutions may undergo slow depolymerization and a reduction in gel strength on resetting may occur. Depolymerization becomes more rapid at temperatures above 65°C, and half may reduce gel strength when a solution is heated at 80°C for 1 hour. The rate and extent of depolymerization depends on the molecular weight of the gelatin, with a lower molecular weight material decomposing more rapidly. Gelatin may be sterilized by dry heat. The bulk material should be stored in an airtight container in a cool, dry, place.

8. Incompatibilities

Gelatin is an amphoteric material and will thus react with both acids and bases. It is also a protein and thus exhibits chemical properties characteristic of such materials, e.g. gelatin may be hydrolyzed by most proteolytic systems to yield its amino acid components. Gelatin will also react with aldehydes and aldehydic sugars, anionic and cationic polymers, electrolytes, metal ions, plasticizers, preservatives and surfactants. It is precipitated by alcohols, chloroform, ether, mercury salts and tannic acid.

9. Safety and Handling Precautions

Gelatin is widely used in a variety of pharmaceutical formulations including oral and parenteral products. In general, when used in oral formulations gelatin maybe regarded as a nontoxic and nonirritant material. Eye protection and gloves are recommended. Gelatin should be handled in a well-ventilated environment.

Acacia [39]

1. **Synonyms**: E414; gum acacia; gum arabic; talha gum.

2. **Empirical Formular and Molecular Weight**

Acacia is a complex, loose aggregate of sugars and hemicelluloses with a molecular weight of approximately 240,000-580,000. The aggregate consists essentially of an arabic acid nucleus to which are connected calcium, magnesium and potassium along with the sugars arabinose, galactose and rhamnose.

3. **Functional Formula**: emulsifying agent; stabilizing agent; suspending agent; tablet binder; viscosity-increasing agent.

4. **Applications in Pharmaceutical Formulation or Technology**

Acacia is mainly used in pharmaceutical formulations as a suspending and emulsifying agent, often in combination with tragacanth. It is also used in the preparation of pastilles and lozenges and as a tablet binder, although used incautiously it can produce tablets with a prolonged disintegration time. Acacia is also used in cosmetics, confectionery and food products.

5. **Description**: as white or yellowish-white colored thin flakes, spheroidal tears, granules or powder. It is odorless and has a bland taste.

6. **Typical Properties**

Acidity/alkalinity: pH = 4.5-5.0 (5% w/v aqueous solution).

Acid value: 2.5

Hygroscopicity: at relative humidities between 25-65%, the equilibrium moisture content of powdered acacia at 25°C is between 8-13% w/w, but at relative humidities above about 70% it absorbs substantial amounts of water.

Solubility: soluble 1 in 20 of glycerin, 1 in 20 of propylene glycol, 1 in 2.7 of water; practically insoluble in ethanol (95%).

Specific gravity: 1.35-1.49

Viscosity (dynamic): 100 mPa s (100 cP) for a 30% w/v aqueous solution at 20°C. The viscosity of aqueous acacia solutions varies depending upon the source of the material, processing, storage conditions, pH and the presence of salts. Viscosity increased slowly up to about 25% w/v concentration and exhibits Newtonian behavior. Above this concentration, viscosity rapidly increases. Increasing temperature or prolonged heating of solutions results in a decrease of viscosity due to depolymerization of particle agglomeration.

7. Stability and Storage Conditions

Aqueous solutions are subject to bacterial or enzymatic degradation but may be preserved by initially boiling the solution for a short for a short time to inactivate any enzymes present; microwave irradiation can be used. Aqueous solutions may also be preserved by the addition of an antimicrobial preservative such as 0.1% w/v benzoic acid, 0.1%w/v sodium benzoate or a mixture of 0.17% w/v methylparaben and 0.03% propylparaben. Powdered acacia should be stored in an airlight container in a cool, dry place.

8. Incompatibilities

Acacia is incompatible with a number of substances including amidopyrine, cresol, ethanol (95%), ferric salts, morphine, phenol, phenol, physostigmine, tannins, thymol and vanillin. An oxidizing enzyme is present in acacia that may affect

preparations containing easily oxidizable substances. Heating at 100°C for a short time may however be inactivated the enzyme.

Many salts reduce the viscosity of aqueous acacia solutions, while trivalent salts may initiate coagulation. Aqueous solutions carry a negative charge and will form coacervates with gelatin and other substances. In the preparation of emulsions, solutions of acacia are incompatible with soaps.

9. Safety and Handling Precautions

Acacia is used in cosmetics, foods, and oral and topical pharmaceutical formulations. Although generally regarded as an essentially nontoxic material, there have been a limited number of reports of hypersensitivtity to acacia after inhalation or ingestion. Severe anaphulactic reactions have occurred following the parenteral administration of acacia and it is now no longer used for this purpose. The WHO has not set an acceptable daily intake for acacia as a food additive since the levels necessary to achieve a desired effect were not considered to represent a hazard to health.

Observe normal precautions appropriate to the circumstances and quantity of material handled. Acacia can be irritant to the eyes, skin and upon inhalation. Gloves, eye protection and a dust respirator are recommended.

Sodium Alginate [40]

1. Synonyms: Algin; alginic acid, sodβ-(1→4)-D-mannosyluronic ium salt; E401; *Kelcosol*; *Keltone*; *Manucol*; *Manugel*; *Pronova*; *Protanal*; *Satialgine-H8*; sodium-polymannuronate.

2. Empirical Formula and Molecular Weight

Sodium alginate consists chiefly of the sodium salt of alginic acid, a linear

glycuronan polymer consisting of a mixture of β-(1→4)-D-mannosyluronic acid and α-(1→4)-L-gulosyluronic acid residues.

3. Functional Category: stabilizing agent; suspending agent; tablet and capsule disintegrant; tablet binder; viscosity-increasing agent.

4. Application in Pharmaceutical Formulation or Technology

Sodium alginate is used in a variety of oral and topical pharmaceutical formulations. In tablet formulations, sodium alginate may be used as both a binder and disintegrant. Sodium alginate has also been used in the preparation of sustained release oral formulations since it can delay the dissolution of a drug from tablets and aqueous suspensions.

In topical formulations, sodium alginate is widely used as a thickening and suspending agent in a variety of pastes, creams and gels, and as a stabilizing agent for oil-in-water emulsions. Recently, sodium alginate has been used for the aqueous microencapsulation of drugs, in contrast with the more conventional microencapsulation techniques which use organic solvent systems.

Therapeutically, sodium alginate has been used in combination with an H_2-receptor antagonist in the management of gastroesophageal reflux, and as a hemostatic agent in surgical dressings. Sodium alginate is also used in cosmetics and food products.

5. Description: as an odorless and tasteless, white to pale yellowish-brown colored powder.

6. Typical Properties

Acidity/alkalinity: pH ≈ 7.2 for a 1% w/v aqueous solution.

Solubility: practically insoluble in ethanol content is greater than 30%. Also, practically insoluble in other organic solvents and acids, in which the pH of the resultant solution is less than pH of the resultant solution is less than pH 3.

Viscosity (dynamic): various grades of sodium alginate are commercially available which yield aqueous solutions of varying viscosity. Typically, a 1% w/v aqueous solution, at 20°C, will have a viscosity of 20-400 mPa s (20-400 cP). Viscosity may vary depending upon concentration, pH, temperature or the presence of metal ions. Above pH 10, viscosity decreases.

7. Stability and Storage Conditions

Sodium alginate is a hygroscopic material although it is stable if stored at low relative humidities and a cool temperature. Aqueous solutions of sodium alginate are most stable between pH 4-10; below pH 3, alginic acid is precipitated. A 1% w/v aqueous solution of sodium alginate exposed to differing remperatures had a viscosity 60-80% its original value after storage for two years. Solutions should not be stored in metal containers. Sodium alginate solutions are susceptible on storage to microbial spoilage which may affect solution viscosity.

8. Incompatibilities

Sodium alginate is incompatible with acridine derivatives, crystal violet, phenylmercuric acetate and nitrate, calcium salts, heavy metals and ethanol in concentrations greater than 5%. High concentrations of electrolytes cause an increase in viscosity until salting-out of sodium alginate occurs; salting out occurs if more than 4% of sodium chloride is present.

9. Safety and Handling Precautions

Sodium alginate is widely used in cosmetics, food products and pharmaceutical formulations, such as tablets and topical products, including wound dressings. It is generally regarded as a nontoxic and nonirritant material although excessive oral consumption may be harmful. Inhalation of alginate dust may be irritant and has been associated with industrially related asthma.

Observe normal precautions appropriate to the circumstances and quantity of material handled. Sodium alginate may be irritant to the eyes or respiratory system if inhaled as dust. Eye protection, gloves and a dust respirator are recommended. Sodium alginate should be handled in a well-ventilated environment.

Carragenan [41]

1. **Synonyms**: Satiagel RPI 15; *E 407*.

2. **Functional Category**

The product can be used in aqueous, dairy, or fruit media, with various total solids contents. It is however standardized in brine, to ensure a constant reactivity in cooked cured meat products.

3. **Description**

The characteristics of carragenan is a creamy-white to light-brown powder, of neutral odor and flavor. Carragenan is a food additive used as a texturant. It is a gelling agent particularly suited to improve texture and overall appearance of cooked cured meat products. Incorporated during injection, at a concentration of between 0.20 to 0.50% of the final product, it helps to reduce cook out losses, it improves the binding and slicing parameters giving a smoother tasting product.

4. **Typical Properties**

Dispersion: to disperse the product without lumps: premix the powder with the other dry ingredients or disperse it in a non-solvent medium (oil, alcohol) and pour the prepartation into the liquid whilst stirring. Continue stirring to obtain a complete dispersion.

Solubility: depends on the medium and the process: it is improved by heat treatment (time, temperature), shear-stress (propeller, exchanger, homogenizer). A complete dissolution can be obtained from 70°C.

Rheology: break stregth of a gel at 1% in brine (495-605 g measured at 10°C).

pH: 7-10 measured in a 1% aqueous solution.

5. Stability and Storage Conditions: stored away from heat and moisture, preferably at a temperature inferior to 25°C and at about 65% relative humidity.

Pectin [42]

1. Empirical Formular and Molecular Weight: a linear polysaccharide containing from a few hundred to about one thousand building blocks per molecule, corresponding to an average molecular weight from about 50,000 to 180,000.

2. Functional Formula: gelling agent; emulsifying agent; stabilizing agent; suspending agent; thickening agent.

3. Applications in Technology: used almost exclusively in foods, minor used in pharmaceutical and cosmetic products.

4. Description: color of powderd pectins varies from off white for some citrus pectins to light brown for apple pectins.

5. Typical Properties

Reological Properties: pectin solutions have low viscosities when compared to other plant gums, and pectin consequently has little use as a thickener. Thin pectin solutions are close to Newtonian in their flow properties, but this changes to pseudoplastic when the pectin concentration increases or when calcium ions are added.

Solubility: soluble in water and insoluble in organic solvents such as alcohols, ethers and hydrocarbons. Pectin is normally predissolved in water before being added to other components of a food. It efficient dissolving equipment is used, pectin may be dissolved to a concentration of 6 to 12%, depending on the pectin type. Pectin solutions are opaque.

Specific gravity: 0.7.

pK value: 3.5.

Viscosity: follows a common logarithmic temperature relationship; thus higher concentrations of pectin solutions can be made at elevated temperatures.

6. Safety and Handling Precautions: store cool and dry. Most pectins are manufactured with only 6-8% moisture and are liable to pick up moisture if not protected by a suitable vaportight packaging.

Xanthan Gum [43]

1. Synonyms: Corn sugar gum; E415; *Keltrol*; *Merezan*; polysaccharide B-1459; *Rhodigel*; xantham gum.

2. Empirical Formula and Molecular Weight

Xanthan gum as a high molecular weight polysacccharide gum. It contains D-glucose and D-mannose as the dominant hexose units, along with D-glucuronic acid, and is prepared as the sodium, potassium, or calcium salt. The molecular weight is approximately $2x10^6$.

3. Functional Category: Stabilizing agent; suspending agent; viscosity-increasing agent.

4. Applications in Pharmaceutical Formulation or Technology

Xanthan gum is widely used in oral and topical pharmaceutical formulations, cosmetics and foods as a suspending and stabilizing agent. It is nontoxic, compatible with most other pharmaceutical ingredients and has good stability. When mixed with certain inorganic suspending agents, such a magnesium aluminum silicate, or organic gums, synergistic rheological effects occur. Although primarily used as a suspending agent xanthan gum has also been used to prepare sustained release matrix tablets.

5. Description: as a cream or white-colored, odorless, free-flowing and fine powder.

6. Typical Properties

Acidity/alkalinity: pH = 6-8 for a 1% w/v aqueous solution.

Freezing point: 0°C for a 1% w/v aqueous solution.

Heat of combustion: 14.6 J/g (3.5 cal/g).

Melting point: chars at 270°C.

Solubility: practically insoluble in ethanol and ether; soluble in cold or warm water.

Specific gravity: 1.600 at 25°C.

Viscosity (dynamic): 1,200-1,600 mPa s (1,200-1,600 cP) for a 1% w/v aqueous solution at 25°C.

7. Stability and Storage Conditions

Xanthan gum is a stable material. Aqueous solutions are stable over a wide pH range (pH 3-12) and temperatures between 10-60°C. It solutions less than 1%w/v concentration may be adversely affected by higher than ambient temperatures, e.g viscosity is reduced. Solutions are also stable in the presence of enzymes, salts, acids and bases. The bulk material should be stored in a well-closed container in a cool, dry, place.

8. Incompatibilities

Xanthan gum is an anionic material and is not usually compatible with cationic surfactants, polymers and preservatives since precipitation occurs. Anionic and amphoteric surfactants at concentrations above 15% cause precipitation of xanthan gum from a solution.

9. Safety and Handling Precautions

Xanthan gum is widely used in oral and topical pharmaceutical formulations, cosmetics and food products and is generally regarded as nontoxic and nonirritant at the levels employed as a pharmaceutical excipient. Observe normal precautions appropriate to the circumstances and quantity of material handled. Eye protection and gloves are recommended.

Locust Bean Gum [44]

1. Synonyms: E 410.

2. Applications in Technology

Premix the texturizer with the other dry ingredients (sugar, edible acid and flovors). Disperse the powders in cold water whilst stirring vigorously. Heating under constant agitation allows its complete dissolution.

3. Description

Locust bean gum as a white to brown powder. It is a food additive used as a texturizer. It is a gelling agent well suited to the preparation of clear water dessert gels, at a dosage of about 0.6-1%. It gives the water gels a soft texture and slightly brittle texture with limited syneresis.

4. Typical Properties

Gel testing in water: break strength of a gel at 1.5% concentration.

pH (1% solution): 7-10.

5. **Stability and Storage Conditions**: store away from moisture and heat, preferably at 15-25°C and at about 65% relative humidity.

APPENDIX II

DATA OF MICROCAPSULES CHARACTERIZATION

Table A-1 Particle size of microcapsules which were prepared by formulation no. 1 (run 1)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	12.50	50.00	36	12.50	50.00	71	12.50	50.00
2	12.75	51.00	37	14.00	56.00	72	12.25	49.00
3	12.00	48.00	38	13.50	54.00	73	12.00	48.00
4	13.25	53.00	39	13.00	52.00	74	13.00	52.00
5	13.50	54.00	40	12.75	51.00	75	12.25	49.00
6	12.00	48.00	41	12.50	50.00	76	12.00	48.00
7	13.50	54.00	42	12.25	49.00	77	13.50	54.00
8	12.25	49.00	43	11.75	47.00	78	12.50	50.00
9	12.00	48.00	44	12.00	48.00	79	12.25	49.00
10	12.50	50.00	45	12.00	48.00	80	13.00	52.00
11	13.00	52.00	46	11.50	46.00	81	12.50	50.00
12	12.00	48.00	47	12.00	48.00	82	12.00	48.00
13	13.00	52.00	48	12.00	48.00	83	11.25	45.00
14	12.50	50.00	49	12.50	50.00	84	12.50	50.00
15	13.75	55.00	50	13.25	53.00	85	12.75	51.00
16	12.00	48.00	51	12.75	51.00	86	12.25	49.00
17	13.25	53.00	52	11.75	47.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	12.50	50.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.75	51.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	11.50	46.00
22	12.50	50.00	57	13.00	52.00	92	12.00	48.00
23	12.25	49.00	58	13.50	54.00	93	13.00	52.00
24	12.25	49.00	59	12.25	49.00	94	12.25	49.00
25	12.50	50.00	60	12.25	49.00	95	12.50	50.00
26	13.50	54.00	61	14.50	58.00	96	12.75	51.00
27	13.50	54.00	62	13.25	53.00	97	11.50	46.00
28	14.50	58.00	63	12.50	50.00	98	13.50	54.00
29	12.75	51.00	64	12.50	50.00	99	12.50	50.00
30	12.75	51.00	65	12.50	50.00	100	13.00	52.00
31	13.00	52.00	66	13.75	55.00			
32	12.50	50.00	67	14.75	59.00		Count	100.00
33	14.00	56.00	68	13.25	53.00		Mean	50.64
34	12.25	49.00	69	12.00	48.00		SD	2.71
35	13.25	53.00	70	13.50	54.00		Variance	7.32

Table A-2 Particle size of microcapsules which were prepared by formulation no. 1 (run 2)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	12.50	50.00	36	12.50	50.00	71	12.50	50.00
2	12.25	49.00	37	12.00	48.00	72	12.75	51.00
3	12.00	48.00	38	13.50	54.00	73	12.25	49.00
4	13.50	54.00	39	13.00	52.00	74	13.00	52.00
5	13.25	53.00	40	12.25	49.00	75	12.25	49.00
6	12.00	48.00	41	12.50	50.00	76	12.00	48.00
7	13.50	54.00	42	12.75	51.00	77	13.00	52.00
8	12.25	49.00	43	13.25	53.00	78	12.50	50.00
9	14.00	56.00	44	13.25	53.00	79	12.75	51.00
10	12.25	49.00	45	12.00	48.00	80	12.00	48.00
11	13.00	52.00	46	12.25	49.00	81	12.50	50.00
12	12.00	48.00	47	12.00	48.00	82	12.25	49.00
13	12.00	48.00	48	12.25	49.00	83	13.75	55.00
14	12.50	50.00	49	12.50	50.00	84	13.00	52.00
15	13.75	55.00	50	12.25	49.00	85	13.25	53.00
16	12.00	48.00	51	12.75	51.00	86	13.00	52.00
17	13.25	53.00	52	11.75	47.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	12.50	50.00
19	11.75	47.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.75	51.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	13.50	54.00
22	12.50	50.00	57	13.00	52.00	92	12.00	48.00
23	12.25	49.00	58	12.25	49.00	93	12.25	49.00
24	12.00	48.00	59	14.75	59.00	94	13.50	54.00
25	12.50	50.00	60	12.25	49.00	95	12.50	50.00
26	14.00	56.00	61	12.25	49.00	96	11.75	47.00
27	12.50	50.00	62	12.75	51.00	97	13.25	53.00
28	13.50	54.00	63	13.25	53.00	98	13.50	54.00
29	12.75	51.00	64	12.50	50.00	99	11.50	46.00
30	13.25	53.00	65	12.50	50.00	100	13.50	54.00
31	13.00	52.00	66	12.25	49.00			
32	12.50	50.00	67	13.25	53.00		Count	100.00
33	12.75	51.00	68	11.50	46.00		Mean	50.56
34	12.25	49.00	69	12.00	48.00		SD	2.43
35	12.25	49.00	70	13.00	52.00		Variance	5.93

Table A-3 Particle size of microcapsules which were prepared by formulation no. 9 (run 1)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	12.50	50.00	36	12.50	50.00	71	12.25	49.00
2	12.75	51.00	37	14.00	56.00	72	12.25	49.00
3	12.00	48.00	38	12.00	48.00	73	12.25	49.00
4	13.25	53.00	39	13.00	52.00	74	13.00	52.00
5	13.50	54.00	40	13.50	54.00	75	12.25	49.00
6	12.00	48.00	41	12.50	50.00	76	12.00	48.00
7	13.25	53.00	42	12.25	49.00	77	13.50	54.00
8	12.75	51.00	43	13.25	53.00	78	12.50	50.00
9	12.50	50.00	44	13.75	55.00	79	13.00	52.00
10	12.50	50.00	45	13.00	52.00	80	12.25	49.00
11	13.00	52.00	46	12.25	49.00	81	12.75	51.00
12	12.25	49.00	47	12.00	48.00	82	12.25	49.00
13	13.00	52.00	48	12.00	48.00	83	11.75	47.00
14	12.50	50.00	49	12.50	50.00	84	12.75	51.00
15	13.75	55.00	50	12.25	49.00	85	12.75	51.00
16	12.00	48.00	51	12.75	51.00	86	12.25	49.00
17	13.25	53.00	52	11.75	47.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	12.50	50.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.75	51.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	11.50	46.00
22	12.50	50.00	57	13.00	52.00	92	12.00	48.00
23	12.25	49.00	58	13.50	54.00	93	13.00	52.00
24	12.25	49.00	59	12.25	49.00	94	13.25	53.00
25	12.50	50.00	60	13.00	52.00	95	12.50	50.00
26	14.00	56.00	61	12.00	48.00	96	12.75	51.00
27	13.50	54.00	62	13.25	53.00	97	13.25	53.00
28	12.00	48.00	63	12.50	50.00	98	13.50	54.00
29	12.75	51.00	64	13.50	54.00	99	12.50	50.00
30	12.75	51.00	65	12.50	50.00	100	12.00	48.00
31	13.00	52.00	66	12.25	49.00			
32	12.50	50.00	67	12.25	49.00		Count	100.00
33	11.25	45.00	68	11.50	46.00		Mean	50.47
34	12.00	48.00	69	13.00	52.00		SD	2.27
35	13.25	53.00	70	12.50	50.00		Variance	5.16

Table A-4 Particle size of microcapsules which were prepared by formulation no. 9 (run 2)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	13.50	54.00	36	12.50	50.00	71	12.75	51.00
2	12.00	48.00	37	14.00	56.00	72	12.00	48.00
3	12.00	48.00	38	13.00	52.00	73	12.25	49.00
4	13.25	53.00	39	13.00	52.00	74	13.00	52.00
5	13.75	55.00	40	12.25	49.00	75	13.75	55.00
6	12.75	51.00	41	12.50	50.00	76	12.00	48.00
7	13.50	54.00	42	12.25	49.00	77	13.50	54.00
8	12.25	49.00	43	13.25	53.00	78	12.50	50.00
9	12.75	51.00	44	14.00	56.00	79	11.75	47.00
10	12.50	50.00	45	12.00	48.00	80	12.25	49.00
11	13.00	52.00	46	13.00	52.00	81	12.50	50.00
12	12.00	48.00	47	12.00	48.00	82	12.25	49.00
13	12.75	51.00	48	12.25	49.00	83	11.75	47.00
14	12.50	50.00	49	12.50	50.00	84	12.75	51.00
15	13.75	55.00	50	12.25	49.00	85	13.00	52.00
16	12.00	48.00	51	12.75	51.00	86	12.25	49.00
17	13.25	53.00	52	11.75	47.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	12.50	50.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.00	48.00	55	11.75	47.00	90	12.00	48.00
21	12.25	49.00	56	11.50	46.00	91	11.50	46.00
22	12.50	50.00	57	13.00	52.00	92	12.00	48.00
23	13.00	52.00	58	14.00	56.00	93	13.25	53.00
24	12.25	49.00	59	13.50	54.00	94	12.25	49.00
25	12.50	50.00	60	13.00	52.00	95	12.50	50.00
26	12.25	49.00	61	12.00	48.00	96	12.75	51.00
27	13.50	54.00	62	13.25	53.00	97	12.50	50.00
28	12.00	48.00	63	12.50	50.00	98	13.50	54.00
29	12.75	51.00	64	13.50	54.00	99	12.50	50.00
30	13.00	52.00	65	12.50	50.00	100	13.00	52.00
31	12.75	51.00	66	11.50	46.00			
32	12.50	50.00	67	13.25	53.00		Count	100.00
33	12.25	49.00	68	11.50	46.00		Mean	50.55
34	14.75	59.00	69	12.00	48.00		SD	2.60
35	12.25	49.00	70	13.50	54.00		Variance	6.73

Table A-5 Particle size of microcapsules which were prepared by formulation no. 12 (run 1)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	12.00	48.00	36	12.50	50.00	71	12.50	50.00
2	11.75	47.00	37	12.25	49.00	72	12.25	49.00
3	12.00	48.00	38	12.00	48.00	73	12.25	49.00
4	12.75	51.00	39	14.75	59.00	74	13.00	52.00
5	13.00	52.00	40	12.50	50.00	75	12.25	49.00
6	13.00	52.00	41	12.50	50.00	76	12.00	48.00
7	13.50	54.00	42	12.25	49.00	77	12.75	51.00
8	12.25	49.00	43	12.50	50.00	78	11.75	47.00
9	11.75	47.00	44	13.75	55.00	79	12.75	51.00
10	12.50	50.00	45	12.00	48.00	80	12.25	49.00
11	12.00	48.00	46	14.00	56.00	81	12.50	50.00
12	12.25	49.00	47	12.00	48.00	82	12.25	49.00
13	13.00	52.00	48	12.00	48.00	83	11.75	47.00
14	13.25	53.00	49	12.50	50.00	84	11.50	46.00
15	13.75	55.00	50	12.25	49.00	85	13.50	54.00
16	12.00	48.00	51	12.75	51.00	86	12.25	49.00
17	13.25	53.00	52	11.75	47.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	11.50	46.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.75	51.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	12.50	50.00
22	12.50	50.00	57	12.00	48.00	92	12.00	48.00
23	12.25	49.00	58	13.50	54.00	93	13.00	52.00
24	12.25	49.00	59	12.25	49.00	94	12.25	49.00
25	12.50	50.00	60	13.00	52.00	95	12.50	50.00
26	14.00	56.00	61	12.00	48.00	96	12.75	51.00
27	13.50	54.00	62	13.25	53.00	97	13.25	53.00
28	14.50	58.00	63	12.50	50.00	98	13.50	54.00
29	12.75	51.00	64	12.50	50.00	99	12.50	50.00
30	14.75	59.00	65	12.75	51.00	100	11.50	46.00
31	13.00	52.00	66	12.25	49.00			
32	12.50	50.00	67	12.25	49.00		Count	100.00
33	11.50	46.00	68	13.00	52.00		Mean	50.37
34	12.50	50.00	69	12.00	48.00		SD	2.71
35	13.25	53.00	70	13.50	54.00		Variance	7.35

Table A-6 Particle size of microcapsules which were prepared by formulation no. 12 (run 2)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	12.75	51.00	36	13.25	53.00	71	11.75	47.00
2	11.75	47.00	37	14.00	56.00	72	12.25	49.00
3	12.00	48.00	38	12.00	48.00	73	12.75	51.00
4	12.25	49.00	39	13.00	52.00	74	13.00	52.00
5	12.75	51.00	40	12.50	50.00	75	12.50	50.00
6	12.00	48.00	41	14.00	56.00	76	12.00	48.00
7	13.00	52.00	42	12.25	49.00	77	13.50	54.00
8	12.25	49.00	43	12.50	50.00	78	11.75	47.00
9	11.75	47.00	44	13.75	55.00	79	12.75	51.00
10	13.75	55.00	45	12.00	48.00	80	12.25	49.00
11	12.75	51.00	46	12.25	49.00	81	11.25	45.00
12	12.25	49.00	47	12.50	50.00	82	12.25	49.00
13	13.50	54.00	48	12.00	48.00	83	11.75	47.00
14	12.50	50.00	49	12.50	50.00	84	11.50	46.00
15	13.75	55.00	50	12.25	49.00	85	12.25	49.00
16	12.00	48.00	51	12.75	51.00	86	12.75	51.00
17	13.25	53.00	52	11.75	47.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	12.50	50.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.75	51.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	11.50	46.00
22	12.50	50.00	57	13.00	52.00	92	12.00	48.00
23	12.25	49.00	58	13.00	52.00	93	13.00	52.00
24	12.25	49.00	59	12.25	49.00	94	12.25	49.00
25	12.50	50.00	60	13.00	52.00	95	12.50	50.00
26	14.00	56.00	61	12.00	48.00	96	12.75	51.00
27	13.00	52.00	62	13.25	53.00	97	12.25	49.00
28	14.50	58.00	63	12.50	50.00	98	13.50	54.00
29	12.75	51.00	64	14.75	59.00	99	12.50	50.00
30	12.75	51.00	65	12.50	50.00	100	13.50	54.00
31	13.00	52.00	66	12.25	49.00			
32	12.50	50.00	67	13.25	53.00		Count	100.00
33	11.50	46.00	68	13.50	54.00		Mean	50.45
34	12.50	50.00	69	12.00	48.00		SD	2.66
35	13.25	53.00	70	13.00	52.00		Variance	7.08

Table A-7 Particle size of microcapsules which were prepared by formulation no. 13 (run 1)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	13.00	52.00	36	12.50	50.00	71	12.50	50.00
2	11.75	47.00	37	14.00	56.00	72	12.25	49.00
3	12.00	48.00	38	12.25	49.00	73	12.25	49.00
4	12.75	51.00	39	13.00	52.00	74	13.00	52.00
5	14.00	56.00	40	12.50	50.00	75	12.25	49.00
6	12.00	48.00	41	12.50	50.00	76	12.00	48.00
7	13.75	55.00	42	12.25	49.00	77	13.50	54.00
8	12.25	49.00	43	13.25	53.00	78	12.25	49.00
9	11.75	47.00	44	13.75	55.00	79	12.75	51.00
10	12.00	48.00	45	12.00	48.00	80	12.25	49.00
11	13.00	52.00	46	12.25	49.00	81	12.50	50.00
12	12.25	49.00	47	12.50	50.00	82	12.25	49.00
13	13.00	52.00	48	12.00	48.00	83	11.75	47.00
14	12.50	50.00	49	12.50	50.00	84	11.50	46.00
15	13.75	55.00	50	12.25	49.00	85	12.75	51.00
16	12.00	48.00	51	12.75	51.00	86	12.25	49.00
17	13.00	52.00	52	12.25	49.00	87	12.75	51.00
18	13.50	54.00	53	13.00	52.00	88	12.50	50.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.75	51.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	11.50	46.00
22	12.50	50.00	57	12.00	48.00	92	12.00	48.00
23	12.25	49.00	58	13.50	54.00	93	13.00	52.00
24	12.25	49.00	59	12.25	49.00	94	12.25	49.00
25	12.50	50.00	60	13.00	52.00	95	12.50	50.00
26	14.00	56.00	61	12.00	48.00	96	13.25	53.00
27	13.50	54.00	62	12.50	50.00	97	12.75	51.00
28	14.50	58.00	63	12.50	50.00	98	13.50	54.00
29	11.50	46.00	64	13.25	53.00	99	12.50	50.00
30	12.75	51.00	65	12.25	49.00	100	13.00	52.00
31	13.00	52.00	66	13.50	54.00			
32	12.50	50.00	67	12.00	48.00		Count	100.00
33	12.75	51.00	68	11.50	46.00		Mean	50.41
34	12.25	49.00	69	12.25	49.00		SD	2.56
35	13.25	53.00	70	14.50	58.00		Variance	6.55

Table A-8 Particle size of microcapsules which were prepared by formulation no. 13 (run 2)

No.	Scales	Size(μm)	No.	Scales	Size(μm)	No.	Scales	Size(μm)
1	14.00	56.00	36	12.50	50.00	71	11.75	47.00
2	12.00	48.00	37	12.50	50.00	72	12.25	49.00
3	12.25	49.00	38	12.25	49.00	73	12.25	49.00
4	12.75	51.00	39	13.00	52.00	74	13.00	52.00
5	13.00	52.00	40	12.50	50.00	75	12.25	49.00
6	12.00	48.00	41	14.00	56.00	76	12.00	48.00
7	12.50	50.00	42	12.25	49.00	77	13.50	54.00
8	12.25	49.00	43	13.25	53.00	78	13.75	55.00
9	11.75	47.00	44	12.25	49.00	79	12.75	51.00
10	12.00	48.00	45	12.75	51.00	80	13.75	55.00
11	13.00	52.00	46	12.25	49.00	81	12.00	48.00
12	12.25	49.00	47	12.50	50.00	82	12.25	49.00
13	13.00	52.00	48	12.00	48.00	83	12.50	50.00
14	12.50	50.00	49	11.75	47.00	84	11.50	46.00
15	13.75	55.00	50	12.25	49.00	85	12.75	51.00
16	12.00	48.00	51	12.75	51.00	86	12.25	49.00
17	13.00	52.00	52	12.50	50.00	87	12.75	51.00
18	13.00	52.00	53	13.50	54.00	88	12.50	50.00
19	12.25	49.00	54	12.00	48.00	89	12.25	49.00
20	12.75	51.00	55	12.25	49.00	90	12.00	48.00
21	12.25	49.00	56	12.25	49.00	91	11.50	46.00
22	12.50	50.00	57	12.00	48.00	92	12.00	48.00
23	12.25	49.00	58	13.50	54.00	93	13.00	52.00
24	12.75	51.00	59	12.25	49.00	94	12.25	49.00
25	12.50	50.00	60	13.00	52.00	95	12.50	50.00
26	14.00	56.00	61	12.00	48.00	96	13.25	53.00
27	13.50	54.00	62	12.50	50.00	97	12.75	51.00
28	12.50	50.00	63	12.50	50.00	98	13.50	54.00
29	11.50	46.00	64	13.25	53.00	99	14.50	58.00
30	12.75	51.00	65	12.50	50.00	100	13.00	52.00
31	13.00	52.00	66	13.50	54.00			
32	14.50	58.00	67	12.00	48.00		Count	100.00
33	12.75	51.00	68	11.50	46.00		Mean	50.44
34	12.25	49.00	69	12.25	49.00		SD	2.55
35	13.25	53.00	70	12.50	50.00		Variance	6.51

Table A-9 Standard calibration of andrographolide

Concentration (mg%)	Absorbance at 224 nm			
	Run1	Run2	Run3	Average
0.8	0.3069	0.3068	0.3070	0.3069
1.0	0.3795	0.3795	0.3792	0.3794
1.2	0.4538	0.4538	0.4538	0.4538
1.4	0.5288	0.5289	0.5284	0.5287
1.6	0.5988	0.5988	0.5988	0.5988
1.8	0.6688	0.6686	0.6690	0.6688
2.0	0.7396	0.7394	0.7392	0.7384

Table A-10 Yield of andrographolide microcapsules

Formulation no.	Observed wt (g)				Theoretical wt (g)	Yield (SD) (%)
	Run1	Run2	Run3	Mean		
1	5.3458	5.4018	5.4018	5.3831	6	89.72 (0.54)
2	5.2973	5.3014	5.3014	5.3000	6	88.33 (0.04)
3	5.2834	5.2769	5.2769	5.2791	6	87.98 (0.06)
4	*	*	*	*	*	*
5	5.3155	5.3068	5.3068	5.3097	6	88.50 (0.08)
6	5.2681	5.2597	5.2597	5.2625	6	87.71 (0.08)
7	5.2878	5.3114	5.3114	5.3035	6	88.39 (0.23)
8	5.2654	5.2807	5.2807	5.2756	6	87.93 (0.15)
9	5.4276	5.4381	5.4381	5.4346	6	90.58 (0.10)
10	5.4118	5.4463	5.4463	5.4348	6	90.58 (0.33)
11	*	*	*	*	*	*
12	5.4189	5.4166	5.4166	5.4174	6	90.29 (0.02)
13	5.4015	5.4143	5.4143	5.4100	6	90.17 (0.12)
14	5.4117	5.4128	5.4128	5.4124	6	90.21 (0.01)

* The microcapsules could not be obtained.

Table A-11 Drug content and drug entrapment of andrographolide microcapsules

Formulation no.	Drug content (%)				Theoretical content (%)	Drug entrapped (SD) (%)
	Run1	Run2	Run3	Mean (SD)		
1	30.92	30.83	30.88	30.88 (0.05)	33.33	92.63 (0.15)
2	28.83	28.60	28.72	28.72 (0.12)	33.33	86.16 (0.34)
3	28.58	28.71	28.56	28.62 (0.08)	33.33	85.85 (0.25)
4	*	*	*	*	*	*
5	30.92	31.01	31.05	30.99 (0.07)	33.33	92.98 (0.21)
6	27.89	27.84	27.69	27.81(0.11)	33.33	83.42 (0.32)
7	28.80	28.58	28.72	28.70 (0.11)	33.33	86.10 (0.34)
8	27.79	28.15	28.22	28.05 (0.23)	33.33	84.16 (0.70)
9	32.72	32.46	32.80	32.66 (0.18)	33.33	97.98 (0.54)
10	31.40	31.66	31.82	31.63 (0.21)	33.33	94.88 (0.63)
11	*	*	*	*	*	*
12	29.95	30.08	29.76	29.93 (0.16)	33.33	89.80 (0.48)
13	29.46	29.12	29.58	29.39 (0.24)	33.33	88.16 (0.73)
14	27.51	27.15	26.72	27.13 (0.40)	33.33	81.38 (1.19)

* The microcapsules could not be obtained.

Table A-12 The summary of the release rate constants (K) of Higuchi equation plots and the correlation coefficients (r) at a selected time range (min) of the andrographolide microcapsules

Formulation no.	Time range (min)	% Released range	r	K (% $min^{-1/2}$)			
				Run1	Run2	Run3	Mean (SD)
1	1-15	22-82	0.9988	21.18	21.16	21.14	21.16 (0.02)
9	1-15	21-78	0.9979	20.06	20.06	19.98	20.03 (0.05)
12	1-15	20-76	0.9995	19.65	19.65	19.66	19.65 (0.01)
13	1-15	20-76	0.9995	19.56	19.57	19.55	19.56 (0.01)

Table A-13 Percent drug released from microcapsules prepared by formulation no.1

Time (min)	0	1	5	10	15	20	25	30	40	50	55	60	65	70	80
1	0	21.74	49.46	68.82	82.39	86.77	91.14	94.98	98.69	99.69	99.99	100.00	100.01	100.02	100.02
2	0	21.77	49.62	68.75	82.42	86.80	91.13	94.96	98.72	99.67	100.00	100.00	100.02	100.01	100.02
3	0	21.83	49.84	68.68	82.51	86.86	91.12	94.82	98.66	99.68	100.01	100.00	100.03	100.00	100.02
Mean	0	21.78	49.64	68.75	82.44	86.81	91.13	94.92	98.69	99.68	100.00	100.00	100.02	100.01	100.02
SD	0	0.05	0.19	0.07	0.06	0.05	0.01	0.09	0.03	0.01	0.01	0.00	0.01	0.01	0.00

Table A-14 Percent drug released from microcapsules prepared by formulation no.9

Time (min)	0	1	5	10	15	20	25	30	40	50	55	60	65	70	80
1	0	20.58	46.72	65.90	77.68	83.04	88.16	93.06	96.94	98.85	99.88	100.00	100.02	100.03	100.03
2	0	20.60	46.73	65.91	77.70	83.02	88.16	93.08	96.89	98.88	99.87	100.00	100.01	100.02	100.02
3	0	20.65	46.73	65.88	77.68	83.01	88.14	93.08	96.93	98.85	99.87	100.02	100.03	100.03	100.04
Mean	0	20.65	46.73	65.88	77.68	83.01	88.14	93.08	96.93	98.85	99.87	100.02	100.03	100.03	100.04
SD	0	0.04	0.01	0.02	0.01	0.02	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.01

Table A-15 Percent drug released from microcapsules prepared by formulation no.12

Time (min)	0	1	5	10	15	20	25	30	40	50	55	60	65	70	80
1	0	19.98	44.87	63.37	76.17	82.50	87.07	90.69	94.89	97.84	98.37	99.79	100.00	100.00	100.02
2	0	19.96	44.88	63.36	76.14	83.52	87.04	90.71	94.85	97.83	98.37	99.82	100.01	100.00	100.01
3	0	19.91	44.83	63.38	76.11	81.45	87.04	90.64	94.90	97.76	98.31	99.76	100.02	100.03	99.97
Mean	0	19.95	44.86	63.37	76.14	82.49	87.05	90.68	94.88	97.81	98.35	99.79	100.01	100.01	100.00
SD	0	0.04	0.03	0.01	0.03	0.04	0.02	0.04	0.03	0.04	0.03	0.03	0.01	0.02	0.03

Table A-16 Percent drug released from microcapsules prepared by formulation no.13

Time (min)	0	1	5	10	15	20	25	30	40	50	55	60	65	70	80
1	0	19.83	43.55	62.83	75.58	80.37	84.52	88.36	92.37	95.70	97.44	98.58	99.73	99.99	100.00
2	0	19.84	43.58	62.88	75.62	80.39	84.55	88.38	92.40	95.73	97.44	98.61	99.78	100.01	100.01
3	0	19.91	43.61	62.81	75.66	80.35	84.52	88.43	92.37	95.76	97.50	98.58	99.71	100.00	99.99
Mean	0	19.86	43.58	62.84	75.62	80.37	84.58	88.39	92.38	95.73	97.46	98.59	99.74	100.00	100.00
SD	0	0.04	0.03	0.04	0.04	0.02	0.02	0.04	0.02	0.03	0.03	0.02	0.04	0.01	0.01

Table A-17 Percent drug remaining of formulation no.1 microcapsules in protected from light (amber-glass) condition

Time (days)	0	15	20	45	60	75	90
1	30.92	30.88	30.54	29.78	28.88	27.50	25.88
2	30.83	30.69	30.40	29.69	28.59	27.31	25.74
3	30.88	30.74	30.44	29.71	28.63	27.36	25.83
Mean (SD)	30.88 (0.05)	30.77 (0.10)	30.46 (0.07)	29.73 (0.05)	28.70 (0.16)	27.39 (0.10)	25.82 (0.07)
Drug remaining (SD) (%)	100.00 (0.00)	99.65 (0.19)	98.99 (0.08)	97.59 (0.08)	96.55 (0.38)	95.44 (0.19)	94.26 (0.15)

Table A-18 Percent drug remaining of formulation no.9 microcapsules in protected from light (amber-glass) condition

Time (days)	0	15	20	45	60	75	90
1	32.72	32.69	32.58	32.37	32.16	31.88	31.52
2	32.46	32.42	32.35	32.28	32.04	31.77	31.43
3	32.80	32.78	32.61	32.34	32.09	31.80	31.48
Mean (SD)	32.66 (0.18)	32.63 (0.19)	32.51 (0.14)	32.33 (0.05)	32.10 (0.06)	31.82 (0.06)	31.48 (0.05)
Drug remaining (SD) (%)	100.00 (0.00)	99.91 (0.03)	99.64 (0.15)	99.44 (0.31)	99.28 (0.06)	99.13 (0.03)	98.93 (0.06)

Table A-19 Percent drug remaining of formulation no.12 microcapsules in protected from light (amber-glass) condition

Time (days)	0	15	20	45	60	75	90
1	29.95	29.83	29.54	29.04	28.34	27.52	26.58
2	30.08	29.98	29.72	29.13	28.44	27.57	26.61
3	29.76	29.66	29.44	29.01	28.31	27.48	26.53
Mean (SD)	29.93 (0.16)	29.82 (0.16)	29.57 (0.14)	29.06 (0.06)	28.06 (0.07)	27.52 (0.05)	26.57 (0.04)
Drug remaining (SD) (%)	100.00 (0.00)	99.64 (0.04)	99.14 (0.12)	98.29 (0.26)	97.60 (0.02)	97.04 (0.09)	96.55 (0.03)

Table A-20 Percent drug remaining of formulation no.13 microcapsules in protected from light (amber-glass) condition

Time (days)	0	15	20	45	60	75	90
1	29.46	29.31	28.92	28.39	27.66	26.83	25.83
2	29.12	29.08	28.67	28.10	27.38	26.57	25.60
3	29.58	29.33	29.25	28.62	27.97	27.11	26.17
Mean (SD)	29.39 (0.24)	29.24 (0.14)	28.95 (0.29)	28.37 (0.26)	27.67 (0.30)	26.84 (0.27)	25.87 (0.29)
Drug remaining (SD) (%)	100.00 (0.00)	99.50 (0.35)	99.00 (0.63)	98.01 (0.16)	97.53 (0.17)	96.99 (0.06)	96.39 (0.13)

Table A-21 Percent drug remaining of formulation no.1 microcapsules in nonprotected from light (clear-glass) condition

Time (days)	0	15	20	45	60	75	90
1	30.92	30.44	29.17	27.31	24.83	21.98	18.79
2	30.83	30.32	29.04	27.18	24.74	21.86	18.72
3	30.88	30.35	29.08	27.24	24.79	21.92	18.74
Mean (SD)	30.88 (0.05)	30.37 (0.06)	29.10 (0.07)	27.24 (0.07)	24.79 (0.05)	21.92 (0.06)	18.75 (0.04)
Drug remaining (SD) (%)	100.00 (0.00)	98.36 (0.08)	95.81 (0.03)	93.63 (0.04)	90.98 (0.06)	88.43 (0.08)	85.54 (0.08)

Table A-22 Percent drug remaining of formulation no.9 microcapsules in nonprotected from light (clear-glass) condition

Time (days)	0	15	20	45	60	75	90
1	32.72	32.54	31.88	30.98	29.71	28.28	26.57
2	32.46	32.30	31.76	30.86	29.62	28.20	26.42
3	32.80	32.55	31.83	30.89	29.68	28.24	26.53
Mean (SD)	32.66 (0.18)	32.46 (0.14)	31.82 (0.06)	30.89 (0.04)	29.67 (0.05)	28.24 (0.04)	26.51 (0.08)
Drug remaining (SD) (%)	100.00 (0.00)	99.40 (0.14)	98.03 (0.27)	97.08 (0.08)	96.04 (0.05)	95.18 (0.03)	93.86 (0.15)

Table A-23 Percent drug remaining of formulation no.12 microcapsules in nonprotected from light (clear-glass) condition

Time (days)	0	15	20	45	60	75	90
1	29.95	29.52	28.56	27.14	25.34	23.17	20.64
2	30.08	29.67	28.76	27.19	25.42	23.24	20.69
3	29.76	29.48	28.52	27.08	25.30	23.11	20.61
Mean (SD)	29.93 (0.16)	29.56 (0.10)	28.61 (0.13)	27.14 (0.06)	25.35 (0.06)	23.17 (0.07)	20.65 (0.04)
Drug remaining (SD) (%)	100.00 (0.00)	98.75 (0.27)	96.81 (0.11)	94.84 (0.26)	93.43 (0.06)	91.40 (0.05)	89.10 (0.08)

Table A-24 Percent drug remaining of formulation no.13 microcapsules in nonprotected from light (clear-glass) condition

Time (days)	0	15	20	45	60	75	90
1	29.46	28.92	28.06	26.58	24.76	22.51	19.98
2	29.12	28.67	27.78	26.23	24.47	22.19	19.72
3	29.58	29.25	28.13	26.64	24.82	22.57	20.04
Mean (SD)	29.39 (0.24)	28.95 (0.29)	27.99 (0.19)	26.48 (0.22)	24.68 (0.19)	22.42 (0.20)	19.91 (0.17)
Drug remaining (SD) (%)	100.00 (0.00)	98.50 (0.36)	96.70 (0.46)	94.62 (0.17)	93.20 (0.08)	90.84 (0.14)	88.81 (0.06)

VITA

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